Where Quantum and Fluids entangle

Quantum Computational Fluid Dynamics
Dissemination, Exploitation and Communication Plan
3rd (final) Update
Project number# 101080085

Call:	HORIZON-CL4-2021-DIGITAL-EMERGING-02
Topic:	HORIZON-CL4-2021-DIGITAL-EMERGING-02-10
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Deliverable number:	D10.5
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Prepared By:	Belda Atilla
Internal Reviewers:	PIs
Final Approval:	Prof. Dr. Dieter Jaksch

This project receives funding from the European Union's Horizon 2020 HORIZON Research and Innovation Actions Programme under Grant Agreement #101080085

Revision History

Version	Date	Who	Changes
0	27.10.2025	B. Atilla	3rd update of Dissemination, Exploitation and Communication Plan

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Executive Summary

QCFD (Quantum Computational Fluid Dynamics) is an EU-funded project under the Horizon 2020 programme/HORIZON Research and Innovation Actions /HORIZON-CL4-2021-DIGITAL-EMERGING-02 call for proposals.

Scientific and technological progress is broadly underpinned by the ability to accurately predict and optimise complex fluid flows which arise across the physical and life sciences including climate research, as well as in the energy, chemical, automotive, aircraft, and ship building industries. The wide separation of length and time scales that need to be covered when designing and optimising flows and a large number of design parameters make numerical simulations highly demanding. Current capabilities are thus insufficient to meet future demands of users in academia and industry.

The overarching goal of this project is to rise to this challenge by developing a versatile quantum algorithmic framework for efficiently solving a wide range of CFD problems without compromising on accuracy. The proposed methodology will be demonstrated on hardware developed in European Quantum Technology Flagship Projects and will prove the feasibility and advantages of our approach using a core set of CFD problems arising in the thermal management of battery-electric-vehicles (BEV). The approach will subsequently be extended to a wider class of flow configurations. Extensive validation and benchmarking will provide detailed quantitative information on hardware requirements for achieving a quantum advantage.

Here we present the third update of the Dissemination, Communication and Exploitation Plan. This document is a deliverable of Work Package 10, Project and Data Management, Dissemination and Communication of the project. It is a comprehensive document defining target audiences, types of topics and results for sharing and further dissemination as well as types of actions, activities and tools for joint dissemination activities of the QCFD Project. These activities are based on the cooperation of all partners and are strongly linked not only to the QCFD project objectives but also to the activities of particular work packages.

The plan will be used by all the partners involved in the QCFD project and form the basis of a common strategy for disseminating, communicating, and exploiting project results.

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List of figure and tables

List of abbreviations

Acronym / Short Name	Meaning
EU	European Union
EC	European Commission
QCFD	Quantum Computational Fluid Dynamics
UHH	University of Hamburg
TUHH	Technical University of Hamburg
FZL	Jülich Research Centre
TUM	Technical University of Munich
ENG	ENGYS SRL
TUC	Technical University of Crete
PlanQc	PlanQc GMBH
CDE	Communication, Dissemination and Exploitation
KPI	Key Performance Indicator
WP	Work Package
PO	Project Officer
SME	Small and Medium Enterprise
WP	Work Package
WPL	Work Package Leader

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1. Introduction

Communication activities should promote the entire action, both the project itself and its ongoing activities and results, to a wider range of audiences, including the public, traditional and social media.

Deliverable 10.5 is an updated version of deliverable 10.2, 10.3 &10.4 and outlines the key objectives, target audiences, and core messages of our communication and dissemination efforts. It presents the updates of the Dissemination, Exploitation and Communication Plan for the QCFD project, including the next activities foreseen for the upcoming months.

On the one hand, this Dissemination, Exploitation and Communication Plan set out the plan for targeting the various relevant stakeholders in an effective manner, while also generally describing the intended applied and scientific dissemination and communication activities for the next project cycle. These include the project website, dynamic social media channels, printed materials, newsletters, press releases and contributions to scientific journals. Additionally, the QCFD Team delves into active participation in conferences, workshops, and events, recognizing their pivotal role in amplifying our project's impact.

The dissemination of project results and information to the wider public is very important to the QCFD Consortium and for this purpose, project updates have been shared via website and social media channels (Twitter, LinkedIn).

The document has been updated with the real activities performed during the first 36 months of the project.

2. Objectives

The key purpose of the QCFD communication strategy is to communicate the project scope, objectives, results and impacts properly and effectively to the interested audience and finally engage a variety of stakeholders in project activities.

The dissemination and exploitation measures aim to inform the target groups about the activities and the outputs of the project.

- to disseminate the project’s results at dedicated events all around Europe as well as in scientific publications.
- valorize the results of the project during and after its lifetime.
- to ensure open access to results produced by the project.

3. Phases of the communication and dissemination strategy

The planning and execution of the project dissemination activities require a schedule closely aligned with key project deliverables and milestones. At this scope, the project will be organized around 3 phases:

Initial Awareness Phase (Month 0-12)

The initial awareness phase, spanning from Month 0 to Month 12, aimed to ensure the project was known to relevant stakeholders and the general public. During this phase, the project's graphical identity was established, including the project logo, branding guidelines, and templates for project documents and presentations. PIs participated in various events and made efforts to disseminate the project outputs.

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Job advertisements related to the project were published on sectoral portals to reach scientists seeking employment in this field. A Project Kick-Off meeting was held at Hamburg University in Month 6, and the first QCFD Researchers Sync meeting was conducted online in Month 8. The first press release with the project was published during this period. Articles and data sets related to the projects started to be published.

Targeted dissemination phase (Month 12-36)

During the targeted dissemination phase (Month 12–36), significant efforts were undertaken to enhance external stakeholders' understanding of the project outcomes, fostering stronger engagement and increasing the potential for future uptake of the QCFD results.

Throughout this phase, the consortium enriched the project website with new content, including publications, meeting summaries, news updates, and publicly available deliverables. Project results were disseminated to target audiences through publications in scientific journals and presentations at conferences and workshops, as outlined in the communication and dissemination activities.

Project Coordination and Review Meetings

- **First Project Coordination Meeting – Hamburg University (14–15 March 2024):**

  The first coordination meeting was hosted by Hamburg University and attended by all consortium partners. The event included several focused sessions: the Principal Investigators Coordination Meeting, the Advisory Board Meeting, and a joint Principal Investigators & Advisory Board session.

- **First Project Review Meeting – Online (4 July 2024):**

  The first review meeting was held virtually with the participation of the QCFD team, the European Commission Project Officer, and external evaluators. Work Package (WP) leaders presented their progress in line with the first periodic report.

- **Second Project Coordination Meeting – Technical University of Munich (9–10 December 2024):**

  The second coordination meeting brought together all partners at TUM. WP leaders presented updates on their progress, followed by a Principal Investigators Coordination Meeting. Over the two-day event, two discussion sessions were held to exchange ideas regarding planned deliverables and the preparation of the required CFD paper, as recommended by external evaluators. The meeting also included a visit to PlanQC's laboratory.

- **Third Project Coordination Meeting – Trieste, hosted by ENGYS (10–11 July 2025):**

  The third coordination meeting was hosted by ENGYS in Trieste. WP leaders presented their ongoing work, and Advisory Board member **Andrew Daley** provided valuable feedback on project progress. The European Commission Project Officer attended online and shared information on future EU calls relevant to the QCFD project. The meeting concluded with a Principal Investigators Coordination Meeting.

Dissemination and Outreach Activities

In addition to the formal meetings, dissemination activities were actively carried out by the Principal Investigators through participation in conferences, workshops, meetings, and training events. These engagements provided effective platforms to present and promote the QCFD project, share interim results, and strengthen collaborations with the broader research and industrial communities.

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Presentation of results (Month 36-48)

This represents the period just prior to the end of the project when the project reaches its most significant output. This will be the more active period matching with the finalization of the project and the publications of the final project results.

Details related to communication and dissemination activities can be found in Annex- 8.2. QCFD Communication and Dissemination Activities

4. Target audience

The consortium has identified several groups that have an interest in or are going to be affected by the QCFD project.

Different groups of stakeholders have diverse interests, and we have thus tailored communication and dissemination activities for different target groups. Specifically, we have been distinguishing between industrial stakeholders who could directly benefit from the project results and potentially invest in follow-on research projects, academic and industrial researchers with expertise in CFD and/or quantum technologies to build a broad research community working on QCFD problems, and lay audiences where the target is to raise general awareness of the potential of quantum computing in industrial applications.

We list the major communication channels and objectives for each target group in Table 1. The primary communication channels and planned dissemination activities are detailed in Table 2, while the activities executed according to these plans are documented in Annex- 8.2. QCFD Communication and Dissemination Activities

TABLE 1: Communication channels and aims

industry CFD experts	Channels: project website, social media channels, data repository, scientific publications, scientific talks and posters, dedicated workshop sessions.
	Aims: project involvement, commercial exploitation of quantum technologies.
OpenFOAM users and developers	Channels: OpenFOAM – QCFD software interface and documentation, dedicated workshop sessions, project website, social media channels.
	Aims: project involvement, extending the OpenFOAM open-source developer community to QCFD applications.
academic quantum computing and CFD community	Channels: scientific publications, scientific workshops, scientific talks and posters, data repository, QCFD software framework and documentation, project website, social media channels.
	Aims: Project involvement e.g. leading to new QCFD algorithms and/or proposals for optimized hardware architectures.
quantum hardware developers in industry and academia	Channels: scientific publications, scientific workshops, scientific talks and posters, data repository, project website, social media channels.
	Aims: Project involvement leading to a detailed understanding of QCFD hardware requirements and, e.g., to QCFD optimized quantum hardware architectures in the longer term.

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students	Channels: project website, social media channels, tutorial examples, online videos, semi-popular publications, student internships and undergraduate research projects.
	Aims: attract PhD students into the project's interdisciplinary field of science.
mass media	Channels: project website, social media channels, press releases.
	Aims: disseminate most important results widely, raise project awareness.
interested lay audiences	Channels: project website, social media, public talks, open house events.
	Aims: General awareness of the project.

TABLE 2: Description of communication channels and dissemination activities

scientific publications	These are the main tools used to communicate the scientific advances and results of the project. Publications are targeted at specialized audiences in CFD research, quantum algorithms and optimization, and quantum hardware development, as well as at a broader interdisciplinary community of researchers. All publications follow the EU guidelines on open access publishing and properly acknowledge the QCFD project. The consortium publishes its results in international peer-reviewed journals, including *Ads, AIAA Journal, APS, IOPScience, Machine Learning: Science and Technology, New Journal of Physics (NJP), npj Quantum Information,* *Physical Review A, Physical Review Fluids, Quantum, Science Advances, Science Direct*
scientific talks and posters	Talks and posters are used to attract stakeholder interest and to disseminate the project results and the QCFD framework widely. Scientific talks are adapted to the target audiences in quantum technologies and CFD. These talks provide unique opportunities to communicate the necessity of an interdisciplinary approach in developing quantum solutions for industrially relevant problems. Events where the consortium presents its results include Wilhelm and Else Heraeus Foundation, CCQ 2nd Plenary Meeting: International Quantum Tensor Network, SPICE Workshop 2023, MCQST conference, Quantum Matter 2023, DESOEQ (Designing out of equilibrium many-body quantum systems) 2023, DOE ASCR 2023 workshop, Beyond IID in Information Theory, International Quantum Tensor Network, ETN Summer School, EQTC 2023, HPCQC 2023, The American Physical Society March Meeting 2024, ISTA colloquium VW CFD Workshop, Airbus/BMW quantum challenge, The Quantum Flagship board membership, QUANTUMatter 2024, EU-Japan 3rd Workshop on Quantum Computing, ECCOMAS 2024, ETH Zürich Workshop, Quantum Café in DG CNECT, Quantum Information and Physics Princeton, Photonics Conference Paderborn, MCQST Workshop Waterloo, XPANSE 2024, Japan-EU

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	Quantum Matchmaking Event, AIRBUS Challenge, Quantum Technologies exhibition, AIAA Journal Seminar Series, UTC Quantum Technology Workshop.
project website	The website provides project information and scientific results. It contains sections dedicated to communication with the major stakeholders listed above. The website design is tested for compatibility with different types of devices, including phones, tablets, and desktop computers.
social media channels	We have a Twitter account for immediate communication of general project news and for direct engagement with target audiences. We also maintain a LinkedIn community group to bring together interested stakeholders.
online videos	We will create a project video accessible from the website and youtube that presents the project and general concept. Where appropriate and possible we will produce video abstracts for scientific publications (e.g. New Journal of Physics).
logo and templates	We created a project logo and presentation templates (e.g. word, power point, keynote) accessible to all project partners.
data repository	Project data containing CFD and QCFD benchmark results are published in institutional repositories, including appropriate metadata, in line with the project's Data Management Plan and the FAIR (Findability, Accessibility, Interoperability, and Reusability) principles. The repository is promoted on the project website.
OpenFOAM – QCFD software interface and documentation	Open-source software developed in this project will be published in a public access git format repository. It will be documented along the guidelines of the data management plan and be publicly accessible.
QCFD software framework and documentation	Open-source software developed in this project will be published in a public access git format repository. It will be documented along the guidelines of the data management plan and be publicly accessible.
tutorial examples	The website will contain a dedicated section containing tutorial QCFD and OpenFOAM – QCFD software interface examples. These will be explained in detail to aid interested researchers setting up their own QCFD calculations. Up to now,UHH hired a bachelor's student to create tutorials on the basic use of the tensor network algorithms. As a test case, the student simulated Burger's equation and created benchmarks for various adjustable parameters. This tutorial set will be made available as part of our open source codebase. Currently, the outcome is available in gitlab repository and available upon request.
workshops	We will hold project workshops approximately after 18, 30 and 42 months of the project. These workshops will focus on communicating results to the CFD, quantum technologies and quantum computing communities. They will contain dedicated sessions for these target audiences and also plenary sessions for all. Round table and breakout discussions, poster and industry focussed sessions will be designed to maximise participant involvement in the workshops. Workshops in months 30 and 42 will also contain tutorial sessions

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	on the structure and usage of the QCFD library. The OpenFOAM interface will be presented in detail in the workshop in month 42.
interactions with EU Flagship projects	Regular meetings, user forum, long-term visits, knowledge and technology exchange. We have established close contacts with the applicants for successor projects of Aqtion, OpenSuperQ and PASQuanS and agreed on closely collaborating with them during the implementation of the projects. TUC collaborated with a team of researchers from Alpine Quantum Technologies (AQT), a leading company specializing in ion-trap-based quantum hardware. The collaboration spanned over a period of four to five months and involved regular research meetings and technical discussions aimed at integrating algorithmic developments with state-of-the-art experimental platforms. This joint effort culminated in a research article published on arXiv, presenting the main findings and methodological advances of the project. The significance of this collaboration was further highlighted through a press release on AQT's official website, which outlined the key outcomes of the study and formally acknowledged the support provided by the QCFD funding program. Felix Motzoi serves as the site representative for FZJ in the OpenSuperQ+ consortium, which follows an ambitious agenda with the ultimate goal of developing a versatile 1,000-qubit quantum-computing system made in Europe and targets applications of quantum computing in material science. Recent consortium meetings facilitated exchanges among hardware developers, cloud providers, industry partners, and algorithm developers, focusing on ongoing efforts to implement QCFD algorithms on European quantum hardware.
student internships and undergraduate research projects	We have been advertising student research opportunities at participating host institutions to attract undergraduate students with broad scientific interests and backgrounds in physics, engineering, computer science, mathematics, or related disciplines. These students are invited to contribute to ongoing research projects within the program. The projects have been developed by B.Sc. and M.Sc. students at the University of Hamburg (UHH) and are related to the **Quantum-Classical Fluid Dynamics (QCFD)** initiative under the **CUI/AIM**, **CUI**, **University of Toulouse III**, **QCFD**, **Deutsche Forschungsgemeinschaft (DFG)**, and **DFG–JST ASPIRE** funding programs. ● Non-equilibrium quantum dynamics of trapped ultracold mixtures of bosons, using ML-MCTDHX ● Simulating Heisenberg spin model with a potassium quantum gas microscope ● Development of a Quantum Simulator Utilizing Neutral Ytterbium Atoms in Optical Tweezer Arrays ● Matrix Product Simulations for Rayleigh-Bénard Convection

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	• Solving the Gross-Pitaevskii equation with quantum-inspired algorithms • Quantum Symplectic Optimization • Bachelor Thesis: Quantum Phase Transitions and Dynamics in Strongly Correlated Systems: An Infinite Matrix Product State Approach • Cavity control of a spin-Peierls transition, quantum optics, quasi-1D spin systems • Matrix Product Simulations for a Direct-Forcing Immersed Boundary Method • Efficient Quantum Error Correction Rydberg • Error detection and correction in Rydberg atom quantum computing • Extending Tensor-Network PDF Methods for Turbulent Reactive Flows with Explicit Velocity Field Representation
press releases	We have collaborated with institutional public relations offices to write press releases highlighting key project research results and to disseminate them widely which can be seen under in Section 8.2 *QCFD Communication and Dissemination Activities* and Section 8.4 *QCFD Social Media Posts*.
semi-popular articles	The QCFD team has begun drafting the QCFD project overview, outlining its general scientific approach, key results, and potential impacts in semi-popular articles. The first CFD paper is scheduled for publication in the first quarter of 2026.
public talks & open house events	Public talks have been used to communicate the project's results and potential impacts to a general audience, aiming to raise public awareness. All talks and events attended by the QCFD team are listed in Section 8.2 *QCFD Communication and Dissemination Activities* and Section 8.4 *QCFD Social Media Posts*.

5. Communication and dissemination rules

5.1. Communication within the QCFD consortium

Communication among partners was crucial to exchanging up-to-date knowledge and data across different WPs, enhancing, and optimizing external communication and dissemination.

The overall responsibility for WP#10, which included Project and Data Management, Dissemination, and Communication, belonged to UHH. However, the assigned lead beneficiary of this work package organized related CDE activities and materials and submitted them for consortium approval. Once approved, the actual plan was ready to be implemented. Upon completion of the CDE activity, a related activity report was prepared for the annual updates of the CDE Plan. All these phases were carefully managed and monitored within the project, ensuring proper mechanisms were in place to avoid deviations or potential failures while disseminating and/or exploiting results.

All partners regularly participated in communication and dissemination activities, specifically:

- Communicating their activities and disseminating their results to their respective networks, on social media, and through news on the project website,
- Contributing content to the newsletter (e.g., articles, interviews),

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- Informing other partners of interesting, related initiatives and events they could participate in,
- Keeping track of their communication and dissemination activities by filling in a dedicated reporting table available in the MS-Teams of the project,
- Disseminating results and publications in open access.

Internal communication was ensured through regular exchanges of information via email and during regular meetings when all partners gathered to discuss achievements, upcoming activities, deadlines, and issues arising within the different work packages. WP leaders also presented main research advances during meetings or other WP leader meetings that were organized as needed.

5.2. Dissemination of own (including jointly owned) Results (Consortium Agreement, Article 8.4)

During the Project and for a period of 1 year after the end of the Project, the dissemination of own Results by one or several Parties including but not restricted to publications and presentations, shall be governed by the procedure of Article 17.4 of the Grant Agreement and its Annex 5, Section Dissemination, subject to the following provisions.

Prior notice of any planned publication shall be given to the other Parties at least 14 calendar days before the publication. Any objection to the planned publication shall be made in accordance with the Grant Agreement by written notice to the coordinator and to the Party or Parties proposing the dissemination within 30 calendar days after receipt of the notice. If no objection is made within the time limit stated above, the publication is permitted.

An objection is justified if

a) the protection of the objecting Party's Results or Background would be adversely affected, or

b) the objecting Party's legitimate interests in relation to its Results or Background would be significantly harmed, or

c) the proposed publication includes Confidential Information of the objecting Party.

The objection must include a precise request for necessary modifications.

If an objection has been raised the involved Parties shall discuss how to overcome the justified grounds for the objection on a timely basis (for example by amendment to the planned publication and/or by protecting information before publication) and the objecting Party shall not unreasonably continue the opposition if appropriate measures are taken following the discussion.

The objecting Party can request a publication delay of not more than 30 calendar days from the time it raises such an objection. After 7 calendar days the publication is permitted, provided that the objections of the objecting Party have been addressed.

In the dissemination of outputs within the scope of the project, PIs act in accordance with these guidelines.

5.3. Information on EU funding (as defined in Article 17.2 of the GA)

Unless otherwise agreed with the granting authority, communication activities of the beneficiaries related to the action (including media relations, conferences, seminars, information material, such as brochures, leaflets, posters, presentations, etc., in electronic form, via traditional or social media, etc.), dissemination activities and any infrastructure, equipment, vehicles, supplies or major result funded by the grant must acknowledge EU support and display the European flag (emblem) and funding statement (translated into local languages, where appropriate)

Quality of information — Disclaimer

Any communication or dissemination activity related to the action must use factually accurate information. Moreover, it must indicate the following disclaimer (translated into local languages where appropriate):

“Funded by the European Union. Views and opinions expressed are however those of the author(s) only and do not necessarily reflect those of the European Union. Neither the European Union nor the granting authority can be held responsible for them.”

Applications For IPR Protection of Results

Include the following standard sentence in each application filed by or on behalf of a beneficiary:

"The project leading to this application has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No:101080085".

Standards Incorporating Results

If results are incorporated in a standard, the beneficiary shall ask the standardization body to include the following statement in (information related to) the standard:

"Results incorporated in this standard received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No:101080085".

CDE Activities

The following must be included in all CDE activities:

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No:101080085.

Infrastructure, Equipment, Major Results

The following must be displayed on all infrastructure, equipment and major results funded by the grant:

This [infrastructure][equipment][insert type of result] is part of a project that has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No:101080085.

When displayed together with another logo, the EU emblem must have appropriate prominence.

The documents prepared within the scope of the project, the website design and the use of promotional materials have all been carried out within these guidelines as can be seen in below.

Sample cover page template of the deliverable (usage of logo and disclaimer):

Where Quantum and Fluids entangle

Quantum Computational Fluid Dynamics
Core Benchmark CFD Set
Project number 101080085

Call:	HORIZON-CL4-2021-DIGITAL-EMERGING-02
Topic:	HORIZON-CL4-2021-DIGITAL-EMERGING-02-10
Type of action:	HORIZON Research and Innovation Actions
Granting authority:	European Commission-EU
Project starting date: fixed date:	1 November 2022
Project end date:	31 October 2026
EU-Project duration:	48 months
Project Coordinator:	University of Hamburg (UHH)
Work Package Leader	Technical University of Hamburg (TUHH)
Cooperations	University of Hamburg (UHH), ENGYS (ENG)
Deliverable number:	D1.1
WP contributing to the deliverable:	WP#1 Core CFD Examples and Algorithms
Deliverable Type:	Data
Revision:	0
Dissemination level:	Public
Due Submission date:	30.04.2024
Prepared By:	TUHH, UHH, ENG
Internal Reviewers:	DJ, TR, PO, SB
Final Approval:	

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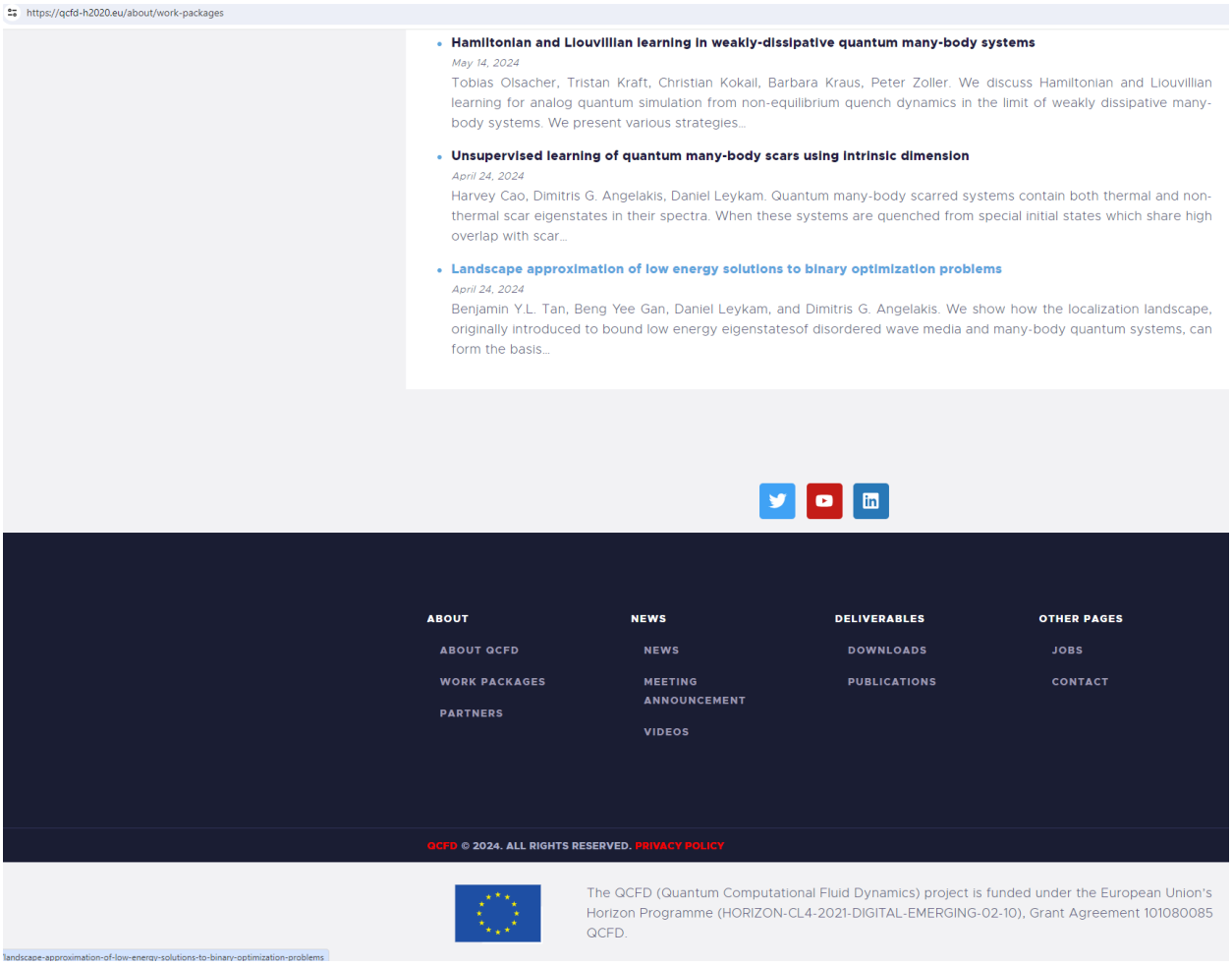
Design of Website (usage of disclaimer)



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Design of Promotional Water Bottle

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6. Tools and channels

The project has been collecting, managing, and benchmarking research data. Data management is described in the 10.01 Data Management Plan.

The data collection strategy is designated to support the scope of scientific and development goals of QCFD. The results developed throughout the project will take the form of scientific publications, whose pre-refereed versions will be available, and outreach material to disseminate the key research advances to the community.

In line with the FAIR (Findability, Accessibility, Interoperability, and Reusability) principles, the project is committed to maintaining transparency throughout its data management processes. To this end, all disseminated information will be accompanied by detailed metadata and comprehensive documentation. This is aimed at facilitating a deeper understanding of the results and enabling the scientific reproduction of these outcomes.

A new branch was created under UHH's Sustainable Research Data Management portal ' https://www.fdr.uni-hamburg.de/search?page=1&size=20&q=QCFD '. This portal will ensure accessibility for project partners while adhering to protocols that respect intellectual property protection regulations for the public.

In addition, data here is stored publicly and its availability is communicated through QCFD's social media accounts and website.

The datasets produced during the 1st reporting period under the project can be found in Annex 8.3 QCFD Datasets Follow-Up.

6.1. Use of graphic identity and EU visibility

A common graphic identity has been defined to allow for better visibility and recognition as well as branding of the QCFD project. All dissemination tools and activities have been referred to or include Project Name, Project Logo, Project Website and Information on EU funding. These have been consistently used for the project website and all other communication templates, such as Power Point, Word, posters and EC Report.

6.2. Project Logos

Where Quantum and Fluids entangle	Where Quantum and Fluids entangle

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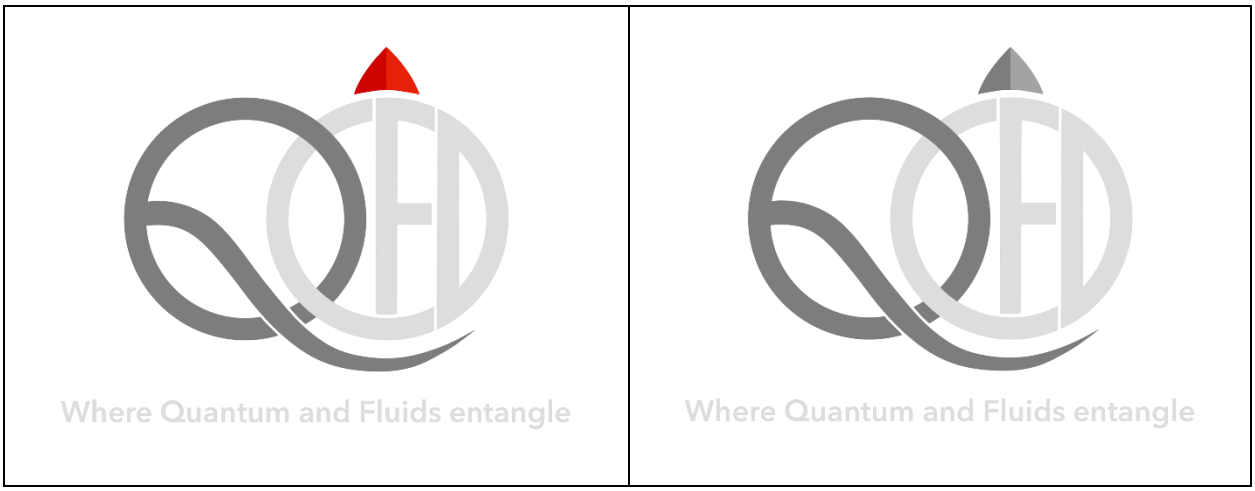
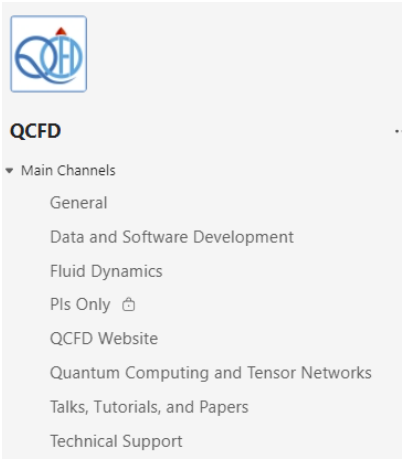


6.3. MS-Teams

The QCFD team has been utilizing Microsoft Teams to enhance internal communication seamlessly and its centralized space feature for storing project-related documentation, ensuring accessibility for all team members. The key features contributing to this accessibility include:

- Creating and managing teams and channels
- Chat and file sharing
- Scheduling meetings and calls
- Project-wide announcements

MS-Teams' QCFD Teams has these channels under it.



Different filing structures were created under the channels according to the needs of the groups. The filing structure under the general channel is as follows:

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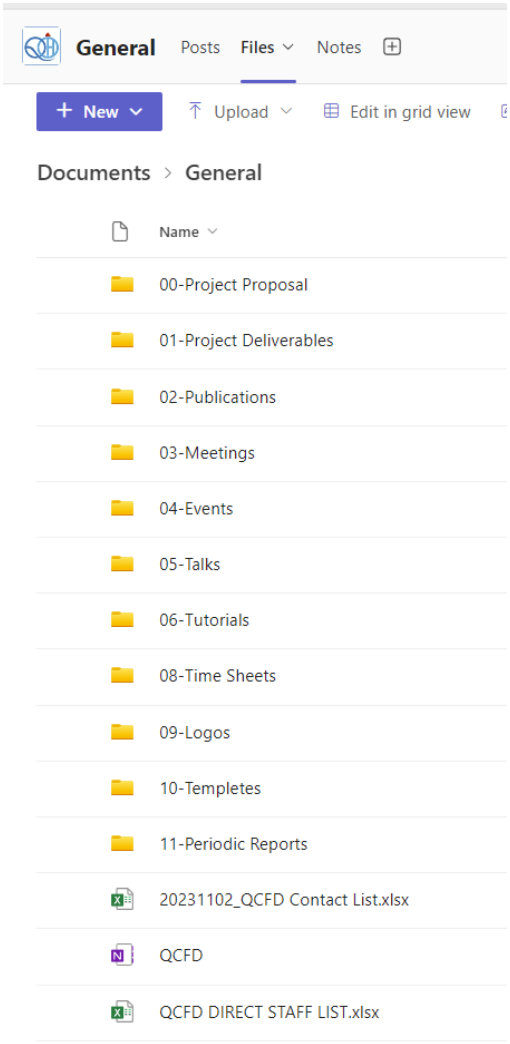

6.4. Open Access to Scientific Data Tool

The project has been collecting, managing, and benchmarking research data. Data management is described separately in the 10.01 Data Management Plan.

The data collection strategy is designated to support the scope of scientific and development goals of QCFD. The results developed throughout the project will take the form of scientific publications, whose pre-refereed versions will be available, and outreach material to disseminate the key research advances to the community.

In line with the FAIR (Findability, Accessibility, Interoperability and Reusability) principles, the project is committed to maintaining transparency throughout its data management processes. To this end, all disseminated information will be accompanied by detailed metadata and comprehensive documentation. This is aimed at not only facilitating a deeper understanding of the results but also enabling and simplifying the scientific reproduction of these outcomes.

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A new branch was created under UHH's Sustainable Research Data Management portal ' https://www.fdr.uni-hamburg.de/search?page=1&size=20&q=QCFD '. This portal will ensure accessibility for project partners while adhering to protocols that respect intellectual property protection regulations for the public.

In addition, data here is stored publicly and its availability is publicly communicated through QCFD's social media accounts and website.

The datasets produced during the 1st reporting period under the project can be found in Annex 8.3 QCFD Datasets Follow-Up.

6.5. Project Website

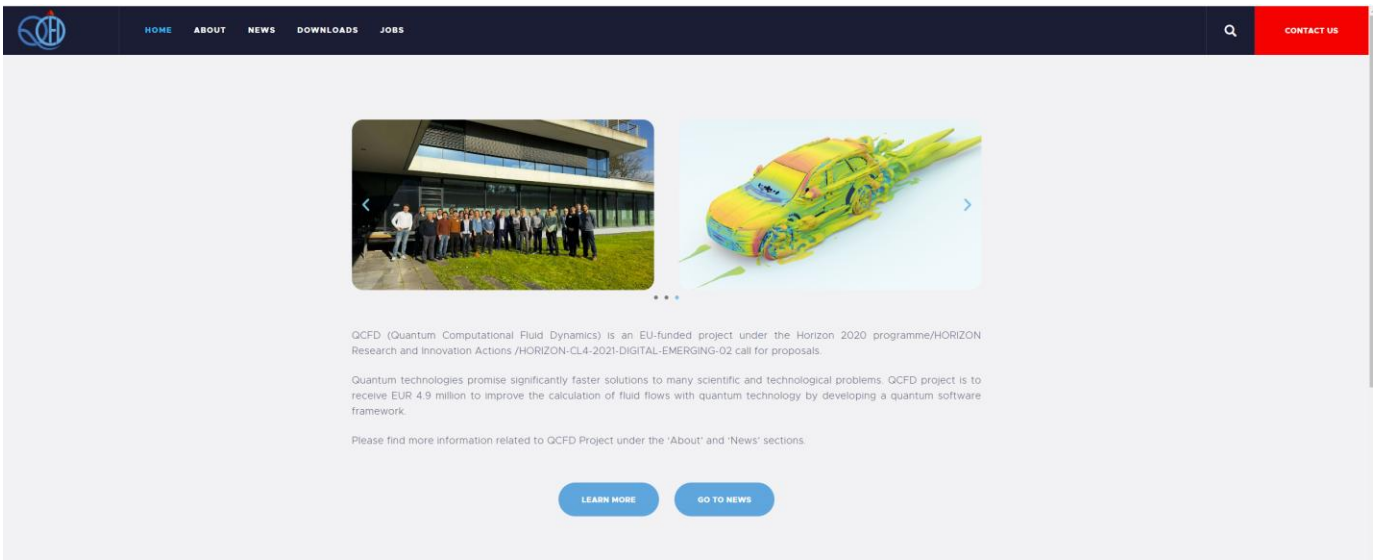
QCFD has developed a user-friendly project website under qcfd-h2020.eu and updates are ongoing.

The website provides the primary source of information for external parties, providing updates on project activities and achievements to all target audiences. The aim is to inform stakeholders and associated industries about project developments and present the project's achievements and the QCFD developments to the public.

All partners have been contributing to the website by providing relevant project information. All communication efforts by project partners and social media have been redirected to the QCFD website. Traffic to the website has been increased by creating mutual links between the partners' websites and other relevant websites.

QCFD website is characterized by its easy navigability, simplicity and user-friendly features. On the menu, the following sections have been created: Home, About, News, Downloads, and Jobs.

6.5.1. Home Section



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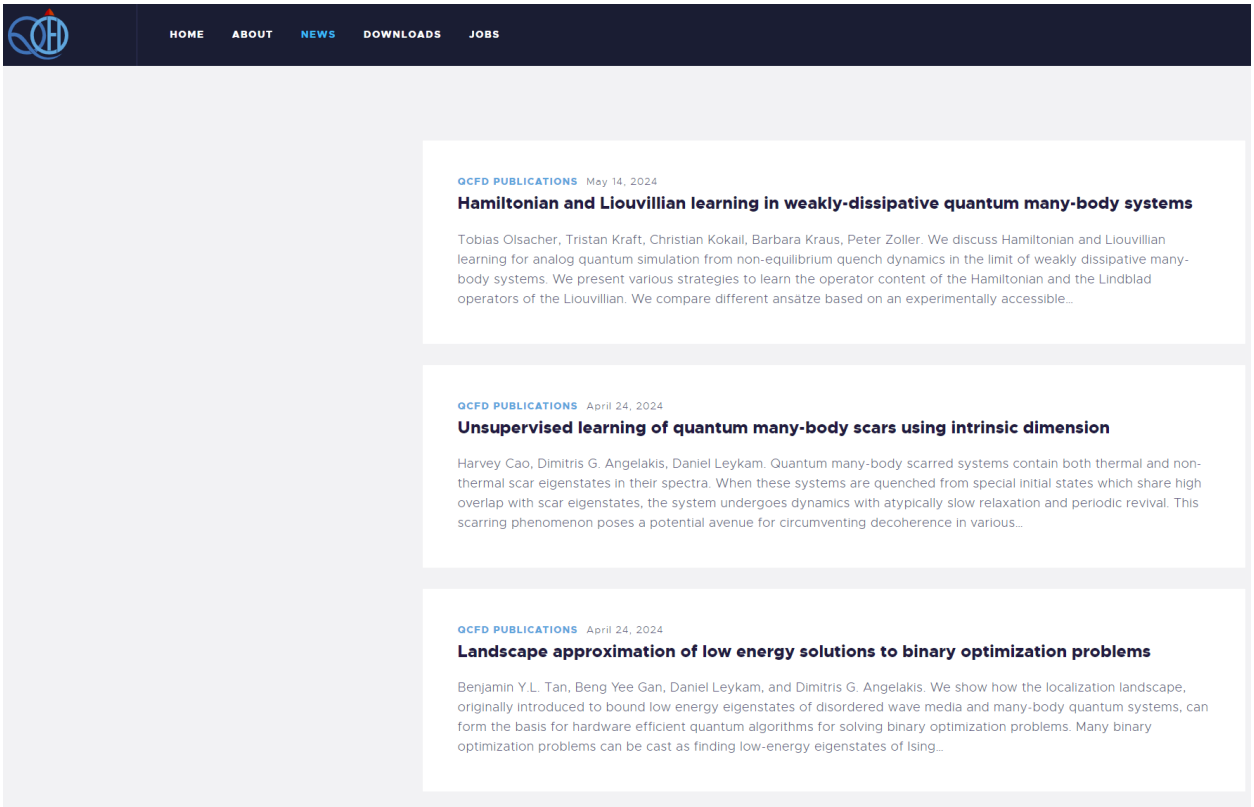
6.5.2. About Section

6.5.3. News Section



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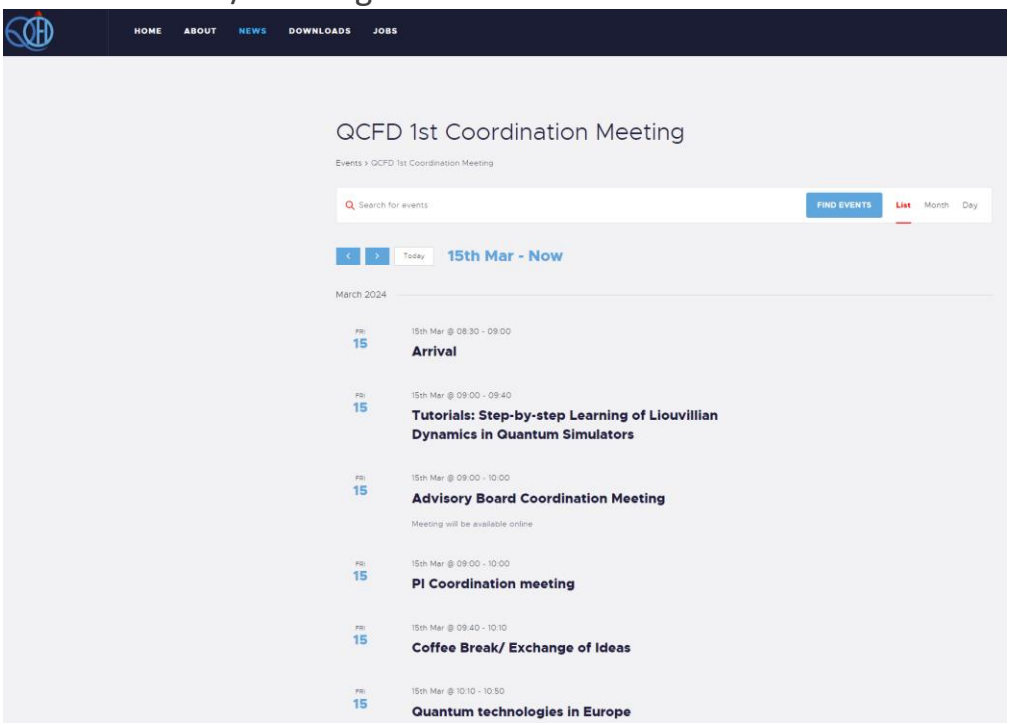
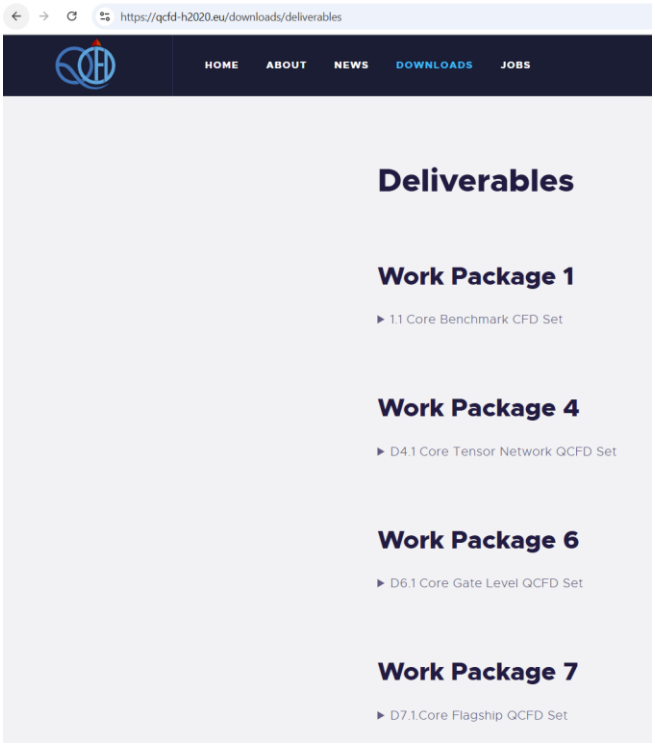
6.5.4. News/Meeting Section



6.5.5. Deliverables Section



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6.6. Social Media

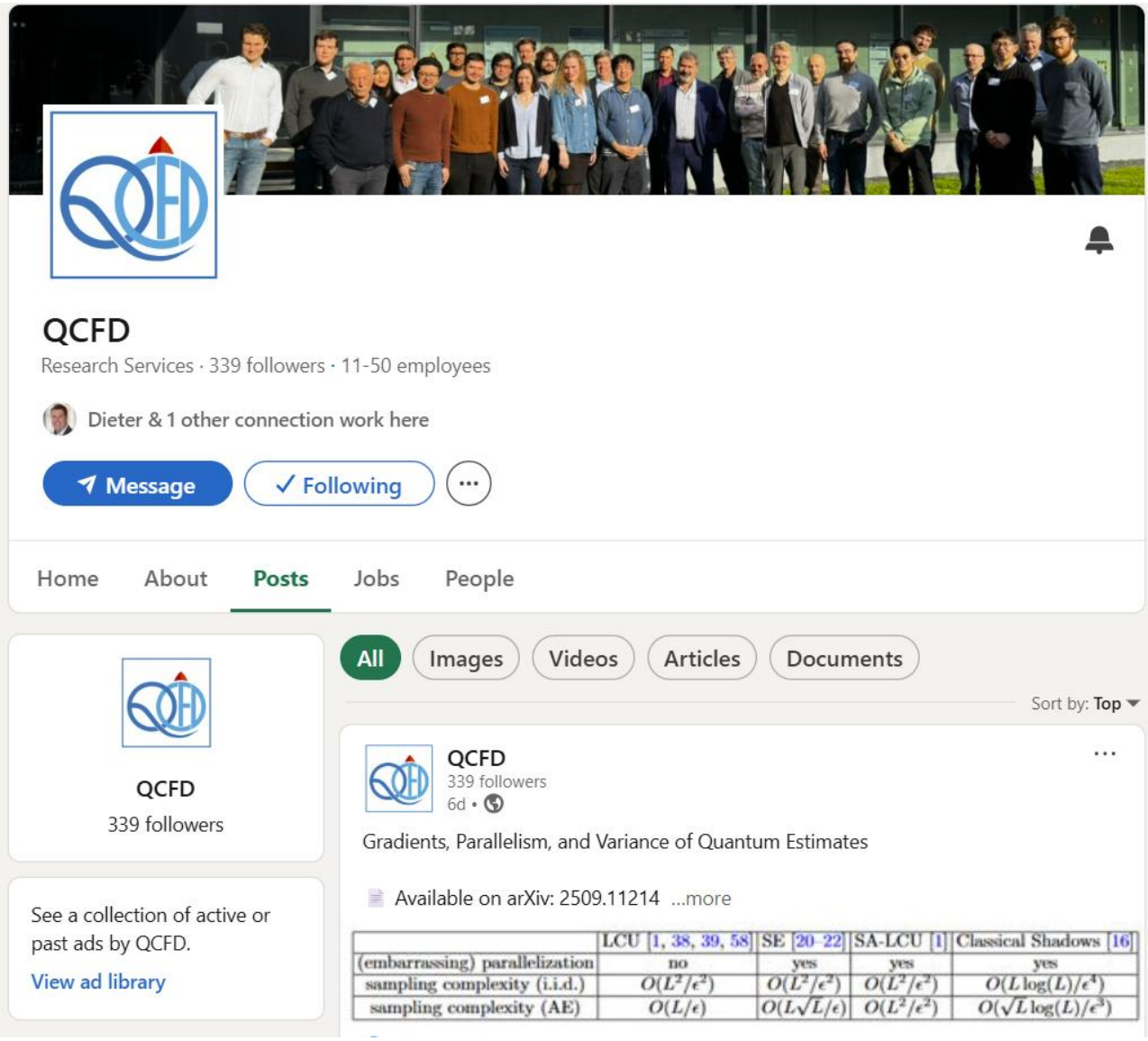
The project's social media accounts have been created on Twitter and LinkedIn to ensure wider dissemination to different age groups and target audiences. Social media has been used as a tool to announce project developments, but most importantly drive traffic to the project website.

Consortium partners have been following the project's social media channels and engaging with them as much as possible. Whenever possible, the partners have been sharing posts on their own corporate websites and social media networks.

Posts published on social media are included in Annex 8.4. Social Media Posts

6.6.1 LinkedIn Account

The number of followers increased to 339 during the last reporting period.



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6.6.2. X (Twitter) Account

Since LinkedIn is generally followed more for project progress, the number of X followers did not increase.

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6.6.3. YouTube Account

Since PIs do not want to share their videos on YouTube, it won't be used in the future.

Please find the talks have been given by QCFD Shareholders during the meetings below:

List of QCFD Team's Talks			
Partner	**Presenter**	**Subject of the Talk**	**Meeting**
UHH	Dieter Jaksch	The Structure of VQA (Variational Quantum Algorithms)	Kick Of Meeting
TUHH	Thomas Rung	Modeling, Simulation and Optimization Finite-Volume Method	Kick Of Meeting
ENGYS	Paolo Geremia	Introduction of ENGYS and Project Updates	Kick Of Meeting
TUM	Barbara Kraus	Entanglement Theory & Verification of Quantum Devices	Kick Of Meeting
FZJ	Felix Motzoi	Quantum Control Theory for Noisy Intermediate-Scale Quantum Algorithms	Kick Of Meeting
TUC	Dimitris Angelakis	Optimizing QCFD Algorithms on Cold Ions, Atoms and Superconducting Hardware	Kick Of Meeting
UHH	Dieter Jaksch	Boundary Conditions in Tensor-Network Computational Fluid Dynamics	Kick Of Meeting
TUHH	Sergio Bengoechea	Computational Fluid Dynamics (CFD) & Adjoint Optimization	Kick Of Meeting
UHH	Dieter Jaksch	Tensor Networks for Probability Simulation of Turbulent Reactive Flows	1st Coordination Meeting
TUHH	TR, PO,SBL	Boundary Condition Treatment for VQA Simulations of PDE Problems on QCs	1st Coordination Meeting
TUM	Barbara Kraus	Gaining Confidence About Quantum Devices	1st Coordination Meeting
FZJ	José da Costa Jesus	Steps Towards Implementation of QCFD on Quantum Hardware	1st Coordination Meeting
ENGYS	Paolo Geremia	Progress Toward User-Space Interfaces for Quantum CFD	1st Coordination Meeting
TUC	Dimitris Angelakis	Small Scale Implementations of QCFD Algorithms in Cloud Quantum Processors: Challenges and First Results	1st Coordination Meeting
PLANQC	Martin Kiffner	Towards QCFD on Neutral Atom Quantum Computers	1st Coordination Meeting
TUM	Tristan Kraft	Step-by-Step Learning of Liouvillian Dynamics in Quantum Simulators	1st Coordination Meeting
EC	Christian Trefzger	Quantum Technologies in Europe	1st Coordination Meeting
ENGYS	Eugene De Villiers	The Aerodynamic Development of the Lightship L1 Trailer	1st Coordination Meeting
Voith	Michael Palm	CFD in Marine Engineering Applications - Voith's Perspective	1st Coordination Meeting

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PLANQC	Sebastian Blatt	Neutral-Atom Quantum Computing in the Munich Quantum Valley	1st Coordination Meeting
UHH	Dieter Jaksch	Quantum tensor programming of PDEs	2nd Coordination Meeting
UHH	Nis-Luca Van Hülst	Advances in using Matrix Product States for non-orthogonal boundary fitted coordinates (NBFCs) systems Software framework - current status	2nd Coordination Meeting
FZJ	Felix Motzoi	D6.1.Core Gate-Level QCFD Set	2nd Coordination Meeting
FZJ	Jose Da Costa Jesus	Hardware implementation efforts	2nd Coordination Meeting
TUM	Tristan Kraft	Experimental Hamiltonian and Liouvillian Learning	2nd Coordination Meeting
ENGYS	Paolo Geremia	"Bridging the Gap: Integrating MPS/MPO with OpenFOAM for accessible Computational Fluid Dynamics acceleration"	2nd Coordination Meeting
TUC	Muhammad Umer	Platform optimized codes for Burger's dynamics and a new proposal on efficiently estimating the cost function	2nd Coordination Meeting
TUHH	Paul Over	Towards VQA for generalised linear and non-linear transport phenomna	2nd Coordination Meeting
UHH	Dieter Jaksch	QCFD Overview	3rd Coordination Meeting
Oxford	Andrew Daley	Tensor networks for nonlinear dynamics	3rd Coordination Meeting
Oxford	Nikita Gourianov	Quantum-inspired advantage for solving partial differential equations	3rd Coordination Meeting
TUHH	Paul Over, Sergio Bengoechea	WP1 - Core CFD Examples and Algorithms WP2- Industry Involvement	3rd Coordination Meeting
UHH	Mario Guillaume Cecile	WP3 - QCFD Algorithms	3rd Coordination Meeting
PLANQC	Martin Kiffner	Quantum and quantum-inspired CFD simulations	3rd Coordination Meeting
TUC	Muhammad Umer	WP5 - Platform Optimized Code	3rd Coordination Meeting
FZJ	Setty Abhishek	WP6 - Gate Level Simulations	3rd Coordination Meeting
EC	Christian Trefzger	Latest Developments in EU Quantum Policy	3rd Coordination Meeting
FZJ	Jose Da Costa Jesus	WP7 - Flagship Hardware Calculations	3rd Coordination Meeting
TUM	Tristan Kraft	WP8 - Validation, Benchmarks and Analysis	3rd Coordination Meeting
ENGYS	Paolo Geremia	From Fluid Dynamics to Tensor Networks: OpenFOAM Data as Matrix Product States	3rd Coordination Meeting

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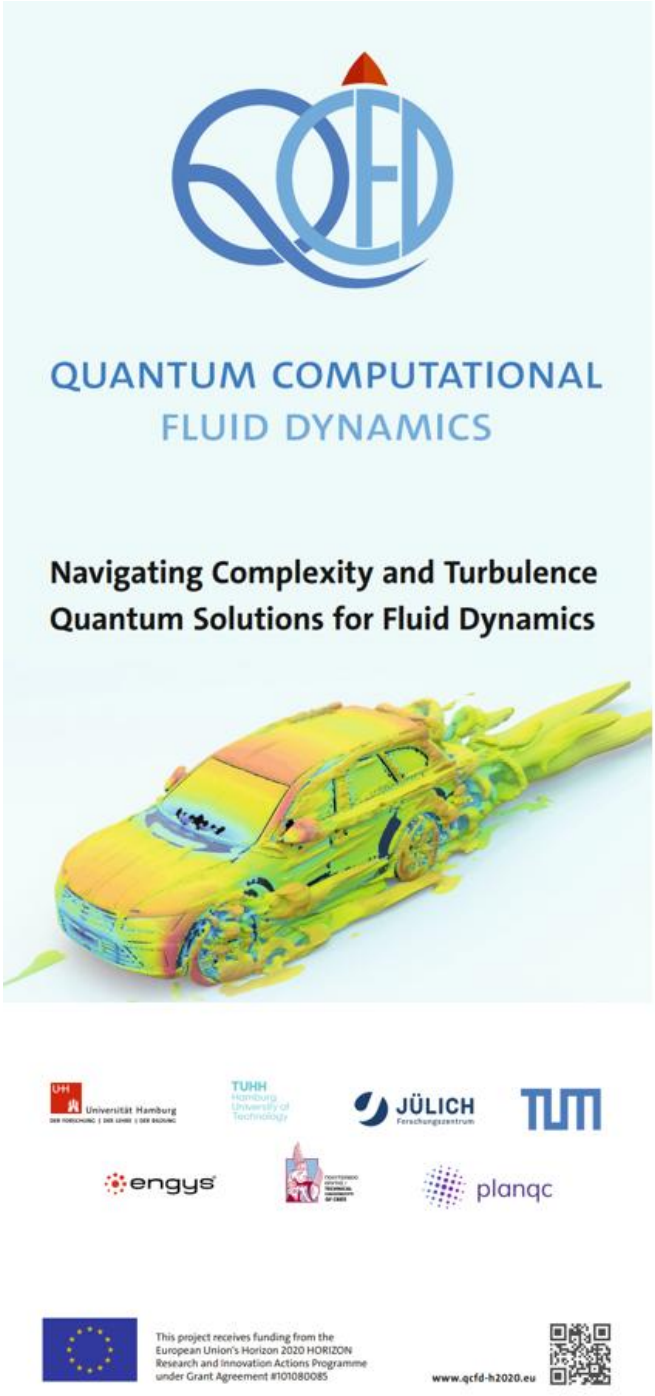
6.7. Printed Material

Roll Up banners were used as printed material during the meetings to increase visibility related to QCFD project.

Design of Roll up Banners (usage of logo and disclaimer):



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www.qcfd-h2020.eu

6.8. Promotional Materials

Water bottles, mugs and New Year's card were made as a promotional product for the project and distributed to partners and parties related to the sector.

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QUANTUM COMPUTATIONAL FLUID DYNAMICS PROJECT
Season's Greetings
Where Quantum and Fluids entangle
We wish you a
Merry Christmas
and a
Happy New Year
Prof. Dr. Dieter Jaksch
Coordinator Principal Investigator
QCFD Project
www.qcfd-h2020.eu
planqc
JÜLICH
engys
TUHH

6.9. Scientific Journals

Scientific papers were published in specialized international peer-reviewed journals like Ads, AIAA Journal, APS, IOP Science, Machine Learning: Science and Technology, New Journal of Physics (NJP), NPJ Quantum Information, Physical Review A, Physical Review Fluids, Quantum, Science Advances, Science Direct. A list of publications can be found under Annex 8.1 QCFD Publications Follow Up.

6.10. Participation in Conferences, Workshops and Events

Project partners have been attending sector-related events, conferences, and workshops, to meet target groups, other stakeholders, public authorities, and the scientific community and to raise awareness about the project objectives and results. These events provide access to target audiences at local, national, European, and international levels. Activities attended can be found under Annex 8.2. QCFD Communication and Dissemination Activities.

7. Monitoring and Reporting

The monitoring system has been established related to publications; communication and dissemination activities, social media posts, datasets and the lists are given under annexes. These lists will be updated and submitted in the following dissemination reports.

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8. Annexes

8.1. QCFD Publications Follow Up

QCFD PUBLICATIONS					
#	**Published on**	**Title of the journal**	**Title**	**Authors**	**Date of Publication**
1	Article in journal	Quantum 8	Hybrid discrete-continuous compilation of trapped-ion quantum circuits with deep reinforcement learning	Preti, Francesco; Schilling, Michael; Jerbi, Sofiene; Trenkwalder, Lea M.; Nautrup, Hendrik Poulsen; Motzoi, Felix; Briegel, Hans J.	1-Jan-23
2	Article in journal	npj Quantum Informatio	Experimental error suppression in Cross-Resonance gates via multi-derivative pulse shaping	B Li, T Calarco, F Motzoi	2-May-24
3	Article in Journal	AIAA Journal	Variational Quantum Algorithms for Computational Fluid Dynamics	Dieter Jaksch; Peyman Givi; Andrew J. Daley; Thomas Rung	1-May-23
4	Article in Journal	Physical Review A	Shallow quantum circuits for efficient preparation of Slater determinants and correlated states on a quantum computer	Chong Hian Chee; Daniel Leykam; Adrian M. Mak; Dimitris G. Angelakis	18-Aug-23
5	Article in Journal	Phys. Rev. Research 6	Gaining confidence on the correct realization of arbitrary quantum computations	Jose Carrasco, Marc Langer, Antoine Neven, Barbara Kraus.	30-Sep-24
6	Article in Journal	Machine Learning: Science and Technology	Reinforcement learning pulses for transmon qubit entangling gates	Ho Nam Nguyen, Felix Motzoi, Mekena Metcalf, K. Birgitta Whaley, Marin Bukov, Markus Schmitt	6-Nov-23
7	Article in Journal	Physical Review Fluids	Tensor network reduced order models for wall-bounded flows	Martin Kiffner; Dieter Jaksch	8-Dec-23
8	Article in Journal	Physical Review A	Landscape approximation of low-energy solutions to binary optimization problems	Benjamin Y. L. Tan; Beng Yee Gan; Daniel Leykam; Dimitris G. Angelakis	26-Jan-24
9	Article in Journal	IOPScience	Unsupervised learning of quantum many-body scars using intrinsic dimension	Cao, Harvey; Angelakis, Dimitris G.; Leykam, Daniel	29-Apr-24

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10	Article in Journal	Science Direct	Boundary Treatment for Variational Quantum Simulations of Partial Differential Equations on Quantum Computers	Paul Over, Sergio Bengoechea, Thomas Rung, Francesco Clerici, Leonardo Scandurra, Eugene de Villiers, Dieter Jaksch	15-Feb-25
11	Article in Journal	npj Quantum Informatio	Gate-set evaluation metrics for closed-loop optimal control on nitrogen-vacancy center ensembles in diamond	P.J. Vetter, T. Reisser, M.G. Hirsch, T. Calarco, F. Motzoi, F. Jelezko, M.M. Müller	2-Oct-24
12	Article in Journal	Quantum	Partitioned Quantum Subspace Expansion	Tom O'Leary, Lewis W. Anderson, Dieter Jaksch, Martin Kiffner.	5-May-25
13	Article in Journal	Physical Review A	Probing the limits of variational quantum algorithms for nonlinear ground states on real quantum hardware: The effects of noise	Muhammad Umer, Eleftherios Mastorakis, Sofia Evangelou, Dimitris G. Angelakis.	1-Jan-25
14	Article in Journal	PRX Quantum	Correction formulas for the two-qubit Mølmer-Sørensen gate	Susanna Kirchhoff, Frank K. Wilhelm, Felix Motzoi	12-Feb-25
15	Article in Journal	IOPScience	Hamiltonian and Liouvillian learning in weakly-dissipative quantum many-body systems	Tobias Olsacher, Tristan Kraft, Christian Kokail, Barbara Kraus, Peter Zoller	8-Jan-25
16	ArXiv.org		Dispersive Qubit Readout with Intrinsic Resonator Reset	M. Jerger, F. Motzoi, Y. Gao, C. Dickel, L. Buchmann, A. Bengtsson, G. Tancredi, Ch. Warren, J. Bylander, D. DiVincenzo, R. Barends, P. A. Bushev	10-Jun-24
17	Article in Journal	Phys. Rev. Lett. 135	A Quantum Information Perspective on Many-Body Dispersive Forces	Christopher Willby, Martin Kiffner, Joseph Tindall, Jason Crain, and Dieter Jaksch	9-Nov-25
18	Article in Journal	Science Advances Vol. 11, No. 5	Tensor networks enable the calculation of turbulence probability distributions	Nikita Gourianov, Peyman Givi, Dieter Jaksch, Stephen B. Pope	29-Jan-25
19	Article in journal	Phys. Rev. A 112	Quantum Algorithm for the Advection-Diffusion Equation with Optimal Success Probability	Paul Over, Sergio Bengoechea, Peter Brearley, Sylvain Laizet, Thomas Rung	1-Jul-25
20	Arxiv.org		Tensor Train Multiplication (TTM)	Alexios Michailidis, Christian Fenton, Martin Kiffner	10-Oct-24
21	Article in Journal	IOPScience	Self-Adaptive Physics-Informed Quantum Machine Learning for Solving Differential Equations	Abhishek Settya,Rasul Abdusalamova, Felix Motzoi	24-Oct-24

22	Arxiv.org		Towards Variational Quantum Algorithms for 1 generalized linear and nonlinear transport phenomena	Sergio Bengoechea, Paul Over, Dieter Jaksch and Thomas Rung	22-Nov-24
23	Article in Journal	IOPscience	Efficient Estimation and Sequential Optimization of Cost Functions in Variational Quantum Algorithms	Muhammad Umer, Eleftherios Mastorakis, Dimitris G. Angelakis	19/05/2025
24	Arxiv.org		Tensor-Programmable Quantum Circuits for Solving Differential Equations	Pia Siegl, Greta Sophie Reese, Tomohiro Hashizume, Nis-Luca van Hulst, Dieter Jaksch	6-Feb-25
25	Article in Journal	New Journal of Physics	Dynamical quantum phase transitions on random networks	Tomohiro Hashizume, Felix Herbort, Joseph Tindall and Dieter Jaksch	1-Jun-25
26	Arxiv.org		Disentangling strategies and entanglement transitions in unitary circuit games with matchgates	Ra´ul Morral-Yepes, Marc Langer, Adam Gammon-Smith, Barbara Kraus, and Frank Pollmann	25-Jul-25
27	Arxiv.org		Quantum-Inspired Tensor-Network Fractional-Step Method for Incompressible Flow in Curvilinear Coordinates	Nis-Luca van Hülst, Pia Siegl, Paul Over, Sergio Bengoechea , Tomohiro Hashizume, Mario Guillaume Cecile, Thomas Rung, and Dieter Jaksch	7-Jul-25
28	Arxiv.org		Resource-Efficient Hadamard Test Circuits for Nonlinear Dynamics on a Trapped-Ion Quantum Computer	Eleftherios Mastorakis, Muhammad Umer, Milena Guevara-Bertsch, Juris Ulmanis, Felix Rohde and Dimitris G. Angelakis	25-Jul-25
29	Article in journal	Phys. Rev. Applied 24	Fast neutral-atom transport and transfer between optical tweezers	Cristina Cicali, Martino Calzavara, Eloisa Cuestas, Tommaso Calarco, Robert Zeier, Felix Motzoi	28-Aug-25
30	Arxiv.org		Real-time adaptive quantum error correction by model-free multi-agent learning	Manuel Guatto, Francesco Preti, Michael Schilling, Tommaso Calarco, Francisco Andrés Cárdenas-López, Felix Motzoi	4-Sep-25
31	Arxiv.org		Gradients, parallelism, and variance of quantum estimates	Francesco Preti, Michael Schilling, József Zsolt Bernád, Tommaso Calarco, Francisco Cárdenas-López, Felix Motzoi	14-Sep-25
32	Article in Journal	PRX Quantum 6	Universal pulses for superconducting qudit ladder gates	Boxi Li, F. A. Cárdenas-López, Adrian Lupascu, Felix Motzoi	19-Sep-25

33	Arxiv.org		Block Encoding of Sparse Matrices via Coherent Permutation	Abhishek Setty	19-Sep-25
34	Arxiv.org		Classical feature map surrogates and metrics for quantum control landscapes	Martino Calzavara, Tommaso Calarco, Felix Motzoi	30-Sep-25
35	Article in Journal	Phys. Rev. Research 7	Quantum algorithms for cooling: A simple case study	Daniel Molpeceres, Sirui Lu, J. Ignacio Cirac, Barbara Kraus	15-Aug-25

8.2. QCFD Communication and Dissemination Activities

QCFD Communications Activities - 01.11.2022 - 30.04.2024							
Beneficiary	**Communication Activity Name***	**Description***	**Who? Target audience***	**How? Communication channel***	**Outcome***	**Status***	**Date**
All	Project Kick-off Meeting	Initial Meeting to discuss project objectives and milestones	- Industry, business partners	- Event (conference, seminar, meeting, workshop..)	Aggreed on project timeline and assigned tasks	Delivered	02-May-23
TUM	MCQST conference	Presentation of research results at the Munich Conference on Quantum Science and Technology	- Research communities	- Event (conference, seminar, meeting, workshop..)	Discussions with conference participants on the presented topic	Delivered	22-Jun-23
TUM	Beyond IID in Information Theory	Presentation of research results at the conference "Beyond IID in Information Theory"	- Research communities	- Event (conference, seminar, meeting, workshop..)	Discussions with conference participants on the presented topic	Delivered	11-Jul-23

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All	QCFD - Researchers Sync	Informal get-togethers to exchange impressions between only researchers of the QCFD Project to avoid potential overlaps in our work and intensify internal communication.	- Industry, business partners	- Event (conference, seminar, meeting, workshop..)	Updated project status and information of upcoming steps	Delivered	18-Jul-23
TUM	International Quantum Tensor Network	Presentation of research results at the conference "International Quantum Tensor Network"	- Research communities	- Event (conference, seminar, meeting, workshop..)	Discussions with conference participants on the presented topic	Delivered	26-Jul-23
TUHH	ETN Summerschool	Attending of a Tensor Network Summer School and presentation of the research results	- Research communities	- Event (conference, seminar, meeting, workshop..)	Feedback on all aspects of the research results presented during the colloquium.	Delivered	11.09-15.09.2023
TUM	EQTC 2023	Presentation of research results at the conference at EQTC 2023	- Research communities	- Event (conference, seminar, meeting, workshop..)	Discussions with conference participants on the presented topic	Delivered	19-Oct-23
All	Researchers Meeting 2.0	Presentation of the research progress of the researchers. Space for open exchange	- Industry, business partners	- Event (conference, seminar, meeting, workshop..)	Vivid discussion and potential collaborations on topic	Delivered	27-Oct-23
ENG	Researcher Discussions	Presentation of the research progress of the researchers. Space for open exchange	- Industry, business partners	- Event (conference, seminar, meeting, workshop..)	Exchange of material and ideas, potential collaborations on quantum algorithms for solving differential equations	Delivered	29-Nov-23

ENG	HPCQC Workshop	Attending of a high performance computing and quantum computing workshop.	- Research communities	- Event (conference, seminar, meeting, workshop..)	Vivid discussion with physicists of UniTrento with opportunity to present our work and communication with NVIDIA developers.	Delivered	14-15/Dec/2023
TUM	Workshop on Quantum Information SRS	Presentation of research results at the Workshop on Quantum Information SRS	- Research communities	- Event (conference, seminar, meeting, workshop..)	Discussions with conference participants on the presented topic	Delivered	25-Feb-24
All	1st Coordination Meeting	Project Coordination Meeting is a regular gathering designed to facilitate effective communication, coordination, and decision-making among the project's stakeholders. This meeting aims to ensure that all team members are aligned with the project's objectives, progress, and upcoming milestones. It provides a platform for discussing any challenges, brainstorming solutions, and making strategic adjustments as needed to keep the project on track.	- Industry, business partners	- Event (conference, seminar, meeting, workshop..)	Updated project status, resolved issues, action items and assignments, adjusted plans, stakeholder alignment, documentation of decisions, next meeting scheduled.	Delivered	14-15/Mar/2024

All	Principal Investigators Coordination Meeting	The QCFD consortium held a PI coordination meeting to discuss several key topics, including updates on the amendment process, budget considerations, deliverables, milestones, dissemination and exploitation of project results, periodic reporting, challenges, and risk updates. Representatives from all partners attended the meeting in person.	- Industry, business partners	- Event (conference, seminar, meeting, workshop..)	Updates and decisions on amendment process, budget, deliverables and milestones, dissemination and communication, periodic reporting, challenges and risks, next meeting	Delivered	15-Mar-24
All	Advisory Board Meeting	The advisory board has been provided with a summary report on the current project's progress. The board was asked to provide feedback on all aspects of the project and the research results presented during the workshop.	- Industry, business partners	- Event (conference, seminar, meeting, workshop..)	Feedback on all aspects of the project and the research results presented during the workshop.	Delivered	15-Mar-24

All	Principal Investigators& Advisory Board Meeting	After the end of the workshop during the coordination meeting, the PIs met with the advisory board members for feedback on the project's progress and possible improvements. The advisory board has been provided with a summary report on the current project's progress. The board was asked to provide feedback on all aspects of the project and the research results presented during the workshop.	- Industry, business partners	- Event (conference, seminar, meeting, workshop..)	Feedback on all aspects of the project and the research results presented during the workshop.	Delivered	15-Mar-24
TUHH	Volkswagen CFD Colloquium	Presentation of recent quantum CFD progress	- Industry, business partners	- Event (conference, seminar, meeting, workshop..)	Feedback on all aspects of the research results presented during the colloquium.	Delivered	18-Apr-24

QCFD Communications Activities - 01.05.2024 - 31.10.2025							
Beneficiary	**Communication Activity Name***	**Description***	**Who? Target audience***	**How? Communication channel***	**Outcome***	**Status***	**Date**
TUM	Quantum Matter International Conference – QUANTUMatter 2024	Presentation of research results at QUANTUMatter 2024	- Research communities	- Event (conference, seminar, meeting, workshop..)	Discussions with conference participants on the presented topic	Delivered	08-May-24
PlanQC	Science discussion meetings	Discussion on PlanQC's roadmap to fault-tolerant quantum computing.	- Industry, business partners	- Event (conference, seminar, meeting, workshop..)	Exchange of Experience	Delivered	14-May-24
TUHH	ECCOMAS Conference	Presentation of flexible boundary condition implementation on quantum computers	- Research communities	- Event (conference, seminar, meeting, workshop..)	Feedback on all aspects of the research results presented during the colloquium.	Delivered	06-Jun-24
All	Deliverables Preparation Workshop	Collaborative workshop aimed at coordinating with project partners to prepare and finalize key project deliverables.	- Industry, business partners	- Event (conference, seminar, meeting, workshop..)	Completed and aligned project deliverables ready for submission	Delivered	
All	Researcher Discussions	Researchers who are working in QCFD project are having online meetings according to their work packages, deliverables, milestones	- Industry, business partners	- Event (conference, seminar, meeting, workshop..)	Completed deliverables, milestones	Delivered	

All	Project Preparation Meetings	All WP leaders presented their progress.	- Industry, business partners	- Event (conference, seminar, meeting, workshop..)	There was an exchange of ideas about the WPs, what has been done, what should be done, challenges and risks. New meetings were organized with the co-leaders of the working groups. Ensured that everyone had the same level of knowledge about the project.	Delivered	19-25 June 2024 02 July 2024
All	Project 1st Review Meeting	All WP leaders presented their progress to European Commission	- EU institutions	- Event (conference, seminar, meeting, workshop..)	The review meeting covered the project activities that we have carried out.	Delivered	04-Jul-24
All	Kick Off - Deliverables D6.1 Core gate-level QCFD & D7.1 Core flagship QCFD set	Assingment of roles and responsibilities to prepare D6.1 and 7.1 with WP Leader FZJ and Co-partners (TUC, PlanQC and UHH)	- Industry, business partners	- Event (conference, seminar, meeting, workshop..)	Roles and new deadlines are assigned.	Delivered	11-Jul-24
TUM	MILLENION & QCFD Projects Cooperation	TUC Angelakis' Group and Dieter Jaksch held a meeting with Thomas Monz 9QCFD Advisory Board Member). The outline of the meeting	- Industry, business partners	- Event (conference, seminar, meeting, workshop..)	Thomas Monz was informed about the basic ideas of the OCFD algorithms and our hardware	Delivered	20-Aug-24

		was: Fluid dynamics – A brief overview Variational quantum CFD algorithms and Methodology Nonlinear Schrödinger Equation Burger's equation Results - Shock wave Summary			implementations. Team discussed the hardware requirements, the gate type, numbers and fidelities for our superconducting works, and the corresponding possibilities for the ion ones, to implement our NLSE and Burgers works there. Angelakis' Group provided the relevant information in a deck and agreed we would follow up with a discussion with his team. Angelakis' Group is now waiting for Thomas Monz to get back to us to get us connected with his team.		
PlanQC	PlanQC New HQ Opening Ceremony	As part of the official opening, PlanQC is organizing a panel discussion. Prof. Dr. Dieter	- Industry, business partners	- Event (conference, seminar, meeting, workshop..)	Meetings were held with QCFD team and investors related to QCFD	Delivered	25-Sep-24

		Jaksch is invited to the event as a moderator of the panel discussion that Dr. Dieter Kranzlmüller (LRZ), Dr. Rudolf Gross (MQV) and one of PlanQC's investors. Prof. Jaksch assessments of the most promising applications and the strengths of the various platforms will be shared with audience.			project and future cooperation opportunuties.		
ENG	Engys Annual User Group Meeting	The ENGYS Annual User Group Meeting (UGM) gathers users from various industries, including automotive, AEC, and Formula 1 teams, to share insights, case studies, and the latest advancements in CFD simulations using HELYX and ELEMENTS. 75 attendees are expected, including representatives from six Formula 1 teams, major automotive and AEC companies, and academic institutions. Dieter Jaksch is invited to give a talk related to QCFD and the ENGYS's role on the project.	- Innovators	- Event (conference, seminar, meeting, workshop..)	ENGYS progress on the project and to do list for future deliverables	Delivered	25-Oct-24

FZJ	Data Management of - Deliverables D6.1	Uploadind data to the FDRsystem and evaluation of D6.1 internally	- Industry, business partners	- Event (conference, seminar, meeting, workshop..)	D6.1 Finalized	Delivered	30-Oct-24
All	Deliverables D10.4	receiving contribution of partners to finalize the deliverable	- Industry, business partners	- Event (conference, seminar, meeting, workshop..)	D10.4 Finalized	Delivered	30-Oct-24

QCFD Communications Activities - 01.11.2025 - 31.10.2026							
Beneficiary	**Communication Activity Name***	**Description***	**Who? Target audience***	**How? Communication channel***	**Outcome***	**Status***	**Date**
All	Meeting	2nd QCFD Coordination Meeting at TUM	- Industry, business partners	- Event (conference, seminar, meeting, workshop..)	To do list for the following reporting period	Status*	09-10/12/2024
TUHH	Deliverabla D1.1 R1	Revisions are done according to the comments of External Experts	- Industry, business partners	- Event (conference, seminar, meeting, workshop..)	D1.1 R1 Finalized	Delivered	18-Jan-25
FZJ	Data Management of - Deliverables D7.1	Uploading data to the FDR system and evaluation of D7.1 internally	- Industry, business partners	- Event (conference, seminar, meeting, workshop..)	D7.1 Finalized	Delivered	31-Jan-25

All	Researchers Bi-Weekly meetings	Researchers Bi-Weekly meetings have started on 8/01/2025 for WP9 Preparation	- Industry, business partners	- Event (conference, seminar, meeting, workshop..)	To Do lists for Researchers	Ongoing	
All	Meeting	3rd QCFD Coordination Meeting at Trieste	- Industry, business partners	- Event (conference, seminar, meeting, workshop..)	To do list for the following reporting period	Delivered	10-11/07/2025
All	D4.2 Scaling and memory requirements	Meetings were held to prepare D4.2 Scaling and memory requirementsbetween researchers and PIs	- Industry, business partners	- Event (conference, seminar, meeting, workshop..)	D4.2 Finalized	Delivered	31-Oct-25
All	D10.5 S&E&C Plan	Meetings were held to prepare D10.5 Dissemination, exploitation and communication plan (final update)	- Industry, business partners	- Event (conference, seminar, meeting, workshop..)	D10.5 S&E&C Plan Finalized	Delivered	31-Oct-25
TUHH	AQMCSE 2025	Conference on applied quantum methods in computational science and engineering.	- Research communities	- Event (conference, seminar, meeting, workshop..)	Feedback on all aspects of the research results presented during the colloquium.	Delivered	08-10/Oct/25
UHH	AQMCSE 2025	Conference on applied quantum methods in computational science and engineering.	- Research communities	- Event (conference, seminar, meeting, workshop..)	Feedback on all aspects of the research results presented during the colloquium.	Delivered	08-Oct-25

QCFD Dissemination Activities 01.11.2022 - 30.04.2024						
Beneficiary	Dissemination activity name*	What Type of disseminatio n activity*	Who? Target audience Reached*	Why? Description of the objective(s) with reference to a specific project output	Status of the dissemination activity*	Date
UHH	Press Release	Other	Citizens	Announcement of projet launch to the public	Delivered	20-Sep-22
UHH	Wilhelm and Else Heraeus Foundation	Conferences	Research communities	The Wilhelm and Else Heraeus Foundation is a private institution that supports scientific research and education with an emphasis on physics. The foundation is best known for organizing and funding a variety of events dedicated to the discussion of research results and the training of young scientists. Dieter Jaksch was the invited talk at Ultracold Quantum Matter: Basic Research and Applications.	Delivered	13-Dec-22
UHH	Nordita winter school 2023	Education and training events	Research communities	Nordita winter school 2023, Dynamics of Open Classical and Quantum Condensed Matter Systems, was organized on Jan 16-27, 2023 in Stockholm. The main audience of the school are PhD students, advanced Master's students and postdocs. Dieter Jaksch gave online lectures about Dynamical symmetries in open many-body quantum systems.	Delivered	23-Jan-23

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UHH	CCQ 2nd Plenary Meeting: International Quantum Tensor Network	Conferences	Research communities	Dieter Jaksch was the invited talk at Flatiron institute New York (Dieter Jaksch: Tensor Networks for Computational Fluid Dynamics (simonsfoundation.org)) on Tensor Networks for Computational Fluid Dynamics	Status of the dissemination activity*	03-Mar-23
UHH	SPICE Workshop 2023	Conferences	Research communities	Dieter Jaksch was invited talk: Dissipation induced non-stationary complex quantum dynamics, SPICE workshop on Non-equilibrium Quantum Materials Design, Universität Mainz, Germany.	Delivered	27-Jun-23
TUC	Periodically driven quesiperiodic systems 2023	Conferences	Research communities	Dimitris Angelakis invited talk: Quantum supremacy with analog quantum processors: Merging complexity theory to thermalization. Bangalore, India	Delivered	19-Jun-23
TUM	MCQST conference	Conferences	Research communities	Barbara Kraus was invited to give a talk "Gaining Confidence on the Correct Realization of Arbitrary Quantum Computations" at the MCQST conference in Sonthofen, GER.	Delivered	22-Jun-23
TUC	Quantum Matter 2023	Conferences	Research communities	Dimitris Angelakis talk: Efficient Preparation of Ansatz States on Near-Term Quantum Computers	Delivered	23-May-23
UHH	DESOEQ (Designing out of equilibrium many-body quantum systems) 2023	Conferences	Research communities	DesOEQ23 is the final meeting of the UK Programme Grant “Designing out of equilibrium many-body quantum systems" (DesOEQ), which combines experimentalists and theorists from the Universities of Strathclyde, Cambridge, and Oxford Dieter Jaksch was an invited talk at the conference with his talk on Quantum Physics in Connected World to discuss	Delivered	03-Jul-23

				the potential of quantum simulation to explore correlation effects.		
UHH	DOE ASCR 2023 workshop	Other scientific collaboration	Research communities	DOE white paper entitled 'Quantum-Enabled Computational Science and Engineering', got accepted to the DOE ASCR 2023 workshop. Dieter Jaksch discussed the paper at the ASCR Workshop on Quantum Computing and Networking and are currently applying for DOE funding to extend the QCFD approach to different types of industry optimization problems. There were roughly 200 people, mainly from US DOE funded research institutes working on quantum computing. They are partly very close to industry and partly academic. The workshop website is Home - ASCR Basic Research Needs in Quantum Computing and Networking (cvent.com)	Delivered	July 11-13, 2023
TUM	Beyond IID in Information Theory	Conferences	Research communities	Barbara Kraus was invited to give a talk "On the verification of quantum computations" at the conference "Beyond IID in Information Theory".	Delivered	11-Jul-23
TUM	International Quantum Tensor Network	Conferences	Research communities	Barbara Kraus was invited to give a talk "Using match gates to Gain confidence in the correct realization of arbitrary quantum computations" at the International Quantum Tensor Network conference in Burghausen, Germany.	Delivered	26-Jul-23
TUHH	ETN Summer School	Education and Training Events	Research Communities	Attending of a Tensor Network Summer School and presentation of the research results	Delivered	11-15-Sep-2023

UHH	ETN Summer School	Education and training events	Research communities	The school aims to teach young PhD students the basics of tensor-product states as well as the most recent technical developments. Dieter Jaksch gave Lectures at the summer school with his Tensor Networks for Computational Fluid Dynamics topic.	Delivered	15-Sep-23
TUM	EQTC 2023	Conferences	Research communities	Barbara Kraus was invited to give a talk "" at the ECQT Conference 2023 in Hannover, Germany.	Delivered	19-Oct-23
UHH	Imperial College London	Education and training events	Research communities	Dieter Jaksch gave a tutorial lecture on: "Solving non-linear partial differential equations on quantum computers" and a more advanced talk on a similar topic to the group of people from traditional ICT and quantum computing research working together to understand how a quantum computer can help speed up some of the conventional computational tasks.	Delivered	20-Nov-23
ENG	Imperial College London	Other scientific collaboration	Research communities	Leonardo and Francesco presented in two different talks the results achieved so far on the resolution of PDEs through variational quantum algorithms.	Delivered	29-Nov-23
ENG	HPCQC 2023	Conferences	Research communities	The workshop has been dedicate to the dissemination of recent achievements at European level in the field of Quantum Computing and HPC.	Delivered	Dec 14-15, 2023

UHH	The American Physical Society March Meeting 2024	Conferences	Research communities	The APS March Meeting is the largest and most prestigious meeting of physicists in the world. More than 10,000 papers will be presented by eminent scientists in the field of physics, including condensed matter physics, materials physics, biological physics, chemical physics, polymer physics, magnetism, and computational physics. Dieter Jaksch was invited as invited talk on 'Variational Quantum Algorithms for Computational Fluid Dynamics'	Delivered	07-Mar-24
TUC	The American Physical Society March Meeting 2024	Conferences	Research communities	Talk by TUC group member on Recovering Electronic Correlation Energy from Hartree-Fock Circuit Ansatze on a Quantum Computer	Delivered	06-Mar-24
UHH	ISTA colloquium	Education and training events	Research communities	Dieter Jaksch was invited as speaker at ISTA Colloquium series which is weekly, institute-wide seminar. ISTA (IST Austria) is a multidisciplinary institution with research in mathematical and physical (MPS), information and system (ISS) and life sciences (LS).	Delivered	11-Mar-24
TUM	Co-organization of conference	Conferences	Research communities	Barbara Kraus co-organized a workshop/conference Exactly Solved Models and Quantum Computing at the Lorentz Center in Oort, NL.	Delivered	18-Mar-24
TUHH	VW CFD Workshop	Other scientific collaboration	Industry, business partners	Thomas Rung is invited as the key speaker to the workshop. This workshop aims to bring together leading experts at the forefront of CFD developments with iindustrial experts. Topics addressed refer to optimization	Delivered	18-Apr-24

				and the use quantum computing strategies in industrial CFD applications.		
FZJ	Research Paper Publication-14	Other scientific collaboration	Research communities	Correction formulas for the two-qubit Mølmer-Sørensen gate	Delivered	26-Apr-24
UHH	Airbus/BMW quantum challenge	Other	Industry, business partners	Students working on QCFD algorithms are participating in the Airbus/BMW quantum challenge 2024 (Airbus and BMW Quantum Computing Challenge 2024 | Airbus).	Delivered	14-Jan-25
UHH	EQuAL Project	Other scientific collaboration	Industry, business partners	UHH established a joint project on combinatorial optimiziation problems with Lufthansa Industry Solutions and with Thales. The research there is not related to QCFD but will benefit from the expertise gained in this project.	Ongoing	
UHH	BMBF projects	Other scientific collaboration	Industry, business partners	UHH applied for three BMBF projects on benchmarking quantum computing platforms. These project proposals are all joint university/industry projects and would start in 2025.	Ongoing	
UHH	The Quantum Flagship board membership	Other scientific collaboration	Industry, business partners	The Quantum Flagship: One of the most ambitious long-term research and innovation initiatives of the European Commission. Dieter Jaksch is a member of the QCB board (Quantum Coordination Board | Quantum Flagship (qt.eu)) to represent QCFD there.	Ongoing	

QCFD Dissemination Activities - 01.05.2024 - 31.10.2025						
Beneficiary	Dissemination activity name*	What Type of disseminatio n activity*	Who? Target audience Reached*	Why? Description of the objective(s) with reference to a specific project output (max 200 characters)*	Status of the dissemination activity*	Date
TUM	QUANTUMatter 2024	Conferences	Research communities	Barbara Kraus was invited to give a talk "Verification of quantum computations and simulations" at Quantum Matter International Conference 2024	Delivered	08-May-24
UHH	Industry involvement-CFD@Volvo	Conferences	Industry, business partners	CFD@Volvo is an annual internal event, a symposium for the CFD community within the Volvo Group which was initiated 10 years ago. The event has been organized in Gothenburg Volvo Conference Hall with an hybrid option. This year there were about 60 attendees in LV-hallen and about 110 attendees on-line. Among the external attendees on-line there where people from Chalmers and Aurobay in addition to Volvo. In total, around 170 people listened to Professor Jaksch.	Delivered	14-May-24
PlanQC	Industry involvement-UHH & PlanQC & Investors	Meeting	Industry, business partners	Dieter Jaksch participated in a Quantum for Industry Development Workshop with PlanQC's Investors. Topics included questions such as: What are relevant markets and their respective sizes for QCFD? What should be focus areas for use cases? The roadmap to fault tolerant quantum computing. Attendees: Alexander Glätzle, Sebastian Blatt, Johannes Zeiher, Markus Wagner,	Delivered	14-May-24

				Verena Zimmermann, Nils Pomberger, Dieter Jaksch		
UHH	EU-Japan 3rd Workshop on Quantum Computing	Collaboration with EU-funded projects	EU Institutions	In the framework of the Japan-EU Digital Partnership established in May 2022. Dieter Jaksch participated as a speaker at the EU-Japan 3rd workshop on Quantum Computing that took place virtually. His presentation was about the development of QCFD algorithms.	Delivered	24-May-24
TUHH	ECCOMAS 2024	Conferences	Research Communities	ECCOMAS is the major European Congress on Computational Methods in Applied Sciences and Engineering. We will communicate the QCFD vision in presentations, report results and expect feedback on all aspects of the research results presented during the colloquium.	Delivered	06-Jun-24
UHH	Interview with Press.	Other	Other	The quantum computing efforts at the Institute for Quantum Physics and the Center of Optical Quantum Technologies were described in an interview. Dieter Jaksch explained his work on developing quantum algorithms for computational fluid dynamics. The President of the University was attended the interview as well.	Delivered	29-Jun-24
UHH	ETH Zürich Workshop	Other scientific collaboration	Research communities	Dieter Jaksch is invited as one of the key speakers to the workshop on “Challenges and perspectives in resonator-mediated many-body physics: From atoms to solid state” which will be held at ETH Zürich, Switzerland. This workshop aims to bring together world-leading experts at the forefront of experiment and theory of many-body	Delivered	17-Jul-24

				physics with interactions mediated and enabled by resonators, both in the microwave and the optical regimes.		
UHH	Quantum Café in DG CNECT	Collaboration with EU-funded projects	EU Institutions	Prof. Dr. Dieter Jaksch is invited to The Quantum Café to give a talk titled: Quantum Computational Fluid Dynamics The Quantum Café is a series of monthly talks where we invite handpicked researchers, scientists, and relevant personalities from the industrial world to present topics at the forefront of science and technology in the quantum domain. The remote audience is mainly composed of EU Colleagues from the European Commission and other European Agencies actively working in quantum-related projects and regulations, like ESA (European Space Agency), HaDEA, REA, EISMEA, ERCEA.	Delivered	06-Sep-24
UHH	Swiss National Science Foundation	Other scientific collaboration	Research communities	Dieter Jaksch is invited for the evaluation of the SNSF Starting Grants Call 2024	Delivered	19 and 20 September 2024
UHH	EU's Innovation Radar website	Other scientific collaboration	EU Institutions	UHH was recognized as a 'key innovator' in the development of innovations by the European Commission's Innovation Radar team. • Innovation Title: Quantum methods for solving Computational Fluid Dynamics This information was published on their website: here: https://innovation-radar.ec.europa.eu/innovatorslogin.	Delivered	25-Sep-24

UHH	PlanQC New HQ Opening Ceremony	Other scientific collaboration	Industry, business partners	As part of the official opening, PlanQC is organizing a panel discussion. Prof. Dr. Dieter Jaksch is invited to the event as a moderator of the panel discussion that Dr. Dieter Kranzlmüller (LRZ), Dr. Rudolf Gross (MQV) and one of PlanQC's investors. Prof. Jaksch assessments of the most promising applications and the strengths of the various platforms will be shared with audience.	Delivered	25-Sep-24
UHH	NATO Innovation Fund	Meeting	International organisation (UN body, OECD, etc.)	Prof. Dr. Dieter Jaksch held a meeting with Ben Balmforth who is a Senior Associate at NIF (NATO Innovation Fund). They exchange information related to funds and the QCFD project and its' partners for future cooperation.	Delivered	08-Oct-24
UHH	Commercial Attachè at Consulate General of Türkiye	Meeting	International organisation (UN body, OECD, etc.)	Prof. Dr. Dieter Jaksch held a meeting with Yildiz Onur who is a Commercial Attachè at Consulate General of Türkiye in Hamburg. They exchange information related to the QCFD project and the industry partners who are looking for partnerships for future cooperation.	Delivered	09-Oct-24
ENG	Engys Annual User Group Meeting	Other	Industry, business partners	The ENGYS Annual User Group Meeting (UGM) gathers users from various industries, including automotive, AEC, and Formula 1 teams, to share insights, case studies, and the latest advancements in CFD simulations using HELYX and ELEMENTS. 75 attendees are expected, including representatives from six Formula 1 teams, major automotive and AEC companies, and academic institutions.	Delivered	25-Oct-24

				Dieter Jaksch is invited to give a talk related to QCFD and the ENGYS's role on the project.		
UHH	WiSe 2024-2025__Lecture series 'Physics in everyday life	Education and training events	Research communities	Prof. Dr. Dieter Jaksch is invited to give a lecture titled: Quantum Bits in Action: Physics and Applications of Quantum Computing" in Winter Semester lecture series in UHH	Delivered	29-Oct-24
TUM	Quantum Inforamtion and Physics Princeton	Conferences	Research communities	Tristan Kraft gave a talk on Experimental Hamiltonian and Liouvillian Learning at Princeton University	Delivered	11-Sep-24
TUM	Photonics Conference Paderborn	Conferences	Research communities	Barbara Kraus was invited to give a plenary talk at QUANTUM PHOTONICS SPOTLIGHT 2024	Delivered	09-Oct-24
TUM	MCQST Workshop Waterloo	Conferences	Research communities	Barbara Kraus gave a talk at MCQST Workshop in Waterloo	Delivered	02-Oct-24

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QCFD Dissemination Activities - 01.11.2025 - 31.10.2026						
Beneficiary	Dissemination activity name*	What Type of disseminatio n activity*	Who? Target audience Reached*	Why? Description of the objective(s) with reference to a specific project output	Status of the disseminatio n activity*	Date
UHH	XPANSE 2024	Other scientific collaboratio n	Industry, business partners	Prof. Dr. Dieter Jaksch is invited to give a talk on XPANSE 2024 event	Delivered	20-Nov-24
UHH	Japan-EU Quantum Matchmaking Event	Other scientific collaboratio n	EU Institutions	Prof. Dieter Jaksch will attend this workshop and meet potential future Japanese collaborators.	Delivered	04-Dec-24
UHH	CFD SURVEY	Other scientific collaboratio n	Industry, business partners	We conducted a survey to understand the needs and interests of CFD-related companies in adopting quantum computing technologies. We wills hare the results on the next paper as it is recommended on the 1st review meeting by external experts	Ongoing	20-Nov-24
UHH	Meeting with SimScale	Other scientific collaboratio n	Industry, business partners	Steve Lainé (Application Engineering and Partnerships Manager) contacted UHH as a result of the survey and he held a meeting with Dieter Jaksch about the QCFD project and future cooperation.	Delivered	06-Dec-24
TUM	MQV Colloqium, Munich Quantum Valley	Other	Research communiti es	Barbara Kraus gave a talk Verification of quantum computing and simulation & indistinguishability of photons	Delivered	01-Jan-25
TUC	Quantum&AI ecosystem in Cyprus	Other	National authorities	Dimitris Angelakis attended National Artificial Intelligence (AI) Taskforce meeting in Cyprus	Delivered	23-Jan-25

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UHH	Quantum Technologies exhibition	Other scientific collaboration	Research communities	QCFD roll ups will be represent in Quantum Technologies exhibition in the DG CONNECT	Delivered	mid-April until the end-September.
TUM	Harvard/ITAMP	Other scientific collaboration	Research communities	Tristan Kraft gave a talk on Hamiltonian and Liouvillian learning as a tool for bounded error quantum simulation	Delivered	12-Mar-25
FZJ	DPG March 2025	Conferences	Research communities	Jose Jesus gave a talk on DRAG methods to reduce single qubit errors, fundamental for future implemnattions of quantum algorithms for the 2025 DPG March meeting	Delivered	12-Mar-25
TUC	SupercomputingAsia2025	Other scientific collaboration	Specific end user communities	Dimitrios Angelakis was invited to SupercomputingAsia2025, Hybrid Quantum Classical Computing session. He presented some of our solutions in qubit efficient quantum algorithms done in partnership with some of the leading international corporations in the areas of logistics, finance, defense and pharma.	Delivered	12-Mar-25
TUC	APS March 2025	Other scientific collaboration	Research communities	Dimitrios Angelakis attended APS March 2025 as invited talk on Quantum optimizationand Quantum Computers	Delivered	17-Mar-25
FZJ	APS Global Physics Summit 2025	Conferences	Research communities	Jose Jesus gave a talk on DRAG methods to reduce single qubit errors, fundamental for future implemnattions of quantum algorithms, title "High-derivative DRAG for error reduction in single-qubit gates"	Delivered	21-Mar-25

FZJ	APS Global Physics Summit 2025	Conferences	Research communities	Dimitrios Georgiadis gave a talk on DRAG methods to reduce two qubit errors, fundamental for future implemnattions of quantum algorithms, title "Analytical flux-tuned iSWAP pulse suppressing leakage channels"	Delivered	21-Mar-25
FZJ	AI4Quantum	Conferences	Research communities	Felix Motzoi was invited to give a talk on machine learning methods in quantum technologies at the Novo Nordisk Foundation Science Cluster	Delivered	27-Mar-25
TUM	QCFD, Hamburg (online)	Conferences	Research communities	Barbara Kraus gave a talk Entanglement Theory & verification of quantum devices	Delivered	01-May-23
UHH	EFRA Project	Other	EU Institutions	QCFD project information was shared with EFRA Project, a HORIZON initiative funded under Call HORIZON-CL4-2022-DATA-01.	Delivered	11-May-25
TUM	Emerging Fundamental Physics in Synthetic Quantum Systems	Conferences	Research communities	Tristan Kraft gave a talk on Bounded-error quantum simulation via Hamiltonian and Liouvillian learning	Delivered	14-May-25
TUM	QUANTUMatter 2024, San Sebastian, Spain	Conferences	Research communities	Barbara Kraus gave a talk Verification of quantum computations and simulations	Delivered	10-May-24
TUC	Delphi Economic Forum	Collaboration with EU-funded projects	Industry, business partners	Dimitrios Angelakis attended Delphi Economic Forum for Unlocking Business Growth: The Impact of Technology Transformation as panel discussion member	Delivered	18-May-25

UHH	AIAA Journal Seminar Series	Other scientific collaboration	Research communities	Prof. Dr. Dieter Jaksch gave this talk: ARIC Brown Bag Session: Quantum Computing for Computational Fluid Dynamics at Meetup: https://www.meetup.com/de-DE/artificial-intelligence-center-hamburg-workshops-events/events/306377089/?recId=c14c417e-caea-4d36-9a2c-93800e222d2c&recSource=event-search&searchId=3761cd66-3064-4bda-a0d9-ac44ad38adee&eventOrigin=find_page%24all	Delivered	20-May-25
FZJ	Meeting of the OSQ+ Consortium	Collaboration with EU-funded projects	Research communities	Felix Motzoi serves as the site representative for FZJ in the OpenSuperQ+ consortium, which follows an ambitious agenda with the ultimate goal of developing a versatile 1,000-qubit quantum-computing system made in Europe and targets applications of quantum computing in material science. Recent consortium meetings facilitated exchanges among hardware developers, cloud providers, industry partners, and algorithm developers, focusing on ongoing efforts to implement QCFD algorithms on European quantum hardware.	Delivered	20-May-25
UHH	Meeting with Digital Catapult	Other	Industry, business partners	Meeting was held with Digital Catapult company in UK. . Information was given related to QCFD project and experience exchanges for future colloborations	Delivered	21-May-25

UHH	Erfolgsgeschichten aus EU-Projekten – Jahrbuch 2025	Other	Research communities	QCFD Porject will be presented in 'Success stories from EU projects – Yearbook 2025 Digital technologies to solve global challenges' by Nationale Kontaktstelle Digitale und Industrielle Technologien (NKS DIT)	Delivered	23-May-25
UHH	Meeting with Oxford and Quantinuum	Other	Industry, business partners	Meeting was held with Oxford and Quantinuum company in UK. Information was given related to QCFD project and experience exchanges for future colloborations	Delivered	28-May-25
UHH	Meeting with TAV	Other	Industry, business partners	Meeting was held with Embraern Information was given related to QCFD project and CFD applications	Delivered	04-Jun-25
FZJ	Control of Quantum Dynamics of Atoms, Molecules and Ensembles by Light 2025	Conferences	Research communities	Felix Motzoi was invited to give a talk on control theory techniques for quantum computing at the CAMEL XX workshop	Delivered	06-Jun-25
UHH	Student Workshop on Integrability 2025	Other	Research communities	Post Doc Mario Guillaume Cecile gave a poster session about QCFD project and Tensor network method in quantum many-body physics during a poster session to a quantum physicist audience during the workshop at Friedrich Hübner (University of King's College London)	Delivered	15-Jun-25
FZJ	BasQIBM25	Conferences	Research communities	Poster by José Diogo da Costa Jesus at the conference Quantum algorithms in pre-fault tolerant hardware	Delivered	16-Jun-25
TUM	MCQST, CalBay Summerschool	Education and training events	Research communities	Barbara Kraus gave a talk Verification of quantum computation and quantum simulation	Delivered	24-Jun-24

UHH	UTC Quantum Technology Workshop	Conferences	Research communities	Prof. Dieter Jaksch gave a talk at UTC Quantum Technology Workshop. This workshop is intended to bring together experts on various aspects of quantum research ranging from computing, simulation, algorithm-building to sensing and communications.	Delivered	24-Jun-25
UHH	Meeting with Embraer	Other	Industry, business partners	Meeting was held with Embraern Information was given related to QCFD project and CFD applications	Delivered	27-Jun-25
UHH	Success Story Yearbook 2025.	Other	National authorities	QCFD Project will be published in the Success Story Yearbook 2025 /NCP DIT website by Nationale Kontaktstelle Digitale und Industrielle Technologien (NKS DIT)	Planned	01-Jul-25
TUM	IQTC-WQC Joint Summer Research Program on Quantum Simulation and Sensing	Other scientific collaboration	Research communities	Tristan Kraft gave a talk on Bounded-error Quantum Simulations	Delivered	01-Aug-25
TUC	Quantum AI Subforum	Clustering activities	Research communities	Dimitrios Angelakis gave a talk at Quantum AI Subforum of the Shanghai Innovation Forum	Delivered	29-Sep-25
TUM	Waterloo-Munich Joint Workshop, Perimeter Institute, Waterloo, Canada	Conferences	Research communities	Barbara Kraus gave a talk Verification of quantum computation and simulation & the indistinguishability of photons	Delivered	01-Oct-24

TUHH	AQMCSE 2025	Conferences	Research communities	Conference on applied quantum methods in computational science and engineering. AQMCSE aims to bring together the quantum industry and academia to discuss applied quantum methods that target real-world applications from the computational sciences. Fields like fluid dynamics and structural analysis, optimization, materials science, scientific machine learning, cryptography, and more stand to benefit from the breakthroughs shared at AQMCSE.	Delivered	08-Oct-25
UHH	AQMCSE 2025	Conferences	Research communities	Conference on applied quantum methods in computational science and engineering. AQMCSE aims to bring together the quantum industry and academia to discuss applied quantum methods that target real-world applications from the computational sciences. Fields like fluid dynamics and structural analysis, optimization, materials science, scientific machine learning, cryptography, and more stand to benefit from the breakthroughs shared at AQMCSE.	Delivered	08-Oct-25
UHH, TUHH, ENGYS, PLANQC	WCCM_ECCOMAS 2026	Conferences	Research communities	QCFD Partner's ssuggestion for a MS on the WCCCM-ECCOMAS 2026 in Munich has been accepted.	Planned	July 19-24 2026

8.3. QCFD Datasets Follow Up

No	PID	Type of PID	Date of Publication	Description of Dataset	Is this Dataset available in open access	Is the metadata of deposited data accessible through open access?
1	10.25592/uhhfdm.14234	DOI	22/03/2022	A quantum-inspired approach to exploit turbulence structures	Yes	Yes
2	10.25592/uhhfdm.14244	DOI	07/03/2024	Measurement and classical optimization strategies for quantum variational problems	Yes	Yes
3	10.25592/uhhfdm.14264	DOI	13/03/2024	Tensor Methods for Solving Incompressible Navier-Stokes Equations and Transport Phenomena	Yes	Yes
4	10.25592/uhhfdm.14270	DOI	16/04/2024	Quantum Computational Fluid Dynamics - WP Core Benchmark CFD Set: Deliverable 1.1. --- Shear Flow	Yes	Yes
5	10.25592/uhhfdm.16636	DOI	16/04/2024	Quantum Computational Fluid Dynamics - WP Core Benchmark CFD Set: Deliverable 1.1. --- Nozzle Flows	Yes	Yes
6	10.25592/uhhfdm.16638	DOI	16/04/2024	Quantum Computational Fluid Dynamics - WP Core Benchmark CFD Set: Deliverable 1.1. --- Periodic Channel Flow (PCF)	Yes	Yes
7	10.25592/uhhfdm.16637	DOI	16/04/2024	Quantum Computational Fluid Dynamics - WP Core Benchmark CFD Set: Deliverable 1.1. --- Double-Bent Pipe	Yes	Yes
8	10.25592/uhhfdm.14232	DOI	17/04/2024	Data sets and figures Master Thesis Variational quantum algorithms for the 1D Burgers' equation	Yes	Yes
9	10.25592/uhhfdm.14236	DOI	24/04/2024	Output Data of Tensor network reduced order models for wall-bounded flows	Yes	Yes

10	10.25592/uhhfdm.14242	DOI	25/04/2024	Quantum Computational Fluid Dynamics - WP Core Benchmark CFD Set: Deliverable 1.1. --- 2D Steady/Unsteady Heat Conduction	Yes	Yes
11	10.25592/uhhfdm.14315	DOI	27/05/2024	Quantum Computational Fluid Dynamics - WP Core Tensor Network QCFD Set: Deliverable 4.1 --- Two-Dimensional Point-Source Propagation	Yes	Yes
12	10.25592/uhhfdm.16153	DOI	17/10/2024	Quantum Computational Fluid Dynamics - WP Core Tensor Network QCFD Set: Deliverable 6.1 --- Burgers and Heat Equation	Yes	Yes
13	10.25592/uhhfdm.16130	DOI	23/10/2024	QCFD Project, Deliverable 6.1, Nonlinear Schrodinger Equation	Yes	Yes
14	10.25592/uhhfdm.16640	DOI	07/01/2025	Quantum Computational Fluid Dynamics - WP Core Benchmark CFD Set: Deliverable 1.1. --- Battery Pack Cooling	Yes	Yes
15	10.25592/uhhfdm.17338	DOI	07/01/2025	Towards Variational Quantum Algorithms for generalized linear and nonlinear transport phenomena	Yes	Yes
16	10.25592/uhhfdm.16681	DOI	17/01/2025	QCFD Project, Deliverable 7.1, Core flagship QCFD set - Nonlinear Schrodinger Equation	Yes	Yes
17	10.25592/uhhfdm.16691	DOI	21/01/2025	QCFD Project, Deliverable 7.1, Core flagship QCFD set - Burgers' equation on planqc's neutral atom quantum computing simulator	Yes	Yes
18	10.25592/uhhfdm.16735	DOI	28/01/2025	Data for Workpackage 7.1. Core Flagship QCFD Set	Yes	Yes
19	10.25592/uhhfdm.17336	DOI	28/02/2025	Boundary Treatment for Variational Quantum Simulations of Partial Differential Equations on Quantum Computers	Yes	Yes
20	10.25592/uhhfdm.18010	DOI	06/10/2025	Dataset Tensor-Programmable Quantum Circuits for Solving Differential Equations	Yes	Yes

8.4. QCFD Social Media Posts

#	1
Date	07/05/2024
Post	🚀 We're thrilled to announce the launch of our LinkedIn page for the Quantum Computational Fluid Dynamics (QCFD) project, a pioneering initiative funded under the Horizon 2020 framework to revolutionize fluid dynamics through quantum computing. 🔍 The QCFD project aims to leverage the unprecedented capabilities of quantum computing to solve complex fluid dynamics problems faster and more accurately than ever before. Our multinational team of experts is working at the cutting edge of technology and science to create simulations that could transform industries ranging from aerospace to automotive and beyond. 🌐 Learn more about our mission, research, and the people behind the innovation by visiting our website: qcfd-h2020.eu 👥 Follow us to stay updated on our progress, insights, and breakthroughs as we advance the frontiers of both quantum computing and computational fluid dynamics. 💡 We believe in the power of collaboration and are open to engaging with industry and academic partners interested in quantum technology and fluid dynamics. Reach out to explore potential collaborations or to simply connect with our team. Join us on this exciting journey to redefine the possibilities of computational fluid dynamics with quantum technology!
#	#QCFD #QuantumComputing #FluidDynamics #Innovation #H2020 #QuantumTechnology #Quantum #QuantumComputationalFluidDynamics
@	UHH, TUHH, FZJ, TUM, ENG, PLANQC, TUC Dieter Jaksch, Thomas Rung, Felix Motzoi, Barbara Kraus, Paolo Geremia, Martin Kiffner, Dimitris G. Angelakis,
Image	

This project receives funding from the European Union's Horizon 2020 HORIZON Research and Innovation Actions Programme under Grant Agreement #101080085

#	2
Date	07/05/2024
Post	🌟 As we continue to push the boundaries of quantum computational technology and fluid dynamics, we want to shine a spotlight on the exceptional consortium that powers the QCFD project. Our collaborative effort spans multiple countries and brings together leading academic institutions and industry partners dedicated to innovation and excellence. 🎓 Academic Partners: UHH, Universität Hamburg: Tensor-network based platform independent QCFD algorithms TUHH, Technische Universität Hamburg: Computational fluid dynamics with industrial applications FZJ, Forschungszentrum Jülich: QCFD algorithms for superconducting qubits TUM, Technical Universität München: Verification and benchmarking of QCFD algorithms TUC, Technical University of Crete: QCFD algorithms for atomic qubits and ion traps Specialists in quantum technology applications. 🏢 Industry Leaders: ENGYS: Computational fluid dynamics software for engineering solutions PlanQC GmbH: Quantum hardware and software development with Rydberg atoms 🤝 This diverse team not only brings a wealth of knowledge and expertise but also embodies the spirit of international cooperation and interdisciplinary collaboration. 🔗 Visit our partners' page to learn more about the organizations making the QCFD project a reality: https://qcfd-h2020.eu/about/partners 👀 Stay tuned as we delve deeper into the specific contributions of each partner and how they're helping us chart new territories in both quantum computing and computational fluid dynamics.
#	#Teamwork #Innovation #Collaboration #Research #QCFD #QuantumComputing #FluidDynamics #Innovation #H2020 #QuantumTechnology #Quantum #QuantumComputationalFluidDynamics
@	UHH, TUHH, FZJ, TUM, ENG, PLANQC, TUC Dieter Jaksch, Thomas Rung, Felix Motzoi, Barbara Kraus, Paolo Geremia, Martin Kiffner, Dimitris G. Angelakis,
Image	planqc JÜLICH Forschungszentrum engys ΠΟΛΥΤΕΧΝΕΙΟ ΚΡΗΤΗΣ TECHNICAL UNIVERSITY OF CRETE TUHH

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#	3
Date	07/05/2024
Post	Reflecting on the Successful Kick-off of the Quantum Computational Fluid Dynamics (QCFD) Project 🚀 We are delighted to share highlights from the kick-off meeting of the QCFD project, which marked the official start of our ambitious journey in advancing computational fluid dynamics through quantum computing. 📆 This pivotal event, held on May 2023 brought together our esteemed partners, demonstrating the collaborative spirit and shared vision that defines the QCFD project. The meeting was hosted by the University of Hamburg 🌍 Global Participation on Key Sessions Participants from various countries shared their insights and expertise, enriching the dialogue and fostering an environment of mutual learning and support. 🔗 Visit our webpage to learn more about the below talks: https://qcfd-h2020.eu/events/category/kick-off-meeting-2023/list?eventDisplay=past ➢ The Structure of VQA (Variational Quantum Algorithms) ➢ Modeling, Simulation and Optimization Finite-Volume Method ➢ Introduction of ENGYS and Project Updates ➢ Entanglement Theory & Verification of Quantum Devices ➢ Quantum Control Theory for Noisy Intermediate-Scale Quantum Algorithms ➢ Optimizing QCFD Algorithms on Cold Ions, Atoms and Superconducting Hardware ➢ Boundary Conditions in Tensor-Network Computational Fluid Dynamics ➢ Computational Fluid Dynamics (CFD) & Adjoint Optimization
#	#KickOffMeeting #Teamwork #Innovation #Collaboration #Research #QCFD #QuantumComputing #FluidDynamics #Innovation #H2020 #QuantumTechnology #Quantum #QuantumComputationalFluidDynamics
@	UHH, TUHH, FZJ, TUM, ENG, PLANQC, TUC Dieter Jaksch, Thomas Rung, Felix Motzoi, Barbara Kraus, Paolo Geremia, Martin Kiffner, Dimitris G. Angelakis,
Image	

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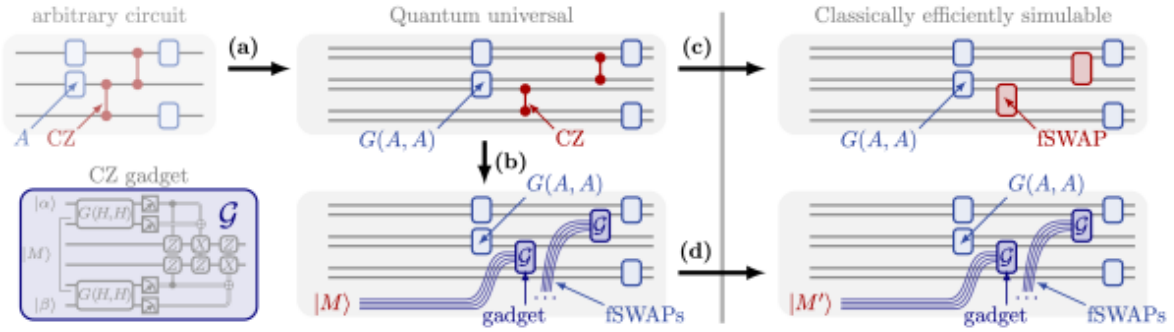
#	4
Date	08/05/2024
Post	🌟 We are excited to announce the completion of two critical deliverables under Work Package 10 of the Quantum Computational Fluid Dynamics (QCFD) project. 📊 Deliverable 10.1 - Data Management Plan 🌐 Deliverable 10.2 - Dissemination, Exploitation, and Communication Plan These documents lay the foundational strategies for data handling and communication, ensuring our research is effectively managed and shared. 🔗 Visit our webpage to download the documents: https://qcfd-h2020.eu/downloads/deliverables
#	#Data #Data Management #Research #QCFD #QuantumComputing #FluidDynamics #Innovation #H2020 #QuantumTechnology #Quantum #QuantumComputationalFluidDynamics
@	UHH, TUHH, FZJ, TUM, ENG, PLANQC, TUC Dieter Jaksch, Thomas Rung, Felix Motzoi, Barbara Kraus, Paolo Geremia, Martin Kiffner, Dimitris G. Angelakis,
Image	

This project receives funding from the European Union's Horizon 2020 HORIZON Research and Innovation Actions Programme under Grant Agreement #101080085

#	5
Date	08/05/2024
Post	We are thrilled to share our recent arXiv publication titled "Gaining Confidence in the Correct Realization of Arbitrary Quantum Computations." The team, consisting of Jose Carrasco, Marc Langer, Antoine Neven, and Barbara Kraus has developed verification protocols that enhance confidence in the performance of quantum devices. 🎯 Key Insights: We've introduced verification circuits that closely resemble the original computation circuits but can be classically efficiently simulated under specific conditions. This makes it possible to test not just the ideal output but also the reliability of the quantum process itself. Our methods combine weak simulation, randomized compiling, and classical statistics to address the challenges of verifying quantum computations. 🌎 This research marks a step towards robust quantum computing, ensuring that both developers and users can trust the results produced by these powerful machines. 📚 Read our full paper here ' https://qcfd-h2020.eu/gaining-confidence-on-the-correct-realization-of-arbitrary-quantum-computations ' to dive deeper into our methods and findings. 🤝 Feel free to reach out if you're interested in collaborating or want to learn more about our work! https://qcfd-h2020.eu/
#	#QuantumComputing #QuantumVerification #Physics #Innovation
@	Jose Carrasco, Marc Langer, Antoine Neven, and Barbara Kraus
Image	

This project receives funding from the European Union's Horizon 2020 HORIZON Research and Innovation Actions Programme under Grant Agreement #101080085

#	6
Date	05/07/2024
Post	We're thrilled to share research from Francesco Preti, Michael Schilling, Sofiene Jerbi, Lea M. Trenkwalder, Hendrik Poulsen Nautrup, Felix Motzoi, and Hans J. Briegel on the hybrid discrete-continuous compilation of trapped-ion quantum circuits using deep reinforcement learning. 🔍 Key Insights: Efficient Quantum Circuit Compilation: Our method significantly reduces the size of quantum circuits, crucial for combating environmental decoherence. Hybrid Optimization: By blending gradient-based and deep reinforcement learning techniques, we optimize both gate orderings and continuous parameters effectively. Practical Applications: This framework is not just theoretical—it's tested on classical simulations of trapped-ion systems and tailored for experimental setups. 🎯 This research pushes the boundaries of what's possible in quantum computing, paving the way for more efficient quantum algorithms and robust computing architectures. 📚 Read the full paper here: https://qcfd-h2020.eu/hybrid-discrete-continuous-compilation-of-trapped-ion-quantum-circuits-with-deep-reinforcement-learning
#	#QuantumComputing #AI #MachineLearning #Innovation #ResearchHighlight
@	Francesco Preti, Michael Schilling, Sofiene Jerbi, Lea M. Trenkwalder, Hendrik Poulsen Nautrup, Felix Motzoi, and Hans J. Briegel
Image	

This project receives funding from the European Union's Horizon 2020 HORIZON Research and Innovation Actions Programme under Grant Agreement #101080085

#	7
Date	05/07/2024
Post	🎉 Exciting news from our team at Universität Hamburg and our collaborative partners across the globe! We're thrilled to share our recent research on "Variational Quantum Algorithms for Computational Fluid Dynamics." 🚀 This study delves into the utilization of quantum computing principles to revolutionize the field of computational fluid dynamics (CFD). By leveraging the unique capabilities of quantum systems, our approach targets problems that remain intractable on conventional supercomputers, particularly in the aeroscience sector. 💡 Our paper discusses the development of novel variational quantum algorithms that are designed to be noise-tolerant and capable of achieving quantum advantage with a relatively small number of qubits. These algorithms are tailored to optimize and solve complex optimization problems across various industries, including aerospace, energy, and more. 🌐 With quantum hardware advancements on the horizon, we are on the cusp of significant breakthroughs that could dramatically reduce computational costs and time, enhancing the accuracy and efficiency of CFD applications. 👥 Special thanks to Dieter Jaksch, Peyman Givi, Andrew J. Daley, Thomas Rung contributing to this groundbreaking work. Let's continue pushing the boundaries of what's possible! 📄 Dive into our full study here: https://qcfd-h2020.eu/variational-quantum-algorithms-for-computational-fluid-dynamics
#	#QuantumComputing #ComputationalFluidDynamics #Innovation #Research #Aeroscience #QuantumAlgorithms #Technology #Engineering
@	Dieter Jaksch, Peyman Givi, Andrew J. Daley, Thomas Rung.
Image	

This project receives funding from the European Union's Horizon 2020 HORIZON Research and Innovation Actions Programme under Grant Agreement #101080085

#	8
Date	05/07/2024
Post	We are excited to share our latest publication on "Nonlinear Quantum Dynamics in Superconducting NISQ Processors", a collaborative effort by researchers from the Technical University of Crete as well as the Centre for Quantum Technologies, National University of Singapore 🔍 Our study shows how recently proposed quantum algorithms for QCFD problems can be implemented in real quantum hardware made of superconducting qubits. We discuss the requirement for large scale implementations and run our algorithms in cloud machines provided by IBM.Our investigation reveals that although quantum hardware noise impairs the evaluation of the energy cost function, certain instances of the problem consistently converge to the ground state. Our comprehensive analysis offers valuable insights into the practical implementation and advancement of the variational algorithms for nonlinear quantum dynamics 💡 Key Highlights: • Implementation of our algorithm on cloud-based IBM Q devices and study of its implementability • Insight into the robustness of QCFD algorithms against hardware-induced noise. 🔗 Read the full paper to explore how we tackled the ground state problem of the nonlinear Schrödinger equation and gain insights into the practical implementation and future potential of these algorithms. https://qcfd-h2020.eu/nonlinear-quantum-dynamics-in-superconducting-nisq-processors 🌐 Stay tuned for more updates from our team as we push the boundaries of what's possible with quantum technologies.
#	#QuantumComputing #NISQ #QuantumTechnology #Innovation #ResearchImpact
@	Muhammad Umer, Eleftherios Mastorakis, Sofia Evangelou, Dimitris G. Angelakis
Image	

This project receives funding from the European Union's Horizon 2020 HORIZON Research and Innovation Actions Programme under Grant Agreement #101080085

#	9
Date	05/07/2024
Post	🌊 We're thrilled to unveil our latest research from the Clarendon Laboratory, University of Oxford, and the University of Hamburg. Our study presents a breakthrough in computational fluid dynamics (CFD) using quantum-inspired tensor network algorithms. 🔍 Focusing on wall-bounded flows, this work extends beyond the conventional direct numerical simulations (DNS) by employing tensor networks to efficiently simulate fluid dynamics under complex boundary conditions. Our framework utilizes matrix product states to represent velocity components, significantly reducing the complexity and computational resources required, showcasing an order of magnitude improvement in runtime on standard hardware setups. 🔢 Our model addresses the incompressible Navier-Stokes equations within a lid-driven cavity scenario, achieving excellent validation against low Reynolds numbers benchmarks and exploring high Reynolds dynamics. Notably, this methodology is not only faster but also scalable and adaptable to a broader range of flow types. 🌐 This research not only paves the way for practical quantum computational fluid dynamics but also demonstrates the potential for significant computational speed improvements in existing classical systems. 🔗 Dive into our full paper for a deep dive into the mechanics, results, and implications of this innovative approach: https://qcfd-h2020.eu/tensor-network-reduced-order-models-for-wall-bounded-flows 🤝 We thank our colleagues and the research community for their invaluable support and discussions that have greatly contributed to this project.
#	#FluidDynamics #QuantumComputing #TensorNetworks #Innovation #ResearchImpact #UniversityOfOxford #ComputationalScience
@	Martin Kiffner, Dieter Jaksch.
Image	

#	10
Date	05/07/2024
Post	We're thrilled to share our latest research on "Boundary Treatment for Variational Quantum Simulations of Partial Differential Equations on Quantum Computers," recently published and co-authored by a team from the Clarendon Laboratory, Hamburg University of Technology and ENGYS. 📈 In this study, we present a variational quantum algorithm tailored to solve initial-boundary value problems defined by second-order partial differential equations, making full use of the unique capabilities of current noisy intermediate-scale quantum (NISQ) hardware. 🔍 Key Highlights: ✓ Utilization of a hybrid classical/quantum computing setup. ✓ Efficient evaluation of objective functions via quantum measurements. ✓ Innovative treatment of boundary conditions specifically optimized for quantum hardware. ✓ This approach not only enhances the robustness and predictive accuracy of quantum simulations but also manages the gate complexity effectively, paving the way for new possibilities in computational fluid dynamics and other fields requiring high precision. 🔗 Dive into our full study here: https://qcfd-h2020.eu/boundary-treatment-for-variational-quantum-simulations-of-partial-differential-equations-on-quantum-computers
#	#ComputationalFluidDynamics #CFD #VariationalQuantumAlgorithms #QuantumComputing #BoundaryConditions #Engineering #Innovation #ResearchImpact #QuantumAlgorithms
@	Paul Overa, Sergio Bengoechea, Thomas Rung, Francesco Clerici, Leonardo Scandurra, Eugene de Villiers, Dieter Jaksch
Image	

This project receives funding from the European Union's Horizon 2020 HORIZON Research and Innovation Actions Programme under Grant Agreement #101080085

#	11
Date	05/07/2024
Post	🔍 Key Highlights: ✓ Our method leverages additional classical processing with a polynomial overhead, beneficial for both near-term and early error-corrected quantum hardware. ✓ We provide a variance-based criterion for determining effective iterative sequences, demonstrating significant stability improvements. ✓ This research opens new avenues for computing accurate ground state energies of complex quantum systems, crucial for advancements in both fundamental research and applied chemistry. 📚 Read the full paper here: https://qcfd-h2020.eu/partitioned-quantum-subspace-expansion
#	#QuantumComputing #Research #Innovation #QuantumAlgorithms #OxfordUniversity
@	🤝 Collaborators: Tom O'Leary, Lewis W. Anderson, Dieter Jaksch, and Martin Kiffner
Image	

This project receives funding from the European Union's Horizon 2020 HORIZON Research and Innovation Actions Programme under Grant Agreement #101080085

#	12
Date	13/05/2024
Post	🔍 Explore our project's detailed overview of #workpackages, each representing a critical facet of #quantumcomputing and #fluiddynamics research. Discover the specialized focus areas and collaborative efforts shaping our scientific endeavors. 🔗 Visit our webpage to reach the details about work packages: https://qcfd-h2020.eu/about/work-packages
#	#Innovation #H2020 #QCFD #Research #Physics
@	
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This project receives funding from the European Union's Horizon 2020 HORIZON Research and Innovation Actions Programme under Grant Agreement #101080085

#	13
Date	13/05/2024
Post	☀️ Exciting times at the University of Hamburg! We've just concluded two dynamic and fruitful days at the inaugural Coordination Meeting for the QCFD Project on March 14th and 15th, 2024. It was inspiring to witness such vibrant collaboration and the exchange of innovative ideas among all attendees. 🗓️ Our discussions were so engaging that we've seen the clear need to delve deeper into many topics. Therefore, we are excited to announce that we will be extending the duration of our next meeting. More details will be provided soon—stay tuned! 💼 Heartfelt thanks to each speaker who contributed their profound insights and expertise, significantly enhancing our discussions: -European Commission, Christian Trefzger, PhD, Quantum Technologies in Europe -Invited Talks -Eugene De Villiers, ENGYS, The Aerodynamic Development of the Lightship L1 Trailer -Michael Palm, Voith Turbo, CFD in Marine Engineering Applications - Voith's Perspective -Sebastian Blatt, planqc, Neutral-Atom Quantum Computing in the Munich Quantum Valley Partners' Presentations: -Dieter Jaksch, Universität Hamburg, Tensor Networks for Probability Simulation of Turbulent Reactive Flows -Sergio Bengoechea Lozano, Hamburg University of Technology, Boundary Condition Treatment for #VQA Simulations of #PDE Problems on QCs -Barbara Kraus, Technical University of Munich, Gaining Confidence About #Quantum Devices -José da Costa Jesus, Forschungszentrum Jülich, Steps Towards Implementation of QCFD on #QuantumHardware -Francesco Clerici, ENGYS, Progress Toward User-Space Interfaces for Quantum CFD -Dimitrios Angelakis, Technical University of Crete, Small Scale Implementations of QCFD #Algorithms in Cloud Quantum Processors: Challenges and First Results -Martin Kiffner, planqc, Towards QCFD on Neutral Atom #QuantumComputers 💼 A special acknowledgment to our advisory board members Andrew Daley, Michael Palm and Thomas Monz for their invaluable guidance and support. Looking forward to our continued progress and next steps together in advancing quantum #CFD!
#	
@	
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#	14
Date	13/05/2024
Post	☀️ We're thrilled to share that our team has reached a significant milestone in the Quantum Computational Fluid Dynamics (QCFD) project, funded by the European Union's Horizon 2020 program.

This project receives funding from the European Union's Horizon 2020 HORIZON Research and Innovation Actions Programme under Grant Agreement #101080085

	As part of Work Package 1, we have completed the Core Benchmark CFD Set which provides some essential benchmarks for quantum/ quantum-inspired approaches on the path towards Computational Fluid Dynamics (CFD). 🎯 This deliverable is one tailor made basement towards the advent of an open-access quantum software framework, designed for a more efficient treatment of the industry's CFD problems. Our benchmarks allow comparisons of classical CFD methods with new quantum strategies, ensuring interfaces between scientific and industry-relevant standards. 🔗 For more details on our findings and to access the data, visit our dedicated repository: fdr.uni-hamburg.de/communities/qcfd. 🔗 Visit our webpage to download the Deliverable 1.1 - Core Benchmark CFD Set: https://qcfd-h2020.eu/downloads/deliverables
#	#QuantumComputing #FluidDynamics #Innovation #H2020 #QCFD
@	TUHH, UHH, ENG

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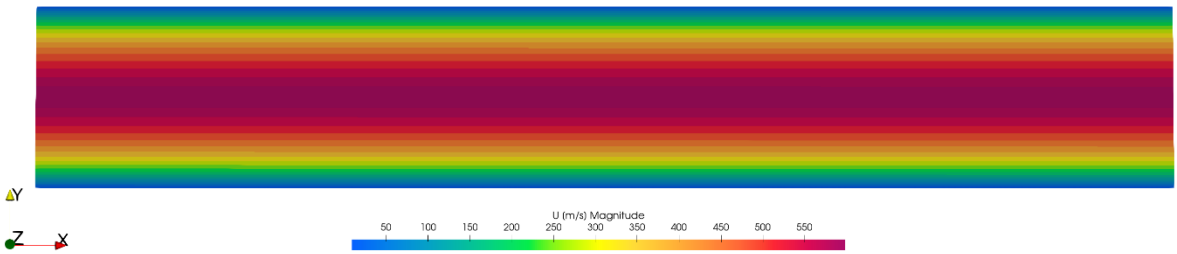
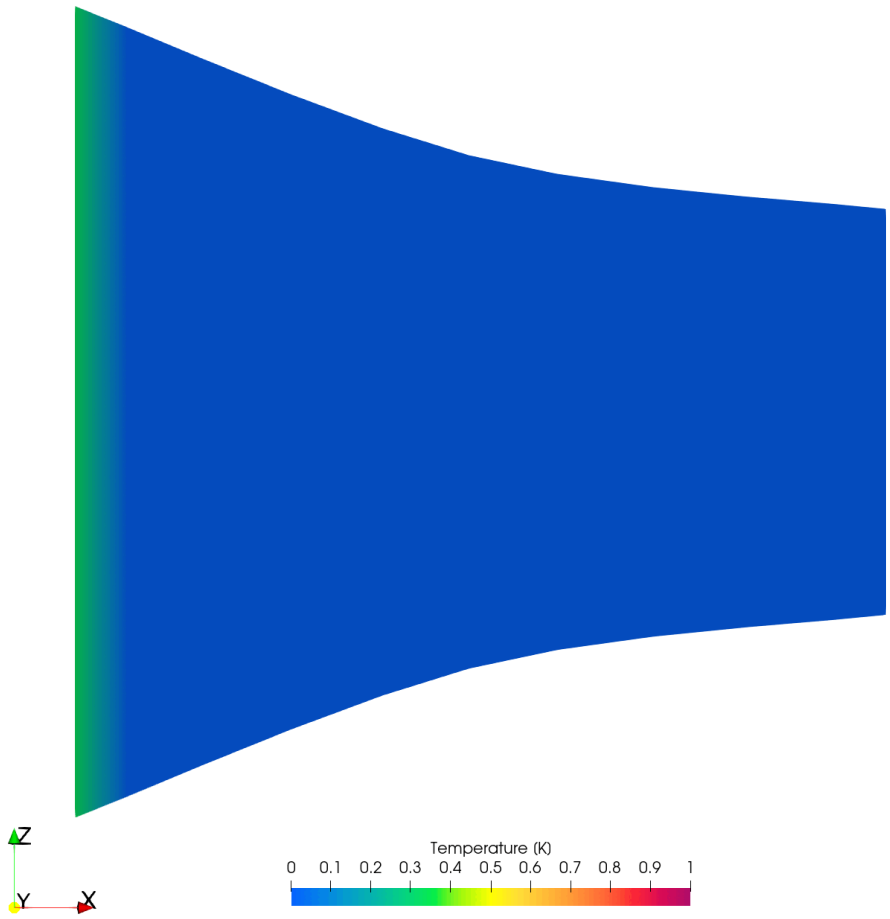
Image	 Time: 0.000000 

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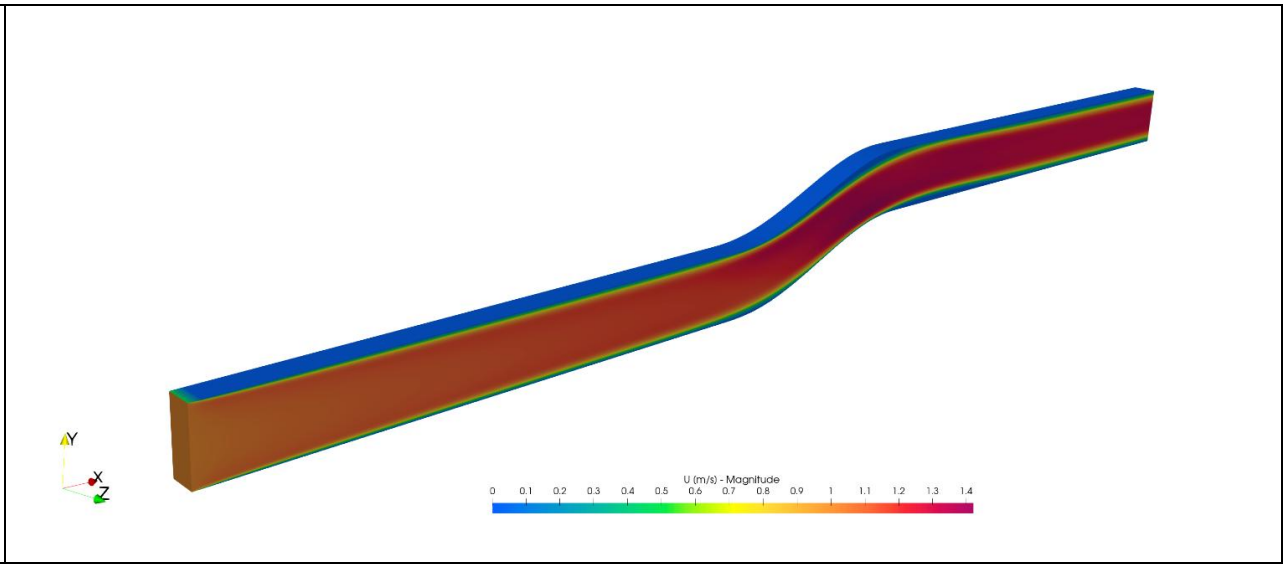
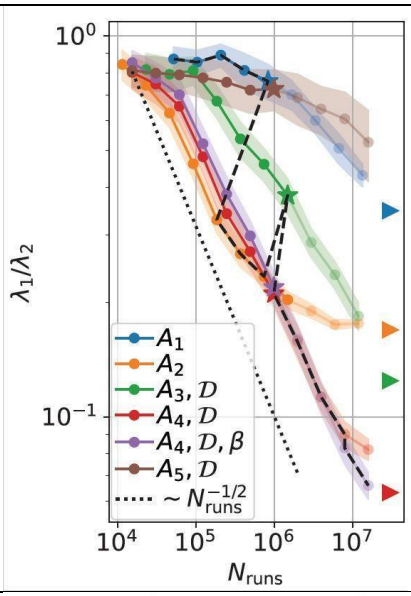
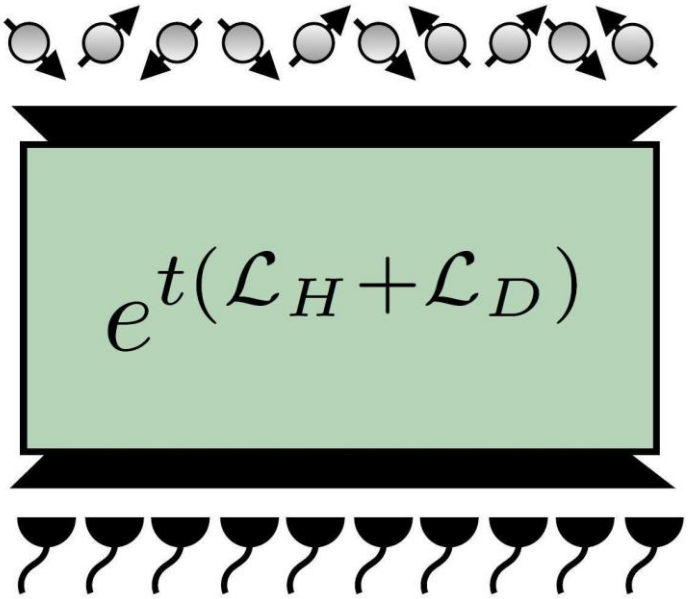


This project receives funding from the European Union's Horizon 2020 HORIZON Research and Innovation Actions Programme under Grant Agreement #101080085

#	15
Date	14/05/2024
Post	🌟 We are excited to share our latest publication, "Hamiltonian and Liouvillian learning in weakly-dissipative quantum many-body systems," led by Tobias Olsacher, Tristan Kraft, Christian Kokail, Barbara Kraus, and Peter Zoller from the University of Innsbruck and Technical University of Munich. 🎯 In this study, we explore advanced strategies for learning Hamiltonian and Liouvillian dynamics in analog quantum simulators. Utilizing non-equilibrium quench dynamics, our approach is pivotal for characterizing quantum simulators, crucial in progressing toward quantum advantage. 🔍 Key insights include: • Strategies for (re-)parameterization approaches to optimize learning efficiency. • Methods to learn the operator structure of Hamiltonians and Liouvillians with a limited measurement budget. • Our results open exciting avenues for more accurate and scalable quantum simulations, enhancing the capability to solve complex quantum many-body problems in condensed matter physics, high-energy physics, and quantum chemistry. 📚 Read our full paper here: https://lnkd.in/emGVz2cy Feel free to reach out for collaborations or discussions!
#	#QuantumComputing #QuantumSimulation #QuantumMechanics #Research #Physics #Innovation
@	

This project receives funding from the European Union's Horizon 2020 HORIZON Research and Innovation Actions Programme under Grant Agreement #101080085

Image	
Image	

This project receives funding from the European Union's Horizon 2020 HORIZON Research and Innovation Actions Programme under Grant Agreement #101080085

#	16
Date	12/06/2024
Post	Last week, we had an amazing time at Science City Day with over 15,000 visitors! Prof. Dr. Dieter Jaksch and his team introduced young science fans to the cool world of quantum cryptography. They showed kids a fun experiment about quantum entanglement and encryption. 🔓🔗 The activities made learning about quantum science easy and fun. Kids learned complex ideas through games and experiments. 🎮🧪 The event was also a great chance to share information about the QCFD Project with the public and politicians. 🌍📊 We can't wait for the next Science City Day to inspire more young minds! 🌠
#	#QCFD #QuantumComputing #FluidDynamics #Innovation #H2020 #QuantumTechnology #Quantum #QuantumComputationalFluidDynamics #Sciencecityday #UHH #Hamburg #ScienceCityDay #QuantumCryptography #STEMEducation #QCFDProject #FutureScientist
@	UHH, Dieter Jaksch
Image	

This project receives funding from the European Union's Horizon 2020 HORIZON Research and Innovation Actions Programme under Grant Agreement #101080085

#	17
Date	13/06/2024
Post	We are thrilled to announce that a team from the Universität Hamburg, including researchers from the QCFD project and part of Professor Dieter Jaksch group, has been selected as a finalist in the Airbus x BMW Group #Quantum #Computing #Challenge, placing them among the TOP 3 applicants in the "Predictive Aeroacoustic & Aerodynamic modeling" category! Advancing to the second phase of the challenge, they and the other two finalists will benchmark and demonstrate their solutions, working side-by-side with industrial experts. This is yet another showcase of our capabilities and commitment to fostering collaboration with industrial partners. For more details please check: https://thequantuminsider.com/2024/06/12/finalists-named-for-the-airbus-bmw-group-quantum-computing-challenge/
#	#Quantum #QuantumComputing #QCFD #Technologies #Finalists #UHH
@	Nis van Hülst, Greta Reese, Theofanis Panagos, Tomohiro Hashizume, Shahram Panahiyan
Image	

This project receives funding from the European Union's Horizon 2020 HORIZON Research and Innovation Actions Programme under Grant Agreement #101080085

#	18
Date	14/06/2024
Post	🌟 We are happy to announce the completion of another deliverable under Work Package 10 of the Quantum Computational Fluid Dynamics (QCFD) project. 🌐 Deliverable 10.3 - Dissemination, Exploitation, and Communication Plan (1st Update) This document lays the foundational strategies for communication, ensuring our research is effectively managed and shared. 🔗 Visit our webpage to download the documents: https://qcfd-h2020.eu/downloads/deliverables
#	#QCFD #QuantumComputing #FluidDynamics #Innovation #H2020 #QuantumTechnology #Quantum #QuantumComputationalFluidDynamics #Dissemination #Exploitation #Communication #plan
@	UHH, TUHH, FZJ, TUM, ENG, PLANQC, TUC Dieter Jaksch, Thomas Rung, Felix Motzoi, Barbara Kraus, Paolo Geremia, Martin Kiffner, Dimitris G. Angelakis,
Image	

This project receives funding from the European Union's Horizon 2020 HORIZON Research and Innovation Actions Programme under Grant Agreement #101080085

#	19
Date	08/07/2024
Post	🎉 We are thrilled to announce the completion of the first period of our Quantum Computational Fluid Dynamics project! 🚀 We held a productive project review meeting to discuss our progress and plans. Thanks to the EU Commission, especially our Project Officer for his continuous guidance and support. Thanks to outside experts for their valuable comments and contributions. Together with our dedicated teams from UHH, TUHH, FZJ, TUM, ENGYS, TUC, and PlanQC, we are making significant strides in advancing the frontiers of computational fluid dynamics using quantum computing. We look forward to continuing our collaboration and achieving more groundbreaking results in the upcoming phases of the project!
#	#QCFD #QuantumComputing #FluidDynamics #Innovation #H2020 #QuantumTechnology #Quantum #QuantumComputationalFluidDynamics #Research #Innovation #EUCommission #Collaboration #Science #Technology
@	UHH, TUHH, FZJ, TUM, ENG, PLANQC, TUC
Image	

This project receives funding from the European Union's Horizon 2020 HORIZON Research and Innovation Actions Programme under Grant Agreement #101080085

#	20
Date	16/07/2024
Post	📢 Exciting Research Update from Forschungszentrum Jülich and Collaborators We are pleased to share our recent research on improving the fidelity of Cross-Resonance (CR) gates in superconducting qubits through multi-derivative pulse shaping. This work, conducted in collaboration with the University of Cologne and the University of Bologna, addresses a significant challenge in scalable quantum computing. Our team has developed a novel control method that significantly reduces errors in CR gates by employing multi-derivative, multi-constraint pulse shaping techniques. This approach has been experimentally validated on the IBM Quantum Platform, achieving CNOT gate fidelities up to 99.7%, the highest reported on multi-qubit, fixed-frequency systems. These improvements enable large-scale systems to fully leverage their superior coherence times, which is critical for advancing quantum computation. 📑 For more information, please read the full paper here: https://qcfd-h2020.eu/experimental-error-suppression-in-cross-resonance-gates-via-multi-derivative-pulse-shaping
#	#QuantumComputing #SuperconductingQubits #QuantumControl #ResearchUpdate #QCFD
@	FZJ
Image	

This project receives funding from the European Union's Horizon 2020 HORIZON Research and Innovation Actions Programme under Grant Agreement #101080085

#	21
Date	16/07/2024
Post	📣 New Insights in Quantum Gate Design with Reinforcement Learning Our recent collaborative research involving the University of California, Berkeley, Lawrence Berkeley National Laboratory, the Max Planck Institute for the Physics of Complex Systems, and Forschungszentrum Jülich has focused on leveraging reinforcement learning (RL) to optimize control pulses for transmon qubit entangling gates. In this study, we utilized a continuous control RL algorithm to design high-fidelity, entangling two-qubit gates for superconducting qubits, such as cross-resonance and CNOT gates. Our approach does not rely on prior information about the physical system, which allows the RL agent to explore a broader range of pulse sequences. The results showed that the RL-optimized pulses not only surpassed standard cross-resonance gates in fidelity but also reduced gate duration, while maintaining robustness against stochastic noise. These findings highlight the potential of RL-based optimization methods to enhance quantum gate design, contributing to the development of more efficient and scalable quantum computing systems. 📑 For more information, please read the full paper here: https://qcfd-h2020.eu/reinforcement-learning-pulses-for-transmon-qubit-entangling-gates
#	#QuantumComputing #ReinforcementLearning #SuperconductingQubits #QuantumControl #QCFD #ResearchUpdate
@	University of California, Berkeley, Lawrence Berkeley National Laboratory, the Max Planck Institute for the Physics of Complex Systems, Forschungszentrum Jülich
Image	

This project receives funding from the European Union's Horizon 2020 HORIZON Research and Innovation Actions Programme under Grant Agreement #101080085

#	22
Date	16/07/2024
Post	📣 Advancements in Quantum Optimal Control on Nitrogen-Vacancy Centers Our collaborative research, involving Ulm University, Forschungszentrum Jülich, and the University of Cologne, has focused on evaluating gate-set performance metrics for closed-loop optimal control experiments using nitrogen-vacancy (NV) center ensembles in diamond. In this study, we systematically explored various measures, including quantum process tomography, linear inversion gate-set tomography, randomized linear gate-set tomography, and randomized benchmarking, to enhance the fidelity and performance of quantum gates. Using a macroscopic ensemble of NV centers, we demonstrated significant improvements across all investigated methods, highlighting the trade-offs between them and their applicability in different contexts. Our findings show that employing quantum optimal control in an application-oriented manner can significantly enhance the gate-set performance, paving the way for more robust and precise quantum operations. 🔗 For more information, please read the full paper here: https://qcfd-h2020.eu/gate-set-evaluation-metrics-for-closed-loop-optimal-control-on-nitrogen-vacancy-center-ensembles-in-diamond
#	#QuantumComputing #QuantumControl #NitrogenVacancyCenters #ResearchUpdate #QCFD
@	Ulm University, Forschungszentrum Jülich, and the University of Cologne,
Image	

This project receives funding from the European Union's Horizon 2020 HORIZON Research and Innovation Actions Programme under Grant Agreement #101080085

#	23
Date	16/07/2024
Post	📣 Exploring Error Corrections for the Mølmer-Sørensen Gate Our collaborative research team, consisting of experts from the Forschungszentrum Jülich, the University of Saarlandes, and the University of Cologne, has developed explicit analytical correction formulas for the two-qubit Mølmer-Sørensen gate. This gate, commonly used in ion trap quantum computing, is known for its robustness against trap heating but is limited by coherent errors from the Lamb-Dicke approximation and sideband transitions. In our work, we utilized the Magnus expansion to derive correction terms up to the fourth order in the Lamb-Dicke parameter, significantly improving the theoretical accuracy over previous methods. We identified critical error contributions that were previously underestimated and provided methods to mitigate these errors, including analytical renormalization of the drive strength and smooth pulse shaping. These corrections are crucial for achieving high-fidelity operations, essential for fault-tolerant quantum computing. Our results align well with experimental fidelity measurements, providing a more accurate framework for optimizing Mølmer-Sørensen gates in practical quantum computing applications. 📑 For more information, please read the full paper here: https://qcfd-h2020.eu/correction-formulas-for-the-two-qubit-molmer-sorensen-gate
#	#QuantumComputing #QuantumControl #IonTrap #ResearchUpdate #QCFD
@	Forschungszentrum Jülich, the University of Saarlandes, and the University of Cologne
Image	

This project receives funding from the European Union's Horizon 2020 HORIZON Research and Innovation Actions Programme under Grant Agreement #101080085

#	24
Date	16/07/2024
Post	📣 Enhanced Dispersive Qubit Readout with Intrinsic Resonator Reset Our research team, including members from Forschungszentrum Jülich, the University of Cologne, Aarhus University, and Chalmers University of Technology, has developed a novel method for dispersive measurement of superconducting qubits. This method enables simultaneous qubit measurement and intrinsic resonator reset, significantly improving the speed and fidelity of the readout process. We have introduced an analytical pulse shaping technique that eliminates the residual intra-cavity field after readout, addressing a key challenge in scalable quantum computing. Our approach reduces the assignment error to below 1% within a duration of less than $3\kappa^{-1}$, even when accounting for system nonlinearities. This method is versatile, extending to multi-state readouts and adaptable to various quantum systems, including ions, atoms, and semiconductor devices. Our findings offer a practical solution to speed up quantum error correction cycles by ensuring rapid cavity reset, paving the way for more efficient quantum computations. 📑 For more information, please read the full paper here: https://qcfd-h2020.eu/dispersive-qubit-readout-with-intrinsic-resonator-reset
#	#QuantumComputing #SuperconductingQubits #QuantumReadout #ResearchUpdate
@	Forschungszentrum Jülich, the University of Cologne, Aarhus University, and Chalmers University of Technology
Image	

This project receives funding from the European Union's Horizon 2020 HORIZON Research and Innovation Actions Programme under Grant Agreement #101080085

#	25
Date	16/07/2024
Post	📢 Investigating Many-Body Dispersive Forces through Quantum Information Theory Our research team, involving members from the University of Oxford, PlanQC GmbH, the Flatiron Research Institute, IBM Research Europe, and the University of Hamburg, has delved into the complex nature of many-body dispersion forces using a quantum information perspective. In this study, we examined the distribution of entanglement in assemblies of quantum Drude oscillators (QDOs), which serve as minimal models for dispersion-bound systems. We derived an analytical relationship between entanglement and energy, demonstrating how the distribution of entanglement governs dispersive bonding. Our findings indicate that the monogamy of entanglement can explain deviations in multipartite dispersive binding energies from commonly used pairwise predictions. We illustrated our results using examples of trimer and extended crystal lattices, providing a quantum information framework for understanding many-body energetics in complex systems. This work has significant implications for modeling and understanding the physical and chemical properties of materials and dipolar fluids at the quantum level. 📚 For more information, please read the full paper here: https://qcfd-h2020.eu/a-quantum-information-perspective-on-many-body-dispersive-forces
#	#QuantumComputing #QuantumInformation #ManyBodyPhysics #ResearchUpdate
@	University of Oxford, PlanQC GmbH, the Flatiron Research Institute, IBM Research Europe, and the University of Hamburg
Image	

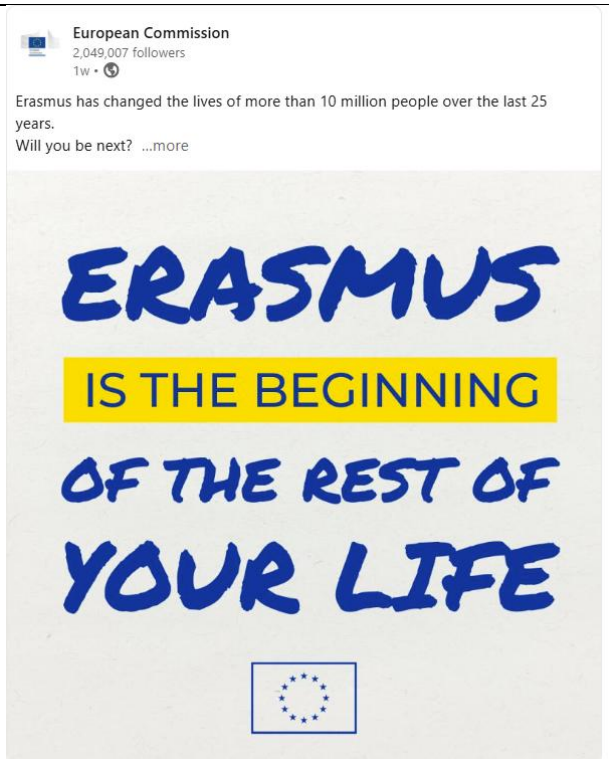
This project receives funding from the European Union's Horizon 2020 HORIZON Research and Innovation Actions Programme under Grant Agreement #101080085

#	26
Date	16/07/2024
Post	📢 Leveraging Tensor Networks for Turbulence Probability Distributions Our research team, with contributions from the University of Pittsburgh, the University of Oxford, the University of Hamburg, and Cornell University, has successfully applied tensor network (TN) methods to the simulation of turbulence probability distributions. In this study, we tackled the challenge of accurately simulating turbulent fluid flows, which are inherently chaotic and multi-scaled, by representing turbulence probability density functions (PDFs) using tensor networks. This approach significantly reduces the dimensionality and computational cost, enabling simulations that were previously impractical. Specifically, we achieved memory and computational cost reductions by factors of O(10^6) and O(10^3), respectively, for a 5+1 dimensional PDF of a chemically reactive turbulent flow. Our findings demonstrate that TNs can efficiently parameterize turbulence PDFs, allowing for accurate simulations on single CPU cores instead of requiring supercomputers. This opens new pathways for directly simulating high-dimensional PDFs of turbulent flows and other chaotic systems. 📚 For more information, please read the full paper here: https://qcfd-h2020.eu/tensor-networks-enable-the-calculation-of-turbulence-probability-distributionsb
#	#Turbulence #TensorNetworks #FluidDynamics #ResearchUpdate
@	University of Pittsburgh, the University of Oxford, the University of Hamburg, and Cornell University
Image	

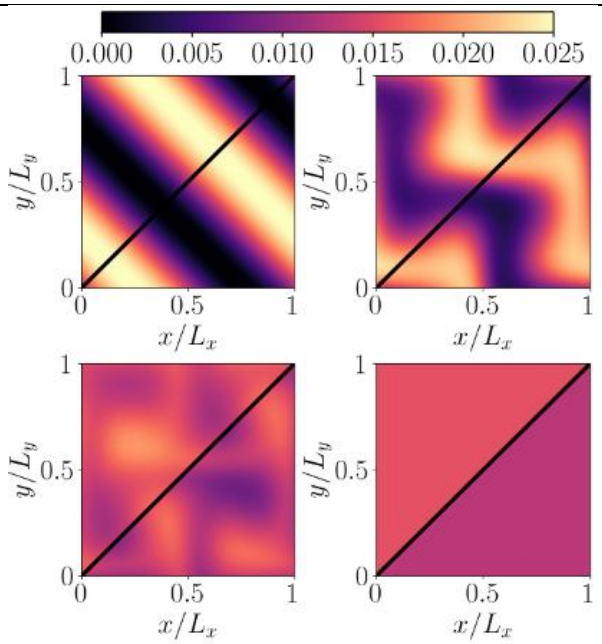
This project receives funding from the European Union's Horizon 2020 HORIZON Research and Innovation Actions Programme under Grant Agreement #101080085

#	27
Date	27/09/2024
Post	Re-post: **We are still buzzing with excitement about yesterday's events at the opening of our new headquarters**! 🎉 Our new space spans 1,400 square meters of freshly renovated labs and offices, positioning us to scale rapidly and continue driving innovation in quantum computing. One of the highlights was presenting a preview of the **1,000-qubit quantum computer** we are building for the **Leibniz-Rechenzentrum**, which will be integrated into their HPC-environment. We were honored to welcome distinguished guests, including Minister-President Dr. Markus Söder, who shared his insights on the transformative potential of quantum computing for Germany and the world. Representing our local Garching community, Jürgen Ascherl was also in attendance, alongside our partners from UVC Partners, Bayern Kapital, DTCF | DeepTech & Climate Fonds, and Amadeus Capital Partners APEX Ventures. Our panel discussion, featuring Ann-Kristin Achleitner, Prof. Dr. Rudolf Gross (Munich Quantum Valley), Prof. Dr. Dieter Jaksch (University of Hamburg), Prof. Dr. Dieter Kranzlmueller (LRZ), and Dr. Fabian Lausen (BMBF), sparked insightful conversations about the future of the German quantum ecosystem. Guests also enjoyed a behind-the-scenes tour of our laboratories and learned more about the founding story of planqc. The occasion especially highlighted our incredible team, who warmly welcomed our guests into our "home" and brought the world of quantum computing and planqc a little closer to everyone in attendance. Here's to an exciting future for quantum technology! 🚀
#	#quantumcomputing #innovation #planqc #celebration #quantumfuture #teamspirit
@	
Image	

This project receives funding from the European Union's Horizon 2020 HORIZON Research and Innovation Actions Programme under Grant Agreement #101080085

#	28
Date	22/10/2024
Post	Re-post: We are happy to host bachelor's and master's students for their projects. Please contact us if you want to apply for the #ERASMUS fund and study with us. Also please reach out if you are looking for hashtag#projectpartners. Details are here:https://lnkd.in/eEF6hSpr Our Contact: belda.atilla@uni-hamburg.de
#	#ERASMUS
@	
Image	

This project receives funding from the European Union's Horizon 2020 HORIZON Research and Innovation Actions Programme under Grant Agreement #101080085

#	29
Date	25/10/2024
Post	**LinkedIn Post** 🚀 Our latest paper on a **Quantum Algorithm for the Advection-Diffusion Equation with Optimal Success Probability** is now published on arXiv! In partnership with the Hamburg University of Technology and the Imperial College London, our QCFD project explores quantum algorithms for fluid dynamics simulations. This research tackles the computational challenges of multidimensional scalar transport problems, achieving 📄 Read the full paper: https://qcfd-h2020.eu/quantum-algorithm-for-the-advection-diffusion-equation-with-optimal-success-probability
#	#QuantumComputing #FluidDynamics #QCFD #Innovation #Research #HorizonEurope
@	TUHH, Imperial College London
Image	 FIG. 2: Contours of the scalar evolving by state-vector simulation (normalized, top-left half) and the corresponding classical solution (unnormalized, bottom-right half) for $t/T = 0$, 0.1, 0.2 and 1 in left-to-right, top-to-bottom order.

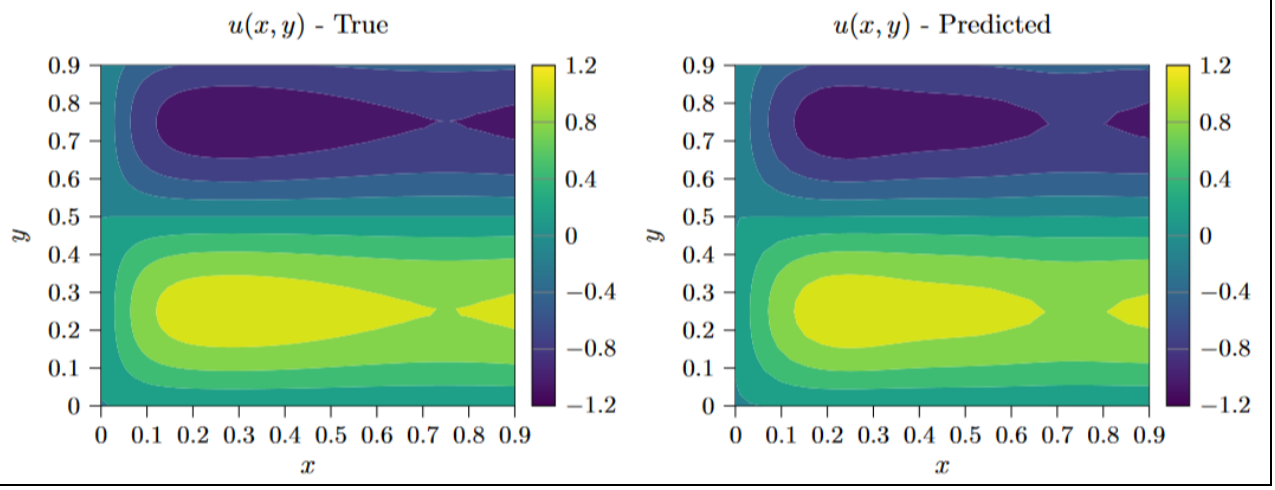
This project receives funding from the European Union's Horizon 2020 HORIZON Research and Innovation Actions Programme under Grant Agreement #101080085

#	30
Date	25/10/2024
Post	QCFD reposted this ENGYS 6,570 followers 1h • + Follow Prof. Dr. Dieter Jaksch of University of Hamburg is delivering a lecture on quantum computing for CFD at the ENGYS UGM 2024. This work is part of the ongoing EU Horizon project QCFD that includes University of Hamburg, TUHH, ...more 
#	#QuantumComputing #FluidDynamics #QCFD #Innovation
@	Engys, UHH, QCFD
Image	

This project receives funding from the European Union's Horizon 2020 HORIZON Research and Innovation Actions Programme under Grant Agreement #101080085

#	31
Date	29/10/2024
Post	We're excited to share that our talented team at planqc just took another leap in advancing quantum computing research with the publication of a new paper! Read the full paper: https://qcfd-h2020.eu/tensor-train-multiplication-ttm Our researchers **Alexios Michailidis, Christian Fenton, and Martin Kiffner** have just posted their paper introducing the **Tensor Train Multiplication (TTM)** algorithm. This breakthrough promises to significantly boost computational efficiency for complex simulations of important real-world problems like engineering simulations and climate forecasting. The publication results from planqc's involvement in an EU-funded research project on Quantum Computational Fluid Dynamics (QCFD), which aims at improving the calculation of fluid flows with quantum technology. **For the tech and math insiders**: Tensor Trains have recently shown great potential in solving challenging PDE problems such as the Navier-Stokes equations. In this approach, algebraic operations like the element-wise addition and multiplication of vectors are realised in terms of tensor network operations. TTM requires only a fraction of resources compared to the conventional approach paving the way for efficient large-scale simulations with GPUs or other memory-limited hardware.
#	#QuantumComputing #FluidDynamics #QCFD #Innovation #Research #HorizonEurope #Tensor
@	planqc
Image	

This project receives funding from the European Union's Horizon 2020 HORIZON Research and Innovation Actions Programme under Grant Agreement #101080085

#	32
Date	30/10/2024
Post	🚀 Our latest paper on a **Self-Adaptive Physics-Informed Quantum Machine Learning for Solving Differential Equations** is now published on arXiv! 📑 Our team has developed a novel approach using self-adaptive, physics-informed quantum machine learning to solve differential equations more efficiently. By leveraging Chebyshev polynomials and variational quantum circuits, we've achieved significant advancements in capturing complex physical systems' behavior— from fluid mechanics to electromagnetism. This work shows how quantum computing is pushing boundaries in scientific computation. 📄 Learn more in our full paper and join us in exploring the future of quantum applications! https://qcfd-h2020.eu/self-adaptive-physics-informed-quantum-machine-learning-for-solving-differential-equations
#	#FluidDynamics #QCFD #Innovation #Research #HorizonEurope #QuantumComputing #MachineLearning #Physics #QCFDproject #QuantumInnovation #ScientificResearch
@	FZJ
Image	

This project receives funding from the European Union's Horizon 2020 HORIZON Research and Innovation Actions Programme under Grant Agreement #101080085

#	33
Date	20/11/2024
Post	QCFD reposted this **planqc** 5,308 followers 1w • Edited • We're excited to share that our talented team at planqc just took another leap in advancing quantum computing research with the publication of a new paper! https://lnkd.in/dEw3M65U Our researchers **Alexios Michailidis**, Christian Fenton, and **Martin Kiffner** have just posted their paper introducing the **Tensor Train Multiplication (TTM)** algorithm. This breakthrough promises to significantly boost computational efficiency for complex simulations of important real-world problems like engineering simulations and climate forecasting. The publication results from planqc's involvement in an EU-funded research project on **Quantum Computational Fluid Dynamics (QCFD)**, which aims at improving the calculation of fluid flows with quantum technology. https://qcfd-h2020.eu/ **For the tech and math insiders:** Tensor Trains have recently shown great potential in solving challenging PDE problems such as the Navier-Stokes equations. In this approach, algebraic operations like the element-wise addition and multiplication of vectors are realised in terms of tensor network operations. TTM requires only a fraction of resources compared to the conventional approach paving the way for efficient large-scale simulations with GPUs or other memory-limited hardware.
#	#QuantumComputing hashtag#FluidDynamics hashtag#QCFD hashtag#Innovation hashtag#Research hashtag#HorizonEurope
@	
Image	

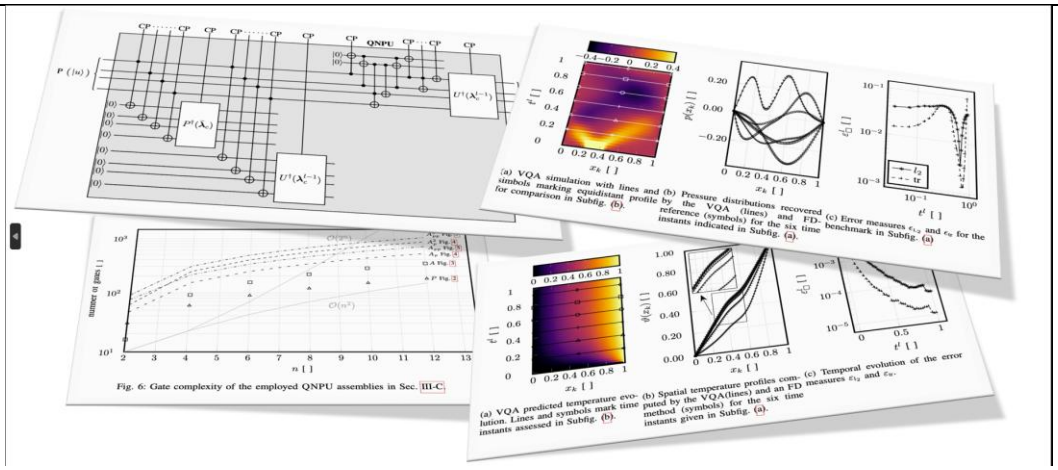
This project receives funding from the European Union's Horizon 2020 HORIZON Research and Innovation Actions Programme under Grant Agreement #101080085

#	34
Date	20/11/2024
Post	QCFD reposted this XPANSE 4,239 followers 1w • Edited • In just 4 days, Abu Dhabi is set to lead the conversation on the future of quantum, with one of XPANSE 2024's themes – QUANTUM WORLD 👇 👇 ...more 
#	
@	

This project receives funding from the European Union's Horizon 2020 HORIZON Research and Innovation Actions Programme under Grant Agreement #101080085

Image	
#	35
Date	22/11/2024
Post	QCFD reposted this XPANSE 4,239 followers 3d • The session Designing Matter with Quantum kicks off at Imaginarium with Dr. Dieter Jaksch Professor of Physics at the University of Oxford, at #XPANSE, hosted by ADQ 
#	
@	
Image	

This project receives funding from the European Union's Horizon 2020 HORIZON Research and Innovation Actions Programme under Grant Agreement #101080085

#	36
Date	26/11/2024
Post	🚀 Exploring the Frontiers of Computational Fluid Dynamics with Quantum Computing! We are thrilled to share our latest publication: "Towards Variational hashtag#Quantum hashtag#Algorithms for Generalized hashtag#Linear and hashtag#Nonlinear hashtag#Transport hashtag#Phenomena", co-authored by researchers from the Hamburg University of Technology, University of Hamburg, and the University of Oxford. 🔍 Key Highlights: -This study introduces a Variational Quantum Algorithm (hashtag#VQA) framework to address thermofluid dynamic transport equations, including heat, wave, and hashtag#Burgers' equations. -The hybrid classical-quantum approach bridges engineering boundary conditions, upwind-biased convection schemes and variable material properties with quantum computing by encoding band matrices from PDEs into quantum gates. -Results demonstrate high predictive accuracy compared to classical methods, with promising scalability leveraging polylog complexity in qubit numbers. 💡 The paper represents a step forward in leveraging quantum algorithms for real-world engineering challenges, paving the way for quantum-enhanced hashtag#CFD libraries! We invite you to explore the full paper and discuss how quantum computing reshapes computational science. 📜 https://lnkd.in/eHqysD-A
#	#QuantumComputing #CFD #VariationalAlgorithms #Research #Innovation #Engineering
@	Hamburg University of Technology University of Hamburg Dieter Jaksch @Sergio Bengoechea @Paul Over
Image	

This project receives funding from the European Union's Horizon 2020 HORIZON Research and Innovation Actions Programme under Grant Agreement #101080085

#	37
Date	14/01/2025
Post	Our young researchers won the international award!! Nis-Luca van Hülst, Dr. Tomohiro Hashizume, Theofanis Panagos, @Greta Sophie Reese and Dr. Shahram Panahiyan from the Department of Physics at the University of Hamburg won the "Airbus-BMW Group Quantum Computing Challenge" in one of five advertised categories. The international competition was advertised by the industrial companies Airbus, BMW and Amazon as well as the online magazine The Quantum Insider. The aim was to use quantum technologies to research new approaches to the challenges of the mobility industry. The research project was led by Dieter Jaksch, professor at the Institute for Quantum Physics and researcher in the Cluster of Excellence “CUI: Advanced Imaging of Matter” at the University of Excellence Hamburg. News link: https://lnkd.in/eT-XuGFW
#	#QCFD #quantumphysics #quantumcomputing Amazon Web Services (AWS) Airbus BMW Group
@	
Image	

This project receives funding from the European Union's Horizon 2020 HORIZON Research and Innovation Actions Programme under Grant Agreement #101080085

#	38
Date	16/01/2025
Post	🚀 **Problem-tailored Optimization of Variational Quantum Algorithms** 👨‍🔬✨ Excited to share insights from the paper!! Efficient Estimation and Sequential Optimization of Cost Functions in Variational Quantum Algorithms! 🌟 **What's New?** This innovative study introduces the **Sequential Grid-Based Explicit Optimization (SGEO)** protocol, redefining optimization in variational quantum algorithms. By expressing parameterized quantum circuits as weighted sums of unitary operators, SGEO enables efficient computation of cost functions and their derivatives, enhancing both speed and accuracy. 🛠️ **Applications**: 🔹 Simulating fluid dynamics governed by the 1D Burgers' equation. 🔹 Approximating ground states of the nonlinear Schrödinger equation. 💡 **Why It Matters**: SGEO significantly outperforms traditional optimizers like COBYLA, showcasing superior accuracy and faster convergence, even in complex, high-dimensional optimization landscapes. 🔬 **Next Steps**: Future research includes exploring the impact of quantum hardware noise and extending this methodology to optimize multi-qubit gates. Let's shape the future of quantum optimization together! 🌐 💡 We invite you to explore the full paper here 📜 link
#	#QuantumComputing #Optimization #QuantumAlgorithms #VariationalQuantumAlgorithms #QuantumResearch #SGEO #VQA
@	
Image	

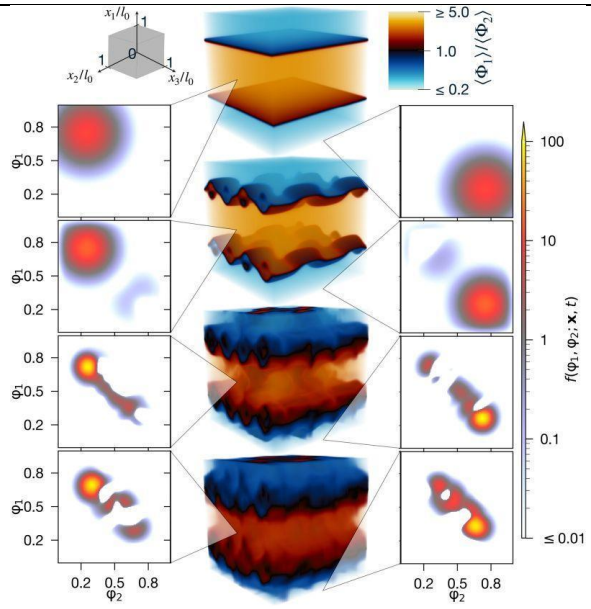
#	39

This project receives funding from the European Union's Horizon 2020 HORIZON Research and Innovation Actions Programme under Grant Agreement #101080085

Date	20/01/2025
Post	🌌 **Exploring Turbulence with Tensor Networks** 🌊 Pleased to share an intriguing approach to tackling the complexity of turbulence modeling presented in the paper "Tensor networks enable the calculation of turbulence probability distributions." 🚀 Using **Tensor Networks (TNs)**, the authors successfully parameterize high-dimensional turbulence probability density functions (PDFs), achieving: • **Memory reduction**: O(106)O(10^6)O(106) • **Computational cost reduction**: O(103)O(10^3)O(103) This method makes it possible to run simulations on single CPU cores that traditionally required supercomputers, opening up incredible possibilities for turbulence modeling in fluid dynamics and beyond. 📄 Read the paper here: https://qcfd-h2020.eu/tensor-networks-enable-the-calculation-of-turbulence-probability-distributions 🔗 Let's discuss how this could reshape computational approaches in physics and engineering!
#	#QCFD #TensorNetworks #TurbulenceModeling #ScientificComputing #ComputationalPhysics #FluidDynamics #Innovation #Research
@	**Nikita Gourianov, Peyman Givi, Dieter Jaksch, Stephen B. Pope.**
Image	

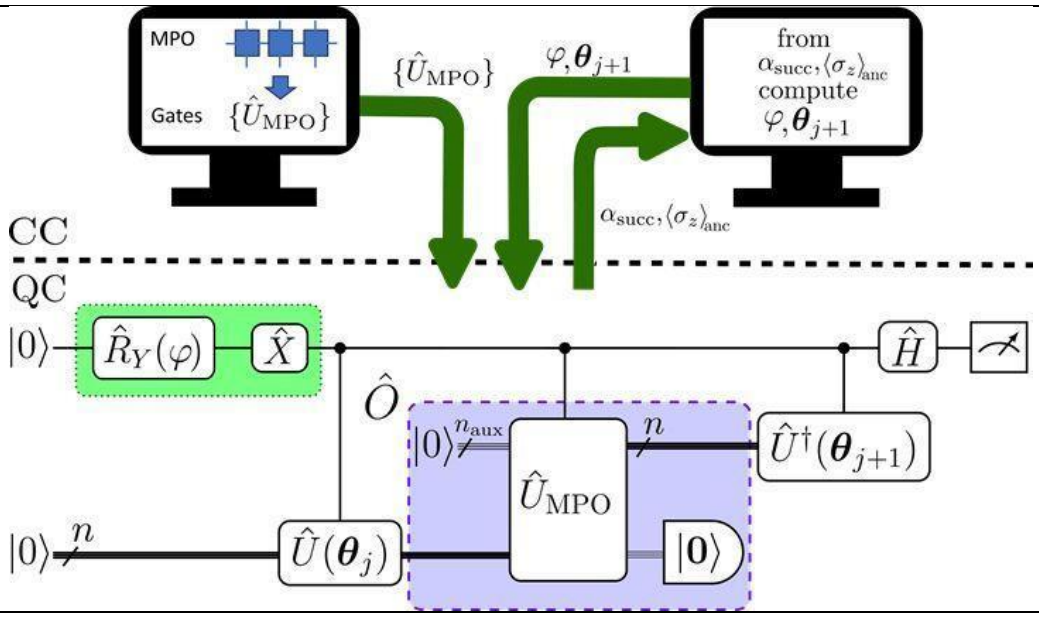
#	40
Date	31/01/2025
Post	🌌 Exploring Turbulence with Tensor Networks Pleased to share an intriguing approach to tackling the complexity of turbulence modeling presented in the paper "Tensor networks enable the calculation of turbulence probability distributions." Using Tensor Networks (TNs), the authors successfully parameterize high-dimensional turbulence probability density functions (PDFs), achieving: 🚀 Memory reduction: O(10^6) 🚀 Computational cost reduction: O(10^3) This method makes it possible to run simulations on single CPU cores that traditionally required supercomputers, opening up incredible possibilities for turbulence modeling in fluid dynamics and beyond. 📄 Read the paper here: https://lnkd.in/ehpSewk9 Thanks to @NikitaGourianov, @PeymanGivi, Dieter Jaksch, and @StephenB.Pope Let's discuss how this could reshape computational approaches in physics and engineering!

This project receives funding from the European Union's Horizon 2020 HORIZON Research and Innovation Actions Programme under Grant Agreement #101080085

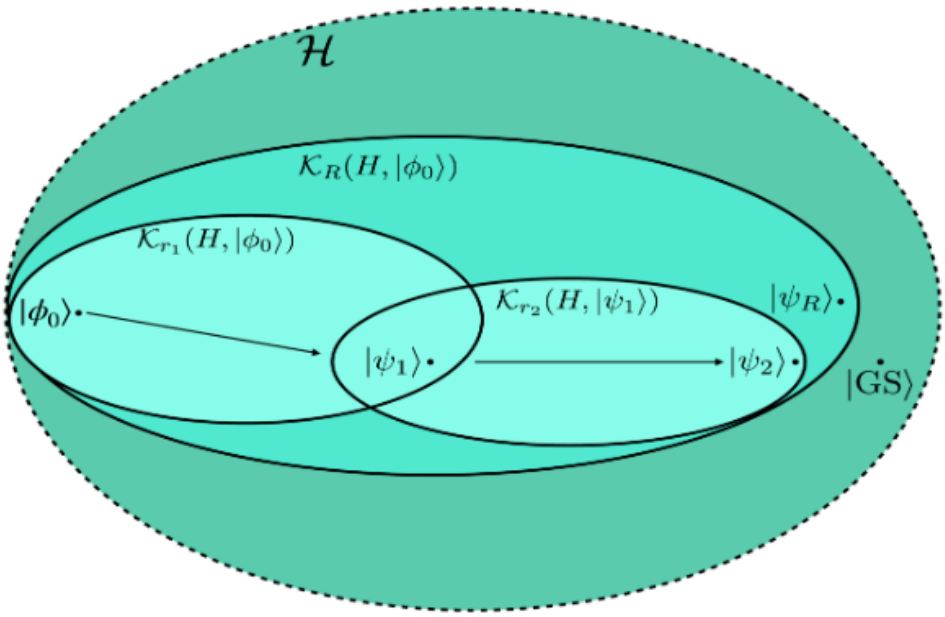
#	#QCFD #TensorNetworks #TurbulenceModeling #ScientificComputing #ComputationalPhysics #FluidDynamics #Innovation #Research
@	NikitaGourianov, @PeymanGivi, Dieter Jaksch, and @StephenB.Pope
Image	

#	41
Date	06/02/2025
Post	🚀 QCFD Deliverables Now Available! We're excited to share that the 1.1 Core Benchmark CFD Set has been revised, and the D7.1 Core Flagship QCFD Set is now published! 📌 Access all QCFD deliverables here: 🔗 https://lnkd.in/e6VSs7W9 Stay tuned for more updates!
#	#QCFD #CFD #H2020 #Research #Engineering #Simulation #Quantum
@	
Image	

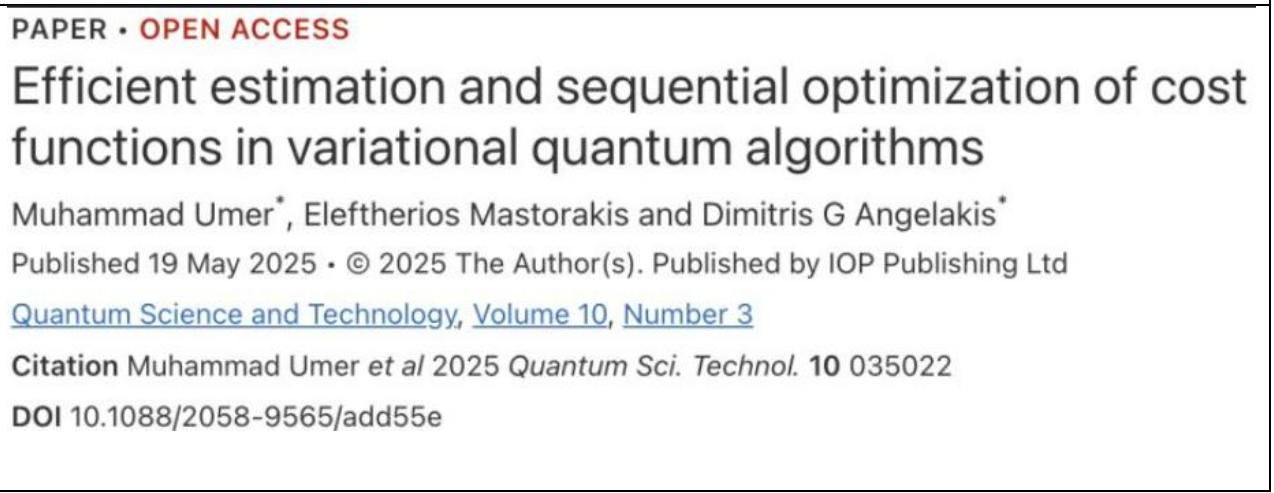
This project receives funding from the European Union's Horizon 2020 HORIZON Research and Innovation Actions Programme under Grant Agreement #101080085

#	42
Date	10/02/2025
Post	🚀 Quantum Computing for Differential Equations 👷 💡 Excited to share our latest research on Tensor-Programmable Quantum Circuits for Solving Differential Equations, published in collaboration with the University of Hamburg and the University of Oxford. 🔹 We present a quantum solver for partial differential equations (PDEs) using a flexible matrix product operator (MPO) representation. 🔹 This approach overcomes unitary constraints and expands the range of solvable PDEs in both classical and quantum systems. 🔹 Demonstrated on the Euler equations with absorbing boundaries, our method offers a promising step toward quantum-powered scientific computing. With increasing quantum hardware capabilities, quantum solvers for PDEs could revolutionize fields like fluid dynamics, material science, and financial modeling. 📖 Read the full paper here: https://lnkd.in/eGJ9GGqp
#	#QuantumComputing #DifferentialEquations #UniversityOfHamburg #QuantumPhysics
@	Tomohiro Hashizume, Greta Sophie Reese Pia Siegl, Nis-Luca van Hülst Dieter Jaksch
Image	

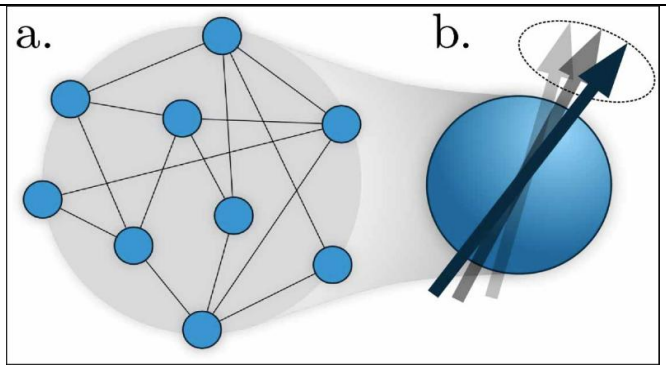
This project receives funding from the European Union's Horizon 2020 HORIZON Research and Innovation Actions Programme under Grant Agreement #101080085

#	43
Date	12/05/2025
Post	Tom O'Leary, Lewis W. Anderson, Dieter Jaksch, and Martin Kiffner's paper is in Quantum Journal! A new paper published in Quantum introduces the Partitioned Quantum Subspace Expansion algorithm, enhancing the stability of quantum subspace methods against statistical noise. This development holds promise for improving the accuracy of quantum simulations on near-term quantum hardware. 📖 Read the full paper here: https://quantum-journal.org/papers/q-2025-05-05-1726/p
#	#QuantumComputing #UniversityOfHamburg #QuantumPhysics #QuantumComputing #Research #Innovation
@	
Image	 Featured image: Illustration of the Partitioned Quantum Subspace Expansion algorithm for 2 partitions.

This project receives funding from the European Union's Horizon 2020 HORIZON Research and Innovation Actions Programme under Grant Agreement #101080085

#	44
Date	21/05/2025
Post	'Efficient Estimation and Sequential Optimization of Cost Functions in Variational Quantum Algorithms' from Muhammad Umer, @Eleftherios Mastorakis and Dimitrios Angelakis is in hashtag#iopscience !! What's New? This innovative study introduces the Sequential Grid-Based Explicit Optimization (SGEO) protocol, redefining optimization in variational quantum algorithms. By expressing parameterized quantum circuits as weighted sums of unitary operators, SGEO enables efficient computation of cost functions and their derivatives, enhancing both speed and accuracy. Applications: ◆ Simulating fluid dynamics governed by the 1D Burgers' equation. ◆ Approximating ground states of the nonlinear Schrödinger equation. Why It Matters: SGEO outperforms traditional optimizers like COBYLA, showcasing superior accuracy and faster convergence, even in complex, high-dimensional optimization landscapes. Next Steps: Future research includes exploring the impact of quantum hardware noise and extending this methodology to optimize multi-qubit gates. We invite you to explore the full paper here 📜 https://lnkd.in/eFMcixVb
#	#QuantumComputing #Optimization #QuantumAlgorithms #VariationalQuantumAlgorithms #QuantumResearch #SGEO #VQA #QCFD
@	
Image	

This project receives funding from the European Union's Horizon 2020 HORIZON Research and Innovation Actions Programme under Grant Agreement #101080085

#	45
Date	17/06/2025
Post	🚀 New Publication Alert! 🧠🔀 Excited to share our latest work published in New Journal of Physics: “Dynamical quantum phase transitions on random networks” 🔗 https://doi.org/10.1088/1367-2630/ade07b In this study, we explore how dynamical quantum phase transitions (DQPTs) behave in quantum spin systems defined on random (Erdős–Rényi) networks. While many observables converge to mean-field (fully connected) behavior in the thermodynamic limit, we uncover a persistent signature of disorder: global many-body correlations that qualitatively modify the dynamics in subtle but significant ways. 🌐 Key contributions: Analytical proof that the wavefunction dynamics converge to the mean-field limit as $\propto N^{-1/2}$. Finite-size numerical simulations (MPS, DTWA, mean-field) that validate the result and reveal surprising differences in the rate function behavior. Insight into how randomness and network topology influence quantum dynamics beyond standard approximations. This work bridges complex networks, quantum dynamics, and many-body physics—and opens exciting paths for experimental realizations with current quantum simulation platforms. With Tomohiro Hashizume*, Felix Herbort, Joseph Tindall and Dieter Jaksch
#	#QuantumPhysics #ComplexSystems #ManyBody #DQPT #RandomNetworks #QuantumSimulation #Research
@	@The Hamburg Centre for Ultrafast Imaging @Flatiron Institute @University of Oxford
Image	

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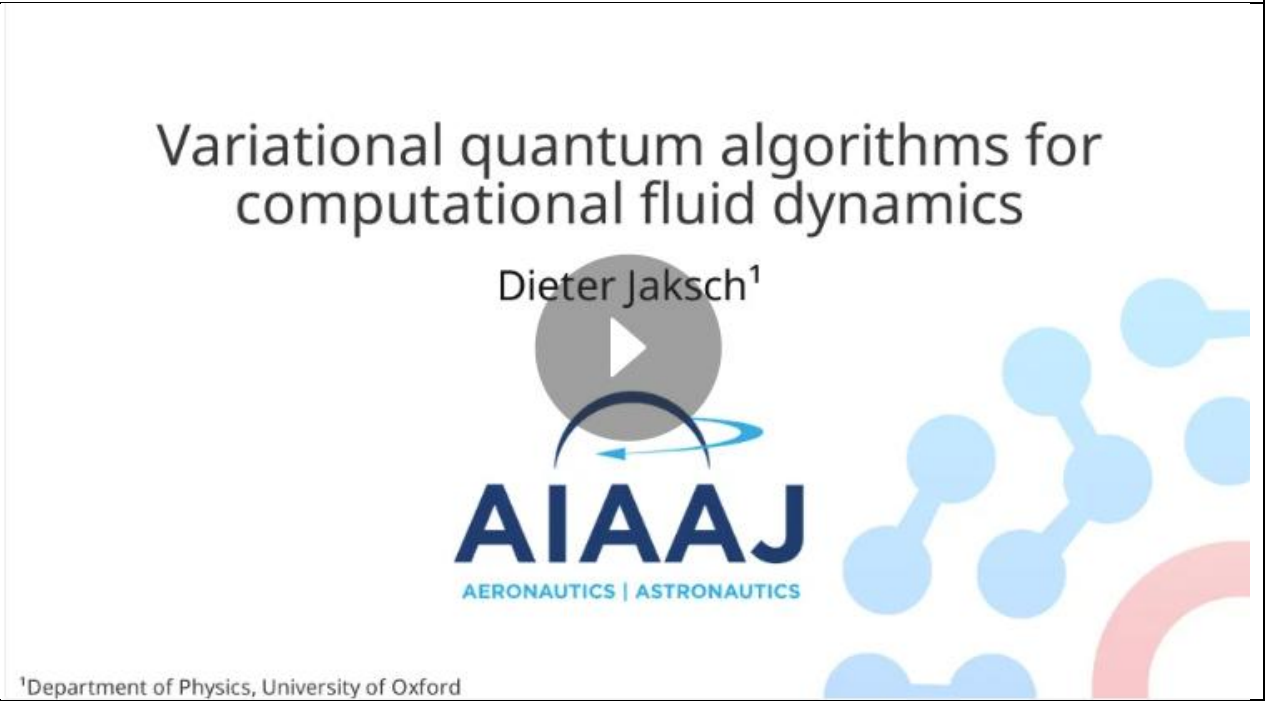
#	46
Date	17/06/2025
Post	🌟 Honored to be selected as a **Cassyni Editor's Pick** for May 2025! Dieter jaksch's recent seminar, part of Cassyni's *Fluid Dynamics* collection, was highlighted by editors Prof. Paola Cinnella (Sorbonne Université) and Prof. Robert Martinuzzi (University of Calgary) as one of the top three for the month. Grateful for the recognition and the opportunity to contribute to this growing platform for open academic exchange. 🎥 The seminar will be featured throughout June on the Cassyni Fluid Dynamics Collection page. Thanks to the Cassyni team—and looking forward to future collaborations.
#	#ResearchSeminar #FluidDynamics #Cassyni #AcademicTalks #EditorPick #Physics #QCFD
@	@University of Oxford @University of Hamburg
Image	

This project receives funding from the European Union's Horizon 2020 HORIZON Research and Innovation Actions Programme under Grant Agreement #101080085

#	47
Date	08/07/2025
Post	🚀 New paper alert! **"Quantum-Inspired Tensor-Network Fractional-Step Method for Incompressible Flow in Curvilinear Coordinates"** arXiv:2507.05222 We introduce a **tensor-network-based solver** for incompressible flow on **curvilinear grids**, achieving: ✅ Up to **20× compression** of flow fields ✅ Operator compressions up to **1000×** ✅ Accurate predictions with <0.3% error ✅ Direct portability to **quantum hardware** By blending concepts from quantum many-body physics, reduced-order modeling, and classical CFD, we push the limits of what's computationally feasible in fluid simulations. Applications include: • Rotating/non-rotating cylinder flows • Steady and unsteady regimes • Future potential for industrial-grade quantum CFD This work is a step forward toward efficient, scalable solvers for high-fidelity fluid simulations.
#	#QuantumComputing #TensorNetworks #CFD #ReducedOrderModeling #NavierStokes #QuantumInspired #NumericalMethods #QuantumFluidDynamics
@	Nis-Luca van Hülst, Pia Siegl, Paul Over, Sergio Bengoechea, Tomohiro Hashizume, Mario G. Cecile, Thomas Rung, and Dieter Jaksch @University of Hamburg @TUHH @OxfordPhysics
Image	

This project receives funding from the European Union's Horizon 2020 HORIZON Research and Innovation Actions Programme under Grant Agreement #101080085

#	48
Date	08/07/2025
Post	**New Research Alert: Disentangling strategies in unitary circuit games** We're excited to share our paper: **"Disentangling strategies and entanglement transitions in unitary circuit games with matchgates"** now on arXiv! In this work, we dive into the dynamics of quantum entanglement in *unitary circuit games*, where an *entangler* and a *disentangler* compete to shape the entanglement structure of fermionic Gaussian states (FGSs). Focusing on matchgate circuits—those naturally linked to free fermions—we introduce: ✅ An **optimal disentangling algorithm** based on a novel "right standard form" (RSF) representation of FGSs ✅ Analytical and numerical characterization of **entanglement phase transitions**, including a sharp critical point at disentangling probability **p = 1/2** ✅ A simplified **Bell pair model** that exactly maps the behavior of Rényi-0 entropy and enables efficient large-scale simulations ✅ Comparative insights into disentangling strategies based on gate count vs. entropy minimization This framework not only deepens our understanding of entanglement in *unitary circuit games* but also paves the way for new protocols in quantum information. 📄 Read the full paper: https://arxiv.org/abs/2507.05055
#	#QuantumComputing #Entanglement #Matchgates #QuantumCircuits #CondensedMatter #QuantumInformation
@	👥 With: Raúl Morral-Yepes, Marc Langer, Adam Gammon-Smith, Barbara Kraus, and Frank Pollmann 🏛️ Affiliations: TUM, MCQST, University of Nottingham
Image	

This project receives funding from the European Union's Horizon 2020 HORIZON Research and Innovation Actions Programme under Grant Agreement #101080085

#	49
Date	16/07/2025
Post	We would like to sincerely thank all the dedicated researchers working within the **QCFD Project** for their **valuable contributions and presentations** during our recent coordination meeting. Your hard work, insights, and commitment are the driving force behind the momentum we've built. This progress would not be possible without you, we're truly grateful to have such a strong and collaborative team. We also extend our heartfelt thanks to the **ENGYS Trieste team** for their continuous **support and hospitality** in making this meeting possible. Your efforts played a crucial role in bringing everyone together. Let's keep pushing the boundaries of **quantum computing** and **fluid dynamics** together!
#	#QCFD #QuantumResearch #Teamwork #ResearchAndInnovation #HorizonEurope #QuantumFuture #Gratitude #ScienceInProgress
@	Nis-Luca van Hülst, Guillaume Cecile, Tomohiro Hashizume, Tristan Kraft, Eleftherios Mastorakis, Muhammad Umer, Spyros Tserkis, Leonardo Scandurra, Sergio Bengoechea, Paul Over, Francisco Cárdenas, Jose Da Costa Jesus, Setty Abhishek
Image	

This project receives funding from the European Union's Horizon 2020 HORIZON Research and Innovation Actions Programme under Grant Agreement #101080085

#	50
Date	16/07/2025
Post	We would like to extend our sincere thanks to **Mr. Christian Trefzger**, Project Officer at the **European Commission**, for joining our **3rd Coordination Meeting** of the **QCFD Project** and delivering his insightful presentation on **"Latest Developments in EU Quantum Policy."** His support is highly valuable to us and plays a crucial role in the progress of our project and its integration into the European quantum ecosystem.
#	#QCFD #QuantumTechnologies #EuropeanCommission #ResearchAndInnovation #EUQuantumPolicy #QuantumFuture
@	**Christian Trefzger, European Commission**
Image	

This project receives funding from the European Union's Horizon 2020 HORIZON Research and Innovation Actions Programme under Grant Agreement #101080085

#	51
Date	
Post	We would like to extend our sincere thanks to **Prof. Andrew Daley**, *QCFD Project Advisory Board Member* and *Professor of Quantum Physics at the University of Oxford*, for joining our **3rd Coordination Meeting** and sharing his insightful presentation on **"Tensor Networks for Nonlinear Dynamics."** We also greatly appreciate his valuable feedback on the QCFD Project, which will help us further refine and develop our processes.
#	#QCFD #QuantumPhysics #QuantumComputing #TensorNetworks #ResearchAndInnovation #OxfordUniversity #QuantumFuture
@	Prof. Andrew Daley, University of Oxford

This project receives funding from the European Union's Horizon 2020 HORIZON Research and Innovation Actions Programme under Grant Agreement #101080085

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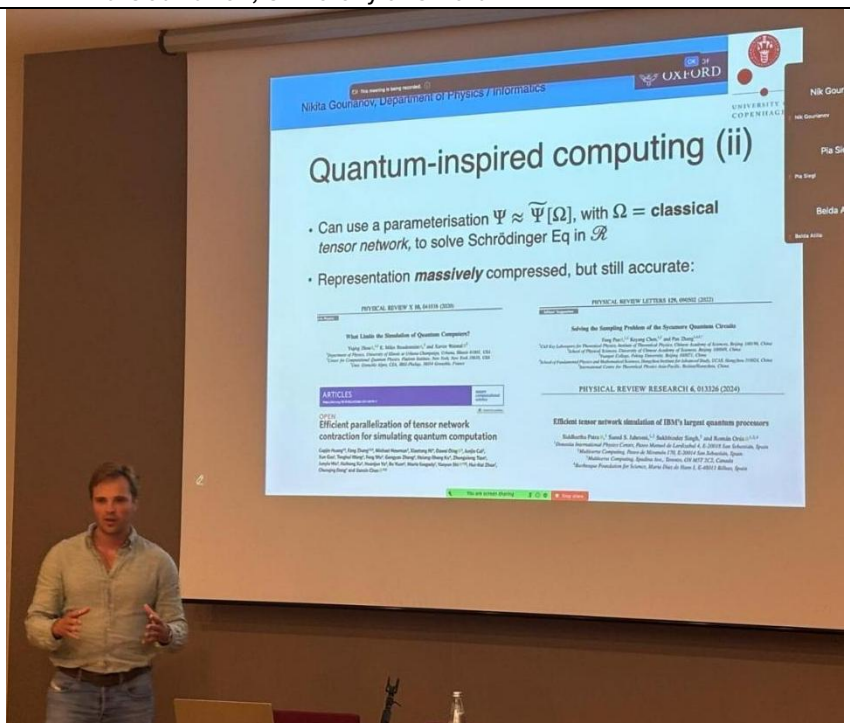
This project receives funding from the European Union's Horizon 2020 HORIZON Research and Innovation Actions Programme under Grant Agreement #101080085

#	52
Date	
Post	We would like to extend our sincere thanks to **Dr. Nikita Gourianov**, *Postdoctoral Research Associate at the University of Oxford*, for delivering an excellent invited talk on **"Quantum-Inspired Advantage for Solving Partial Differential Equations"** as part of the **QCFD Project's 3rd Coordination Meeting**. His insights brought a valuable complementary perspective to our ongoing discussions at the intersection of quantum computing and fluid dynamics.
#	#QCFD #QuantumPhysics #QuantumComputing #TensorNetworks #ResearchAndInnovation #OxfordUniversity #QuantumFuture
@	**Dr. Nikita Gourianov**, University of Oxford
Image	

This project receives funding from the European Union's Horizon 2020 HORIZON Research and Innovation Actions Programme under Grant Agreement #101080085

#	53
Date	
Post	We would like to extend our sincere gratitude to the **QCFD Project Principal Investigators**: **Barbara Kraus**, **Dieter Jaksch**, **Dimitris G. Angelakis**, **Eugene de Villiers**, **Martin Kiffner**, **Felix Motzoi**, **Paolo Geremia**, and **Thomas Rung** for their **active participation, insightful contributions**, and continued commitment during our **3rd Coordination Meeting**. Their expertise, collaboration, and guidance are key to the scientific progress and success of the QCFD Project. We are proud to be working together toward advancing quantum computing and fluid dynamics.
#	#QCFD #QuantumComputing #FluidDynamics #ResearchAndInnovation #HorizonEurope #QuantumFuture #Collaboration #ThankYou
@	
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This project receives funding from the European Union's Horizon 2020 HORIZON Research and Innovation Actions Programme under Grant Agreement #101080085

#	54
Date	25/07/2025
Post	**Universal Pulse Design for Superconducting Qudit Gates** We are excited to share our research from the Institute for Quantum Control (FZ Jülich) and partners at the University of Cologne and the University of Waterloo: **"Universal pulses for superconducting qudit ladder gates"** arXiv:2412.18339 Qudits—multi-level extensions of qubits—can supercharge quantum processing by encoding more information per system. But controlling higher levels reliably remains a core challenge. Our team presents a **universal, analytical pulse framework** for achieving high-fidelity and fast quantum gates across qudit levels. **What's new?** ● Recursive extension of the DRAG method for qudits ● Robust pulse shapes that suppress leakage, phase, and multi-photon errors ● Achieve gate errors below 10^{-4} within 10 ns durations ● Demonstrated **universal quantum speed limits** for all qudit levels This work bridges theory and practical control, bringing scalable, high-precision qudit computation closer to reality—especially in superconducting transmon platforms.
#	#QuantumComputing #Qudits #QuantumControl #SuperconductingCircuits #DRAGPulses #Transmon #arXiv #QCFD #QuantumResearch
@	
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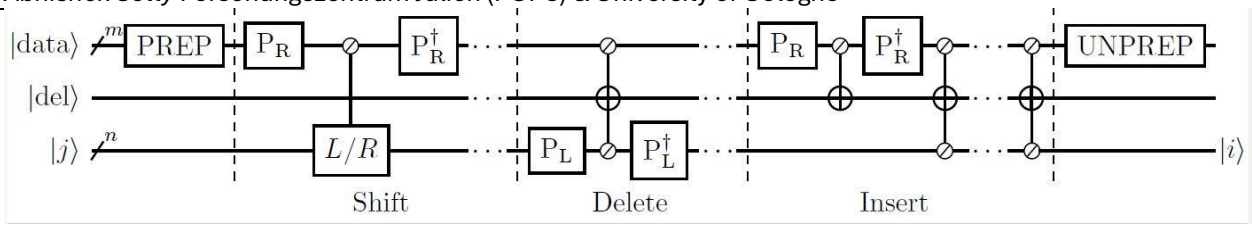
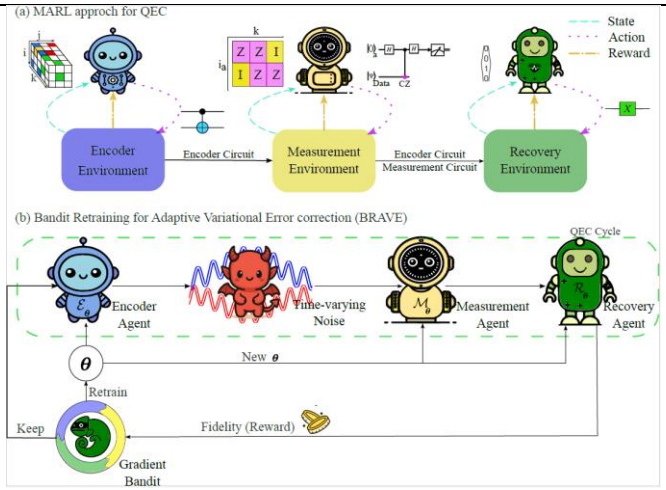
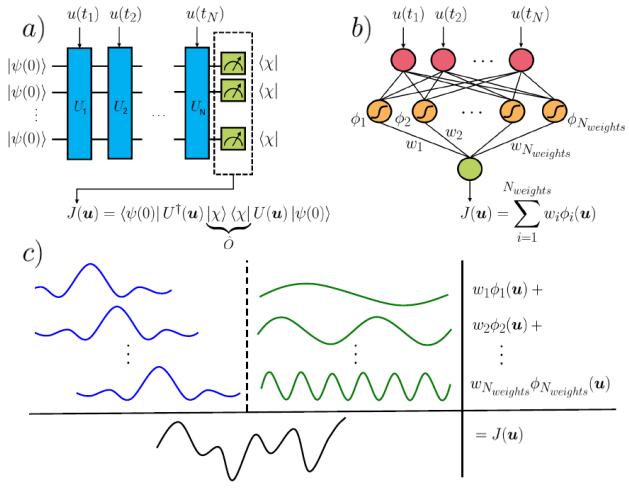
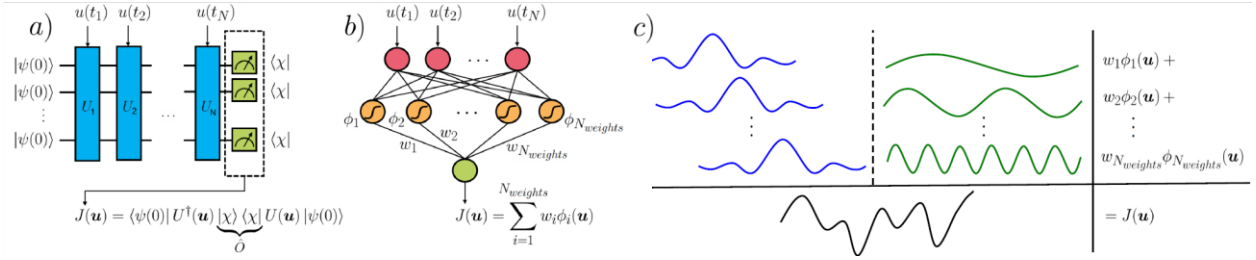
This project receives funding from the European Union's Horizon 2020 HORIZON Research and Innovation Actions Programme under Grant Agreement #101080085

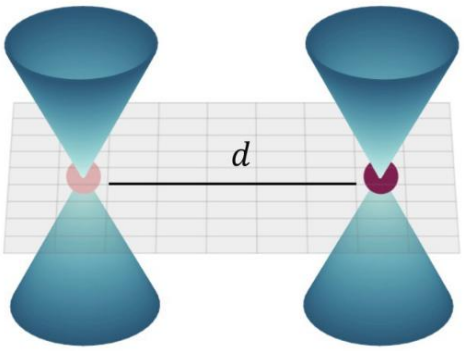
#	55
Date	07/10/2025
Post	🚀 **New preprint out!** Our latest work, **"Block Encoding of Sparse Matrices via Coherent Permutation"**, is now available on arXiv: https://arxiv.org/abs/2508.21667v2 Block encoding is a key technique in quantum algorithms such as QSVT, Hamiltonian simulation, and quantum linear solvers — but efficient circuit-level implementations for arbitrary sparse matrices remain challenging. In this paper, we present a **unified framework** that: ● Introduces *coherent permutation operators* for amplitude reordering, ● Connects block encoding to **combinatorial optimization**, ● Enables **hardware-efficient** quantum circuit constructions with reduced depth and control overhead. We demonstrate the approach on structured sparse matrices, showing significant gains in circuit efficiency and practicality. 🔹 Authors: *Abhishek Setty* 🔹 Institutions: Forschungszentrum Jülich (PGI-8) & University of Cologne
#	#QuantumComputing #QuantumAlgorithms #BlockEncoding #QuantumCircuits #Research
@	*Abhishek Setty* Forschungszentrum Jülich (PGI-8) & University of Cologne
Image	

This project receives funding from the European Union's Horizon 2020 HORIZON Research and Innovation Actions Programme under Grant Agreement #101080085

#	56
Date	08/10/2025
Post	Real-Time Adaptive Quantum Error Correction by Model-Free Multi-Agent Learning Available on arXiv: 2509.11214 Please visit QCFD Website to read full paper: https://qcfd-h2020.eu/real-time-adaptive-quantum-error-correction-by-model-free-multi-agent-learning Quantum error correction must adapt to changing noise in real devices. This work presents a multi-agent reinforcement-learning (MARL) framework that autonomously learns full QEC cycles — encoding, syndrome measurement, and recovery — without any prior model assumptions. A complementary algorithm, BRAVE (Bandit Retraining for Adaptive Variational Error Correction), enables real-time adaptation to time-dependent noise, improving logical fidelity by over an order of magnitude compared with static QEC codes. ◆ Authors: M. Guatto, F. Preti, M. Schilling, T. Calarco, F.A. Cárdenas-López & F. Motzoi ◆ Institutions: Forschungszentrum Jülich (PGI-8), University of Cologne, University of Bologna
#	#QuantumErrorCorrection #ReinforcementLearning #QuantumAI #AdaptiveQuantumSystems
@	
Image	

This project receives funding from the European Union's Horizon 2020 HORIZON Research and Innovation Actions Programme under Grant Agreement #101080085

#	57
Date	08/10/2025
Post	**Classical Feature-Map Surrogates and Metrics for Quantum Control Landscapes** *Available on arXiv: 2509.25930* Please visit QCFD Website to read full paper: https://qcfd-h2020.eu/classical-feature-map-surrogates-and-metrics-for-quantum-control-landscapes Quantum-control optimization can be understood through the lens of machine-learning representations. This study derives **Fourier, Taylor, and kernel-based feature-map models** for quantum landscapes, establishing analytical bounds on gradients, smoothness, and the onset of barren plateaus. The framework connects **landscape structure, symmetries, and optimization hardness**, providing practical tools for designing efficient hybrid quantum-classical algorithms. ◆ **Authors:** M. Calzavara, T. Calarco & F. Motzoi ◆ **Institutions:** Forschungszentrum Jülich (PGI-8), University of Cologne, University of Bologna\
#	#QuantumControl #MachineLearning #QuantumOptimization #QuantumScience
@	
Image	 

#	58
Date	08/10/2025
Post	**Fast Neutral-Atom Transport and Transfer between Optical Tweezers** *Published in* Physical Review Applied 24 (2025) — [DOI: 10.1103/PhysRevApplied.24.024070] Please visit QCFD Website to read full paper: https://qcfd-h2020.eu/fast-neutral-atom-transport-and-transfer-between-optical-tweezers Efficient atom transport is a crucial step for neutral-atom quantum processors and simulators. This study introduces an optimized **shortcuts-to-adiabaticity (STA)** framework for fast and accurate transfer of neutral atoms between optical tweezers. The work demonstrates that STA protocols can achieve atom-transfer operations **up to eight times faster** than reported in recent experiments, without compromising coherence or fidelity. It further provides simple analytical control formulas, directly applicable to experimental quantum platforms. ◆ **Authors:** C. Cicali, M. Calzavara, E. Cuestas, T. Calarco, R. Zeier & F. Motzoi ◆ **Institutions:** Forschungszentrum Jülich (PGI-8), University of Cologne, OIST, University of Bologna
#	#QuantumTechnologies #QuantumControl #NeutralAtoms #OpticalTweezer
@	
Image	

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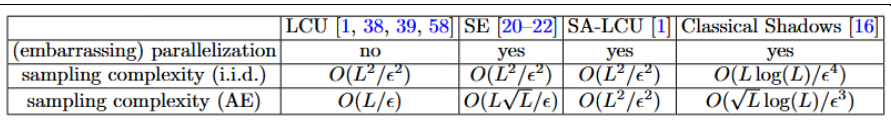
#	59
Date	08/10/2025
Post	**Gradients, Parallelism, and Variance of Quantum Estimates** *Available on arXiv: 2509.11214* Please visit QCFD Website to read full paper: https://qcfd-h2020.eu/gradients-parallelism-and-variance-of-quantum-estimates Precise gradient estimation is essential for variational quantum algorithms. This publication provides a unified analysis of **observable and gradient estimators** on near-term quantum hardware, comparing standard and **Linear Combination of Unitaries (LCU)** methods. The study derives variance bounds, discusses amplitude-estimation speed-ups, and extends the framework to **multi-qubit and control-gradient** computations, bridging variational and fault-tolerant regimes. ◆ **Authors:** F. Preti, M. Schilling, J.Z. Bernád, T. Calarco, F.A. Cárdenas-López & F. Motzoi ◆ **Institutions:** Forschungszentrum Jülich (PGI-8), Wigner Research Centre for Physics, University of Cologne, University of Bologna
#	#QuantumAlgorithms #QuantumGradients #QuantumOptimization #QuantumComputing
@	
Image	

	LCU [1, 38, 39, 58]	SE [20–22]	SA-LCU [1]	Classical Shadows [16]
(embarrassing) parallelization	no	yes	yes	yes
sampling complexity (i.i.d.)	$O(L^2/\epsilon^2)$	$O(L^2/\epsilon^2)$	$O(L^2/\epsilon^2)$	$O(L\log(L)/\epsilon^4)$
sampling complexity (AE)	$O(L/\epsilon)$	$O(L\sqrt{L}/\epsilon)$	$O(L^2/\epsilon^2)$	$O(\sqrt{L}\log(L)/\epsilon^3)$

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