



NVAO  THE NETHERLANDS

# INITIAL ACCREDITATION

ACADEMIC MASTER

QUANTUM COMPUTER SCIENCE

University of Amsterdam

SUMMARY REPORT

15 March 2024



## 1 Peer review

The quality of a new programme is assessed by means of peer review. A panel of independent peers including a student reviews the plans during a site visit to the institution. A discussion amongst peer experts forms the basis for the panel's final judgement and the advisory report. The focus is on the curriculum, the teaching and learning environment, and student assessment.

The Accreditation Organisation of the Netherlands and Flanders (NVAO) takes a formal decision on the quality of the new programme based on the outcome of the peer review. This decision can be positive, conditionally positive or negative. Following a positive NVAO decision with or without conditions the institution can proceed to offer the new programme. Upon completion of the programme graduates are entitled to receive a legally accredited degree.

This summary report contains the main outcomes of the peer review. A full report with more details including the panel's findings and analysis is also available. NVAO bases an accreditation decision on the full report.

Both the full and summary reports of peer reviews are published on NVAO's website [www.nvao.net](http://www.nvao.net). More information on NVAO and peer reviews of new programmes can be found there.

## 2 Panel

### Peer experts

- Prof. dr. ir. W. (Wim) van Petegem (chair), Associate Professor at the Faculty of Engineering Technology, KU Leuven;
- Dr. ir. S.J.A. (Sissi) de Beer, Associate Professor in Sustainable Polymer Chemistry and Programme Director of the bachelor's programme Applied Physics and the master's programme Applied Physics at the University of Twente;
- Prof. dr. K.L.M. (Koen) Bertels, Professor of Quantum Computer Engineering at the University of Ghent and founder of QBee;
- N. (Nienke) Wessel BSc (student member), master's student Computing Science (Specialisation: Data Science) at Radboud University.

### Assisting staff

- Anne Martens MA, secretary;
- drs. Dirk van Loon, NVAO policy advisor and process coordinator.

### Site visit

Amsterdam, 29 January 2024.

### 3 Outcome

The NVAO-approved panel reaches a positive conclusion regarding the quality of the master's programme Quantum Computer Science (QuCS) offered by University of Amsterdam (UvA). The institution intends to offer the programme of 120 ECTS credits as a fulltime programme in Amsterdam.

The ambitious programme intends to educate computer scientists who understand quantum computing at a deep level, responding to the needs in industry and research institutes that work with quantum computers. It focuses on the development of software and algorithms and has a clear theoretical and research focus. QuCS has been developed by UvA's Faculty of Science in close cooperation with the Dutch research centre for quantum software and technology QuSoft. The programme aligns with relevant international academic and disciplinary frameworks.

The programme's courses cover relevant knowledge as well as academic, programming and soft skills. QuCS has a strong research orientation, which is reflected in the content of the courses, the profiles of the academic staff members and the strong cooperation with QuSoft. It is a plus that the curriculum includes a course that addresses ethics and awareness of the impact of the discipline on society. Overall, the programme offers a considerable degree of flexibility and enables students to create a personal learning trajectory based on their interests. The programme offers adequate guidance in this process. The programme deploys a suitable variety of assessment modes that support students' learning processes.

Students finish the programme with a substantial and well-thought-out thesis project, which will be carried out at QuSoft or a (research) organisation in the quantum field. The thesis project requires them to show that they can conduct research in a relatively independent way. The project may be combined with an internship at a company or at a research centre. It is a good idea that participates in the Quantum Talent Learning Centre to coordinate internships.

The academic staff members are highly qualified. They are active researchers at UvA's Faculty of Science and/or QuSoft and many are leading experts in their field. Their involvement in current research ensures that new developments are incorporated in the programme. The lecturers cooperate in a truly interdisciplinary team to design and deliver the programme. The programme benefits from the staff's experience in other master's programmes offered by UvA's Faculty of Science, both in terms of curriculum development and assessment.

The panel concludes that QuCS is an attractive and relevant new programme. It enables students to deepen their understanding of quantum computing and prepares them for a research-related career in academia or industry. The panel agrees with the programme's argumentation regarding its choice for an English-taught curriculum and a study duration of 120 ECTS credits.

### 4 Commendations

The programme is commended for the following features of good practice.

1. Development – The programme has been developed in close cooperation with researchers, lecturers and students. The use of the EU Competence Framework for Quantum Technologies is a strength.

2. Lecturers – The programme has been designed and will be delivered by dedicated and highly qualified academic staff members, who are active researchers.

3. Admission – The admission requirements are clearly defined and fit for the challenging programme.

4. Thesis – The thesis project is well-thought-out and requires students to show that they can conduct research in a relatively independent way

5. Experience – The programme builds on the experience in related UvA master's programmes that have a similar setup.

## 5 Recommendations

For further improvement to the programme, the panel recommends a number of follow-up actions.

1. Learning outcomes – Sharpen the learning outcomes related to research skills.

2. Advisory Board – Involve more representatives from the quantum industry in the further development of the programme to cover its broad spectrum, prevent bias in a rapidly evolving domain and to ensure that the programme educates students who are valuable to both academia and industry.

3. Learning lines – Improve the visibility of the learning lines related to skills development.

4. Community feeling – Make concrete plans before the start of the programme to foster a sufficient community feeling amongst QuCS students and staff.

## 6 What comes next?

NVAO grants initial accreditation to a new programme on the basis of a panel's full report. The decision is valid for a maximum of six years. For conditional accreditation other regulations apply. Upon accreditation the new programme will follow the NVAO review procedures for existing programmes. NVAO publishes the accreditation decision together with the full report and this summary report.<sup>1</sup>

Each institution has a system of quality assurance in place ensuring continuous follow-up actions and periodic peer-review activities. Peer reviews help the institution to improve the quality of its programmes. The progress made since the last review is therefore taken into consideration when preparing for the next review. The follow-up activities are also part of the following peer-review report. For more information, visit the institution's website.<sup>2</sup>

## 7 Samenvatting

Het NVAO-panel oordeelt positief over de kwaliteit van de wo-masteropleiding Quantum Computer Science (QuCS) van de Universiteit van Amsterdam (UvA). De instelling is

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<sup>1</sup> <https://www.nvao.net/nl/besluiten>

<sup>2</sup> <https://www.uva.nl/en>

voornemens de opleiding van 120 EC (studiepunten) als voltijdse opleiding in Amsterdam aan te bieden. De opleiding voldoet aan de drie standaarden van het NVAO beoordelingskader. Voor deze beoordeling heeft het panel gesprekken gevoerd met vertegenwoordigers van de opleiding op 29 januari 2024 te Amsterdam.

De ambitieuze opleiding is bedoeld om computerwetenschappers op te leiden die een diep begrip hebben van kwantumcomputers. QuCS speelt daarmee in op de behoeften in het werkveld en bij onderzoeksinstituten die met kwantumcomputers werken. De opleiding is gericht op de ontwikkeling van software en algoritmen en heeft een duidelijke focus op theorie en onderzoek. QuCS is ontwikkeld door de Faculteit der Natuurwetenschappen, Wiskunde en Informatica (FNWI) van de UvA, in nauwe samenwerking met het Nederlandse onderzoekscentrum voor kwantumsoftware en -technologie QuSoft. De opleiding sluit aan bij relevante internationale academische en disciplinaire kaders.

De kernvakken van het programma behandelen relevante kennis. Daarnaast ontwikkelen studenten academische vaardigheden, programmeervaardigheden en *soft skills*. QuCS is sterk georiënteerd op onderzoek; dit is zichtbaar in de inhoud van de cursussen, de profielen van de docenten en de sterke samenwerking met QuSoft. Het is een pluspunt dat het curriculum een cursus bevat over ethiek en bewustzijn van de impact van het vakgebied op de maatschappij. Over het geheel genomen biedt het programma een aanzienlijke mate van flexibiliteit en stelt het studenten in staat om een persoonlijk leertraject samen te stellen op basis van hun interesses. Het programma biedt voldoende ondersteuning bij het keuzeprocess en maakt gebruik van passende toetsvormen die het leerproces van studenten ondersteunen.

Studenten sluiten het programma af met een substantieel en goed doordacht scriptieproject, dat wordt uitgevoerd bij QuSoft of een (onderzoeks)organisatie in het kwantumbied. In het project laten ze zien dat ze op een relatief zelfstandige manier onderzoek kunnen doen. Het project kan worden gecombineerd met een stage bij een bedrijf of onderzoekscentrum. Het is een goed idee dat de UvA deelneemt aan het Quantum Talent Learning Centre om stageplaatsen te coördineren.

De academische stafleden zijn hooggekwalificeerd. Zij zijn actief als onderzoeker aan FNWI en/of QuSoft en velen zijn toonaangevend in hun vakgebied. Hun betrokkenheid bij actueel onderzoek zorgt ervoor dat nieuwe ontwikkelingen in het programma worden verwerkt. De docenten werken samen in een interdisciplinair team om het programma te ontwerpen en uit te voeren. Het programma profiteert van de ervaring van de docenten in andere masteropleidingen binnen FNWI, voor zowel de curriculumontwikkeling als de toetsing.

Het panel concludeert dat QuCS een aantrekkelijke en relevante nieuwe opleiding is. De opleiding stelt studenten in staat om hun kennis en vaardigheden op gebied van kwantumcomputers te verdiepen en bereidt hen voor op een onderzoeksgelateerde carrière in de academische wereld of de industrie. Het panel onderschrijft de keuze voor een Engelstalig curriculum en een studieduur van 120 EC.

Meer informatie over de NVAO-werkwijze en de toetsing van nieuwe opleidingen is te vinden op [www.nvao.net](http://www.nvao.net). Voor informatie over de Universiteit van Amsterdam verwijzen we naar de website van de instelling.<sup>3</sup>

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<sup>3</sup> <https://www.uva.nl/>

The summary report was written at the request of NVAO  
and is the outcome of the peer review  
of the new master's programme  
Quantum Computer Science  
offered by Universiteit van Amsterdam

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