

FUNDING INITIATIVE QUANTUM AUSTRIA

ANNUAL REPORT 2023



$$i\hbar \frac{\partial}{\partial t} \psi(r,t) = \left[-\frac{\hbar^2}{2m} \Delta + V(r,t) \right] \psi(r,t)$$



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The QUANTUM AUSTRIA Funding Initiative

The Austrian Research Promotion Agency (FFG) and the Austrian Science Fund (FWF) are implementing the Quantum Austria Funding Initiative (Qu-AT) from 2021 to 2026. The initiative is carried out on behalf of the Federal Ministry of Education, Science and Research (BMBWF) and is financed by the European Union under the [NextGenerationEU Recovery and Resilience Plan](#) (2020–2026). Austria is using funding from the Recovery and Resilience Plan to invest EUR 107 million into developing quantum research and technologies. The aim is to stimulate research, development and innovation activities in the field of quantum research and technology, and to maintain competitiveness, in line with the research, technology and innovation policy objectives of the Austrian Federal Government. Funding will go towards both basic research and the development of practical applications. The FFG and the FWF are working closely together on allocating funding and are using a selection of their respective funding instruments for personnel and infrastructure. Part of the funding is earmarked for research infrastructure in the field of next generation high performance computing, quantum computing, and their intersections.

Funding is provided for projects with clearly defined goals, methods, durations and financing volumes, in accordance with the conditions of the respective funding

agency. Applications must address topics of quantum research and quantum technology. The research questions may include, for instance, the following topics:

- Specific preparation and control of quantum states;
- New algorithms and mathematical theoretical concepts that exploit the superposition and entanglement of quantum states;
- Developments and applications in quantum communication; quantum sensor technology, quantum metrology, quantum simulation, quantum computing and quantum information;
- Development of ideas based on quantum phenomena in the neighbouring fields of physics, mathematics, chemistry, and in biological systems.

Target groups

The Quantum Austria Funding Initiative allows researchers, universities, non-university research institutions and companies working in the field of quantum research and technology to select from existing FFG and FWF funding instruments. Cooperation between the two funding agencies ensures the availability of a wide range of funding options for researchers at universities, universities of applied sciences, and non-university research institutions as well as for R&D activities conducted by start-ups, businesses and industry.

Implementation of Qu-AT and activities in 2023

Following the launch of the initiative and the opening and implementation of the first Calls in 2021 and 2022, most of the approved projects started work in 2023. The approval of the new Cluster of Excellence '**Quantum Science Austria**' at the 92nd FWF Board Meeting in March 2023 was another building block of the funding initiative. The scientists in Innsbruck, Vienna, Linz and Klosterneuburg pose innovative, elementary questions in quantum science that can only be solved by combining the unique expertise available in Austria.

On 13/11/2023, an event for the community was organised by the Austrian Science Fund (FWF) and the Austrian Research Promotion Agency (FFG) in cooperation with the Federation of Austrian Industries (IV). Titled "Key Technologies Forum: Industrial Applications for Quantum Technology", the possibilities and opportunities arising from the use of quantum technology in industrial applications were outlined and discussed. Quantum Austria projects were given the opportunity to present their activities. A total of 123 participants and two online speakers took part in the event.

In late 2023, another FFG Call was started; submissions to the FWF can be made until 30/06/2024.

Activities of the Qu-AT bodies

Steering Committee

With the conclusion of the 2nd Development Agreement for the Financing Agreement (FV) 2021–2023 in June 2023, the Financing Agreement (FV) 2021–2023 and the **1st Development Agreement for Quantum Austria 2021–2023** were amended in accordance with § 7 (11) in conjunction with § 5 (8) of the Research Financing Act (FoFinaG, Federal Law Gazette I No. 75/2020). As a result, the programs for Quantum Austria were expanded to include the Excellence Initiative and the Clusters of Excellence as well as partial

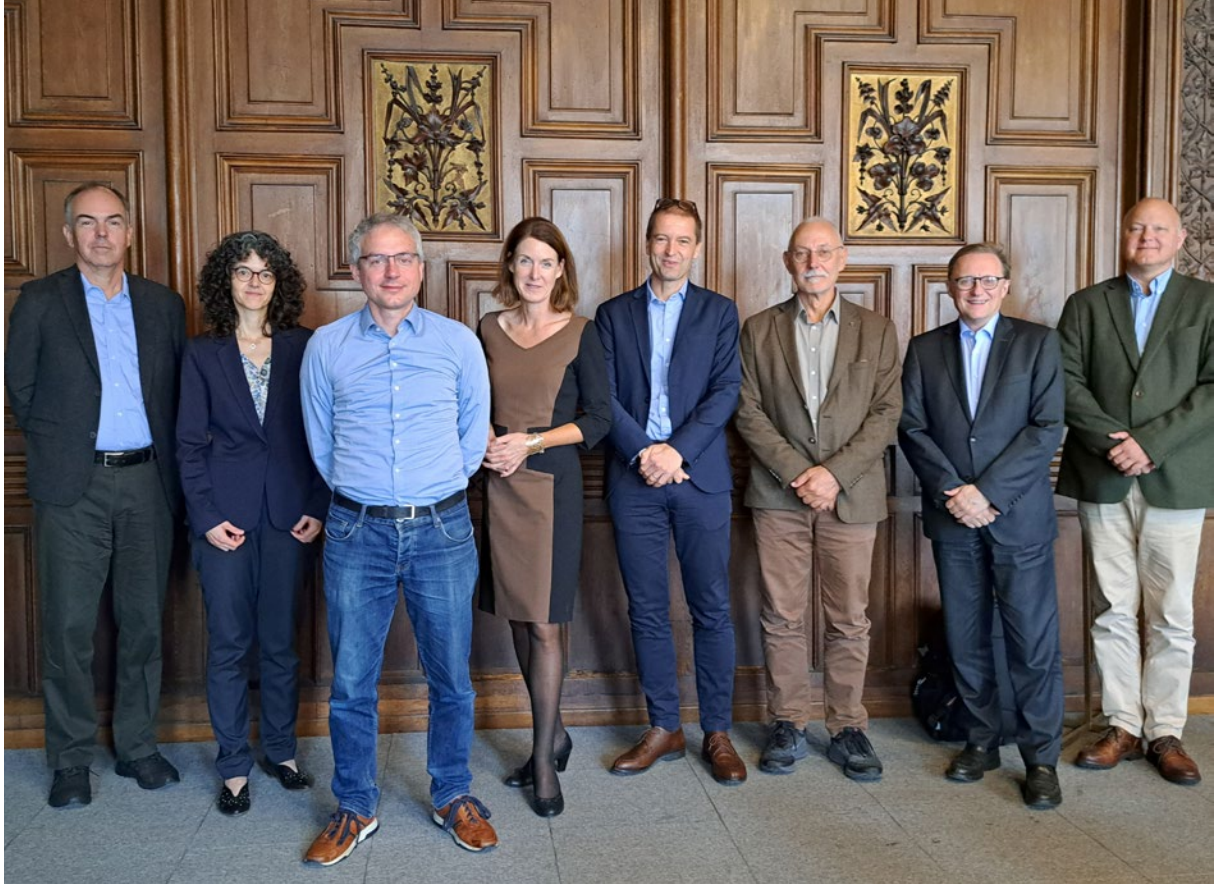
funding up to a funding rate of 60% for the Cluster of Excellence (COE) 'Quantum Science Austria'.

A cooperation agreement, together with a sideletter and a supplementary agreement to the cooperation agreement, was concluded between the two funding agencies FFG and FWF to define the framework conditions for joint implementation of the initiative. Under these agreements, the contracting parties have created the option of reallocating funding budgets under the conditions specified in the agreements in order to best meet the needs of the research community. This option is granted in the implementation agreement with the FFG and in the FWF's development agreement with the BMBWF. In 2022 and 2023, this option was used twice on the recommendation of the Steering Committee (primary point of contact of the BMBWF in its role as the initiative's contracting entity for the FFG, and as the supervisory body for the FWF; it is used for the operational control of the Quantum Austria Funding Initiative).

The 2022 annual report already described a reallocation of EUR 10 million to the FFG.

Two meetings of the Steering Committee were held in 2023. The third overall meeting of the Steering Committee in April 2023 served to discuss the status quo of the call management of the two agencies and further call planning. The additional funding requirement announced by the FWF at this meeting was based on the partial funding of the Cluster of Excellence 'Quantum Science Austria' from Qu-AT funds and the parallel and continuing high number of applications for the other FWF funding programs used in Quantum Austria. At the overall fourth meeting of the Steering Committee in September 2023, the FWF's funding requirements were specified. On the recommendation of the Steering Committee, EUR 2.55 million from FFG funds that had not yet been committed were finally reallocated to the FWF.

The BMBWF launched a third Call via the FFG, which opened on 22 December 2023 (submission deadline 29/2/2024) and provides EUR 5 million in funding.



Group photo of Qu-AT SAB BMBWF (from left): Dieter Kranzmüller (LMU), Mari Carmen Banuls (MPG), Michael Marthaler (HQS), Henrietta Egerth (FFG), Christof Gattringer (FWF), Glinos Konstantinos (vornals EK), Daniel Weselka (BMBWF), Stefan Hanslik (BMBWF)

SAB

In November 2023, another (3rd) meeting of the initiative's Strategic Advisory Board (Qu-AT SAB) was held in Vienna. In addition to the reports of the FWF and FFG, three projects (FWF: Cluster of Excellence 'Quantum Science Austria'; FFG: R&D infrastructure project **MUSICA** (Multi-Site Computer Austria, Call topic 2) and flagship project **HPQC** (High-Performance Integrated Quantum Computing, Call topic 1)) were invited to present their past and future activities.

Completed Calls and project approvals

FFG Calls and project funding

In 2023, the last project remaining on the reserve list from the first Call received its funding commitment. As a result, all projects recommended for funding from the first and second Calls for funding could be approved.

On 22/12/2023, the third Call was opened, which is dedicated to projects involving basic research in quantum computing. There will be a particular focus on projects which address the research and development of highly security-relevant quantum computers using multi-valued logic.

The FFG uses several project types (funding instruments) for the implementation of the Quantum Austria initiative. They include established instruments with minor adjustments made to the framework conditions, such as project duration and submission eligibility.

The Calls are assigned to the two key topics of the initiative (in accordance with the Austrian Recovery and Resilience Plan):

- Topic 1 – Research Cooperation and R&D Infrastructure
- Topic 2 – HPC Infrastructure Update and Transfer to Regular Operations

The Call documents were made publicly available via the [program webpages](#).

Overview of Quantum Austria Calls carried out by FFG:

1st Call

Launch	15/12/2021		
Indicative budget	€39.2m Topic 1: €19.2m Topic 2: €20.0m	R&D Projects HPC Infrastructure	Requested funding: €64,740,486 €20,000,000
Submission deadlines 30/03/2022	Topic 2, R&D Infrastructure Topic 1, Bridge	1 submission 0 submissions	€20,000,000
27/04/2022 (Topic 1)	Individual Project of Industrial Research (IR) Cooperative R&D Project R&D Infrastructure	5 submissions 7 submissions 12 submissions	€2,938,954 €11,412,584 €40,878,673
31/05/2022 (Topic 1)	Flagship Project	2 submissions	€9,510,275
Total		27 submissions	€84,740,486
Evaluation committees		Funding recommendation	Max. funding
12/05/2022	Topic 2 – R&D Infrastructure	1 project	€20,000,000
13/06/2022	Topic 1 – Cooperative R&D Project	5 projects	€7,797,536
14/06/2022	Topic 1 – R&D Infrastructure	9 projects	€27,189,382
15/06/2022	Topic 1 – Individual Project (IR)	4 projects	€2,319,045
13/07/2022	Topic 1 – Flagship Project	1 project	€4,374,061
Funding recommendation		20 projects	€61,680,024

2nd Call

Launch	05/10/2022		
Indicative budget	€9.0m (allocated to Topic 1, R&D Infrastructure)		
Submission deadline	25/11/2022	3 submissions	Requested funding €11,049,214
Evaluation committee	14/12/2022		Max. funding
Funding recommendation		1 project	€8,999,279

Summary 2022 – 1st and 2nd Call

Projects submitted	30
Total funding requested	€95,789,700
Projects recommended for funding	21
Total funding recommendation (max.)	€70,679,303
Total costs of the projects recommended for funding	€74,590,719

3rd Call

Launch	22/12/2023
Indicative budget	€5.0m (allocated to Topic 1)
Submission deadline	29/02/2024

BMBWF funding decisions (up to 31/12/2023)

Approved projects and funding	21	€70,679,303
R&D Infrastructure	11	€56,188,661
Individual Project (IR)	4	€2,319,045
Cooperative R&D Project	5	€7,797,536
Flagship Project	1	€4,374,061
Participations (number of project partners)	56	
Universities	30	€59,753,014
Research organisations	9	€4,275,430
SMEs	11	€5,935,125
Large enterprises	5	€586,854
Other	1	€128,880
Of which total international partners	6	€1,090,377

FWF – Calls and project approvals

The FWF uses existing funding programs of the **FV 2021–2023** Financing Agreement (Qu-AT-relevant funding programs and program elements) for the Quantum Austria Calls. The requirements for submitting an application are in line with the requirements for the existing FWF programs and the supplementary application guidelines for the funding initiative. In 2023, it was still possible to submit an application with a shorter duration (than the maximum funding period) for the Principal Investigator Projects and the Erwin Schrödinger Fellowships including a return phase. Applicants were asked to contact the FWF in advance in order to adapt the project duration in accordance with the initiative deadlines.

The Call documents are made available on the FWF's **Qu-AT webpage**. Approved FWF projects are listed on the **"In Focus" page and research radar**.

FWF – Project applications and approvals

Since the start of the Call, a total of 65 researchers from Austria's universities and the Austrian Academy of Sciences (ÖAW) submitted quantum research projects totalling EUR 41.7 million to the FWF in 2021, 2022 and 2023. In the eight approval rounds, a total of 29 projects¹ in Graz, Innsbruck, Linz and Vienna (research institutions of the principal investigators) as well as two foreign universities (Schrödinger Fellowships) were funded to the tune of EUR 21.3 million as a result of

their excellent scientific quality². This corresponds to an approval rate of 29.2% (by number of applications) in 2023. The approval rate in 2022 was 56.4% (by number of applications). Overall, the approval rate corresponds to 46% (according to the number of applications).

Part of the Quantum Austria funds will be invested in the FWF Cluster of Excellence 'Quantum Science Austria' in which more than a hundred researchers at several locations work together to decipher the mysteries of the quantum world; the Cluster of Excellence is one of Austria's largest cooperative research projects. It advances basic research in the quantum sciences and aims to expand the frontiers of knowledge and serve as a motor for future innovations. The focus is placed on fundamental questions about the quantum nature of space, time and gravity, new paradigms in quantum information science, and the physics of quantum many-body systems. The scientists in Innsbruck, Vienna, Linz and Klosterneuburg pose innovative, elementary questions in quantum science that can only be solved by combining the unique expertise available in Austria. The new Cluster of Excellence will allow the research groups to further intensify collaboration and establish an internationally recognised center of quantum sciences in Austria.

Details and figures on the Calls are shown in the following tables.

1 One Principal Investigator Project was transferred to the German Research Foundation (DFG) in accordance with the **money follows researcher** rule; the associated funds were withdrawn.

2 The funding amount takes into account the withdrawal of funds and supplementary approvals (for projects that have already been approved), including inflation adjustments and child allowances.

Overview of Calls carried out by FWF:

FWF Calls			
Launch	26/11/2021		
Indicative budget	Topic 1: €20.66m		Requested funding
Submission deadlines	Principal Investigator Projects	39 submissions	€15,073,258.46
30 June 2024			
30 August 2022	ESPRIT Program	11 submissions	€3,548,625.50
30 August 2022	Erwin Schrödinger Fellowships including a return phase	8 submissions	€1,227,772.50
	1,000 Ideas Program (TAI)	6 submissions	€874,873.50
	Clusters of Excellence	1 submission	€21,000,000.00
Total		65 submissions	€41,724,529.96
Board meetings		Project approvals	Funding amounts
88th Board Meeting, May 2022	ESPRIT Program	2 projects	€588,031.96
	Principal Investigator Projects	3 projects*	€1,331,387.37
89th Board Meeting, June 2022	ESPRIT Program	2 projects	€692,947.96
	Schrödinger Program	1 project	€185,340.00
	1,000 Ideas Program	2 projects	€303,577.84
90th Board Meeting, October 2022	Principal Investigator Projects	5 projects	€1,755,172.13
	ESPRIT Program	2 projects	€693,031.96
91st Board Meeting, November 2022	Schrödinger Program	1 project	€198,090.00
	Principal Investigator Projects	3 projects	€1,380,353.00
92nd Board Meeting, March 2023	ESPRIT Program	1 project	€294,015.98
	Principal Investigator Projects	1 project	€422,240.00
93rd Board Meeting, May 2023	Clusters of Excellence	1 project**	€12,000,000.00
	Principal Investigator Projects	2 projects	€811,985.31
95th Board Meeting, October 2023	Principal Investigator Projects	1 project	€236,859.06
96th Board Meeting, November 2023	Principal Investigator Projects	2 projects	€652,051.56
Approved projects and total funding		29 projects	€21,545,084.13
Total after withdrawal of funds* and supplementary approvals (for projects already approved)***		28 projects	€21,335,177.25

* One Principal Investigator Project was transferred to the German Research Foundation (DFG) in accordance with the money follows researcher rule; the associated funds were withdrawn
 ** Approved funding from Quantum Austria; balance is financed from the FWF budget.
 *** Supplementary approvals include, e.g., inflation adjustments and child allowances.

Summary of Calls up to and including 2023

Projects submitted	65
Total funding requested	€41.724m
Approved projects	28
Total approved project funding after withdrawal of funds and supplementary approvals (for projects already approved)	€21.335m

FWF funding decisions (up to 31/12/2023)

Approved projects and funding (after withdrawal of funds and supplementary approvals (for projects already approved))	28	€21,335,177.25
Principal Investigator Projects	16	€6,286,150.53
ESPRIT Program	7	€2,331,316.00
Schrödinger Program	2	€409,168.07
1,000 Ideas Program	2	€308,542.65
Clusters of Excellence	1	€12,000,000.00
Research institution of principal investigator*	Approved projects	Approved funding amount (incl. supplementary approvals)
Universities	26	€20,924,740.65
Austrian Academy of Sciences (ÖAW)	2	€590,038.87

* For Erwin Schrödinger Fellowships: institution of origin of the principal investigator in Austria.

Indicators according to the CID Annex (jointly for FFG and FWF)

A total of 49 future-oriented, transformative and innovative projects of basic and advanced research are receiving funding under the Quantum Austria initiative.

Element i	Number	Funding amount
Projects of basic research	28	€21,335,177.25
Projects of industrial research	10	€14,490,642.00
R&D infrastructure projects	11	€56,188,661.00
Total	49	€92,014,480.25

The projects are investing in 21 research infrastructures (including software development) and research collaborations, with the aim of expanding the knowledge base for the (further) development of quantum computing, quantum simulation, quantum communication, quantum optics, quantum sensor technology, quantum metrology and fundamental quantum developments. 59 projects** are establishing or developing technologies for the entire field of quantum science in the above areas, as well as quantum information.

Element ii	FFG projects	Funding amount	FWF projects**	Funding amount**
Quantum computing	9	€40,660,887*	7	€13,669,615.55
Quantum simulation	2	€3,550,862	10	€15,219,369.96
Quantum communication	4	€4,115,544	3	€12,558,728.63
Quantum optics	1	€3,999,626	9	€3,168,093.54
Quantum sensor technology	2	€6,109,983	4	€12,660,079.35
Quantum information			10	€15,272,043.96
Quantum metrology	1	€3,251,634		
Fundamental quantum developments	2	€8,990,767	16	€6,129,294.14
Total	21	€70,679,303	59	€78,677,225.13

* including HPC upgrade at €20m

** The basic research projects (FWF) include multiple assignments.

Quantum Austria was also able to strengthen cross-border cooperation with the following countries:

Element iii	Consortium partners in FFG projects	Collaborations in FWF projects
Australia		1
China		2
Germany	2	5
France	1	1
Great Britain		4
India		1
Ireland		1
Italy	1	3
Japan		1
Canada		2
New Zealand		1
Netherlands		1
Poland		1
Sweden		3
Switzerland	1	4
Slovenia	1	
Spain		3
USA		1
Total	6	35

With regard to cooperation with relevant European initiatives and projects, the FFG and FWF are also supervising applied research activities in the QuantERA program. Furthermore, the FFG supports Austrian stakeholders in European formats such as Quantum Flagship, Horizon Europe, the Digital Europe Program (including EuroQCI), and the Connecting Europe Facility. Special mention should be made of the European Chips Act, which was introduced in 2023. The associated Chips for Europe Initiative also promotes the development of quantum chips.

Budget

List of the approved funding amounts

Overview of the projects approved in the Quantum Austria initiative by the end of 2023:

Number of projects:

FFG: 21 projects (with 56 participations)

FWF: 8 projects (29 approved, 1 temporarily put aside)

Quantum Austria total: 49 projects

The detailed operational budget is shown in the tables in the previous section (Completed Calls). In 2023, the FFG paid out operational funding of EUR 11,084,471 to the funding recipients (first instalments for 10 projects); the

Overall situation on 31/12/2023

	Available funding (€ million)	Approved funding	Approval rate
FFG	77.00	70.68	91.79 %
FWF	23.04	21.34	92.62 %
Qu-AT total	100.04	92.02	91.98 %

remaining first instalments will be disbursed in the year 2024. The total funding paid out for 28 FWF projects in 2023 amounted to EUR 10,860,178.44.

Call implementation

The Call was implemented in accordance with the relevant guidelines and agreements, in particular the **Special Directive** (FFG) and the **1st Development Agreement for Quantum Austria 2021–2023** (FWF) and the 2nd Development Agreement on the Financing Agreement 2021-2023.

Both agencies use existing funding instruments to implement the Calls. Changes required due to the particular characteristics of the Quantum Austria initiative were laid out in the relevant Call guidelines. The Calls were implemented in accordance with the needs of the community, and the consulting services offered by both agencies were proactively communicated by means of information events. Individual consulting services were provided via various channels including telephone, email, video conferences, etc. The projects were selected according to the established processes in both agencies (**Funding Law and Finances** (FFG), **General Principles of the FWF Decision-Making Procedure**). Independent international experts are involved in the review process.

The funding decisions for FFG projects are made by the BMBWF, and for the FWF by the FWF Scientific Board.

The funding agreements for all FFG Calls closed by the end of 2023 were signed and the first instalments paid out as per the relevant guidelines. The first interim reports have already been submitted in 11 projects and 6 more are pending. The FFG examines the content of the interim reports and checks the submitted accounts. Further instalments will be paid following successful completion of these checks.

The funding agreements were signed and first funding amounts paid out to the 7 FWF projects approved in 2023. The annual accounts must be presented by 30/4/2024 or submitted as part of the annual financial report (as at the end of the calendar year) via the Austrian Federal Computing Center (BRZ) interface by April of the following year.

The FWF and FFG are working closely together to implement the funding initiative, and coordination meetings were held as required.

Following the decisions of the FWF Board, the projects were compared with those of the FFG in order to reveal any potential instances of multiple funding.

Outlook

In the first quarter of 2023 the FFG received a funding decision for another project (R&D Infrastructure instrument) from the BMBWF. This allowed the FFG to provide funding to all the projects on the reserve list from the first Call and to use the entire duration of the initiative.

As of 31/12/2023, funding agreements had been concluded for 21 FFG-projects, and all the projects have started. At the beginning of Q1/24, the first interim reports were submitted in 11 projects, and 6 more are pending.

Towards the end of 2023, an agreement was reached with the contracting entity BMBWF on how further use of the funds can be optimised in order to meet both the Quantum Austria objectives and the Recovery and Resilience Plan (RRP) under the European Union's NextGenerationEU program (2020–2026). Consequently, another Call was prepared and the 3rd Call with a focus on quantum

computing was launched on 21/12/2023. Six project proposals with 15 participations and a total funding volume of EUR 8.2 million were submitted by the 29/2/2024 submission deadline. The funding decision is expected in early Q2/24.

As of 31/12/2023, funding agreements had been concluded for 28 FWF-projects, and 27 projects have started.

A networking meeting organised by the FWF and FFG is also planned for 2024. This event for the community will exploit synergies by once again coinciding with the meeting of the Strategic Advisory Board this year.

In the course of 2024, an interim report on the status of the Quantum Austria initiative will be prepared, marking a further milestone in the RRP.

FUNDING INITIATIVE
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