Proposal Evaluation Form

EUROPEAN COMMISSION

Horizon Europe Framework Programme (HORIZON)

Evaluation Summary Report - Postdoctoral Fellowships

Call:	HORIZON-MSCA-2023-PF-01
Type of action:	HORIZON-TMA-MSCA-PF-EF
Proposal number:	101146634
Proposal acronym:	QuTrFI
Duration (months):	24
Proposal title:	Quantum Transport of Magnons in Ferromagnetic Insulators
Activity:	EF-PHY

N.	Proposer name	Country	Total eligible costs	%	Grant Requested	%
1	UNIVERSITEIT UTRECHT	NL	187,624.32	100.00%	187,624.32	100.00%
	Total:		187,624.32		187,624.32	

Abstract:

Magnons, the elementary excitations of magnetization, are promising as a solid-state quantum platform due to their versatile transduction properties, tunable non-linearity, scalability, and low losses. Quantum state generation of magnons has been discussed theoretically at length and demonstrated experimentally. While magnons excel in mm-scale classical energy transport, their suitability for quantum information transport is an open question. Quantum transport is vital for inter-node communication and entanglement generation. Such a prospect is bolstered by indirect evidence of long magnon coherence lengths in the form of demonstrations of sub-mm magnetic spheres as a high-quality magnonic cavity. This proposal aims to develop a quantum transport theory for magnons in ferromagnetic insulators like Yttrium Iron Garnet (YIG) and propose an experimental platform to assess the quantum coherence characteristics of magnons.

Recent experiments with magnetic spheres show that magnons can be probed and manipulated via a cavity quantum electrodynamics (cQED) setup, involving a superconducting transmon and a microwave cavity. To keep the theory closer to real experiments, I will model magnon-mediated communication between two cQED setups. This arrangement enables the excitation of both classical and non-classical magnon waves, which in turn helps to distinguish between classical and quantum magnon coherence lengths.

Formulating a quantum magnon transport theory is pivotal to validating the potential of magnetic insulators for local communication within quantum networks. As magnons couple with various systems including magnets, mechanical oscillators, and spin centers, this proposal advances the development of a more general quantum/wave computing model, where computational nodes communicate through magnetic films or wires.

Evaluation Summary Report

Evaluation Result

Total score: 88.00 % (Threshold: 70 /100.00)

Criterion 1 - Excellence

Score: **4.80** (Threshold: 0 / 5.00 , Weight: 50.00%)

• Quality and pertinence of the project's research and innovation objectives (and the extent to which they are ambitious, and go beyond the state of the art).
• Soundness of the proposed methodology (including interdisciplinary approaches, consideration of the gender dimension and other diversity aspects if relevant for the research project, and the quality of open science practices).
• Quality of the supervision, training and of the two-way transfer of knowledge between the researcher and the host
• Quality and appropriateness of the researcher's professional experience, competences and skills.

Strengths:

- The research and innovation objectives are of an excellent overall scientific quality, and address an important challenge in the actively developing magnonics subfield of spintronic technologies, important as a potential platform for quantum information processing. The specific objectives put forward in the proposal are well-motivated, clearly specified in a measurable and verifiable form, and are realistically achievable within the proposed time frame.

- The proposal is very ambitious and going far beyond the current state of the art. Namely, it aims to develop an advanced quantum transport theory of magnons in ferromagnetic insulators, fully including relevant microscopic decoherence mechanisms and long-range interactions, and capable of realistic predictions in an experimentally relevant setup, which would represent a substantial advancement in the field.

- The methodology is sound, relying on pertinent theoretical approaches suitable to reach the stated goals. Underlying concepts and models are comprehensively and convincingly explained, plausible ways to overcome arising challenges are proposed. The research actions are correctly framed with respect to the state-of-the-art, and efficiently fit the proposal objectives.

- The proposed research is intrinsically interdisciplinary, and properly combines the necessary expertise from physics of magnetism, open quantum systems, and quantum optics.

- Open science practices are implemented in a best possible way that perfectly fits the standards of the field and the nature of the proposal; this includes early sharing of research via a preprint server, and making relevant codes available on public repositories.

- The supervisor is one of the leading scientists in the field, with an excellent expertise on the topic, and an excellent track record including publications, attracted highly competitive funding, international collaboration, and advanced level supervision.

- The two-way transfer of knowledge between the researcher and the host is convincingly demonstrated in great detail. The expertise of the host in quantum transport in spin systems perfectly complements the expertise of the researcher in cavity optomagnonics, excellently fitting the project goals.

- The researcher's overall professional performance and existing scientific, technical, and soft skills, relative to their experience level, are excellent and perfectly fit the research proposal demands. The researcher has a very good track record in terms of publications, conference participation, and productive international collaborations, as well as an extensive experience in teaching and mentoring.

Weaknesses:

- A minor weakness is that the planned training activities for the researcher are not described in sufficient detail.

Criterion 2 - Impact

Score: **4.00** (Threshold: 0 / 5.00 , Weight: 30.00%)

• Credibility of the measures to enhance the career perspectives and employability of researchers and contribution to their skills development.
• Suitability and quality of the measures to maximise expected outcomes and impacts, as set out in the dissemination and exploitation plan, including communication activities.
• The magnitude and importance of the project's contribution to the expected scientific, societal and economic impacts.

Strengths:

- It is convincingly argued that scientific and management skills gained by the researcher during the proposed project, as well as the acquired collaboration network, will enable them to attract further funding on a larger scale and thus boost the researcher's independency, thereby enhancing their career perspectives, particularly in academia.

- The proposed dissemination strategy matches the standards of the field and efficiently targets academic peers and the scientific community; since the measures outlined are standard and meant for a narrow scope, this is only a moderately positive point.

- It is convincingly argued that the proposed research, enabling reliable predictions of magnon coherence time in realistic experimental setups, will have substantial long-lasting impact both on the computational and experimental aspects of magnonics, marking an important methodological progress in the field with potential relevance for quantum technologies. Economical impact is irrelevant for this proposal as it deals with basic science.

Weaknesses:

- The planned outreach activities lack diversity of communication channels and thus will be of limited efficiency for targeting the general audience.

- Although the proposed research is positioned as a theoretical effort specifically aimed at experimental applications, exploitation activities targeting potential users are not discussed in sufficient detail.

Criterion 3 - implementation

Score: **4.00** (Threshold: 0 / 5.00 , Weight: 20.00%)

• Quality and effectiveness of the work plan, assessment of risks and appropriateness of the effort assigned to work packages.
• Quality and capacity of the host institutions and participating organisations, including hosting arrangements.

Strengths:

- The work plan is properly structured into work packages and clearly formulated tasks. The deliverables and milestones are presented in a perfectly clear and measurable way, and allow for a proper monitoring of the progress.

- Research risks are properly identified, and proposed mitigation measures are reasonable and efficient.

- The overall quality of the research environment offered by the host is excellent.

- The infrastructure, logistics, and facilities offered by the host institution are of excellent quality, and are fully sufficient for the project implementation.

Weaknesses:

- Although a Gantt chart is included and correctly presents the timing and interdependencies of work packages, it does not properly reflect managing, training, and dissemination activities.

- Although the effort distribution between tasks is mostly appropriate, the duration of some tasks is too short to allow for effective completion of the objectives, some tasks are scheduled to run for only one month.

- Although the previous international experience of the researcher makes a smooth integration plausible, the planned measures for integration of the researcher and the scope of support services of the host are not discussed in sufficient detail.

Scope of the application

Status: **Yes**

Comments (in case the proposal is out of scope)

Not provided

Exceptional funding

A third country participant/international organisation not listed in the General Annex to the Main Work Programme may exceptionally receive funding if their participation is essential for carrying out the project (for instance due to outstanding expertise, access to unique know-how, access to research infrastructure, access to particular geographical environments, possibility to involve key partners in emerging markets, access to data, etc.). (For more information, see the HE programme guide)

Please list the concerned applicants and requested grant amount and explain the reasons why.

Based on the information provided, the following participants should receive exceptional funding:

Not provided

Based on the information provided, the following participants should NOT receive exceptional funding:

Not provided

Use of human embryonic stem cells (hESC)

Status: **No**

If YES, please state whether the use of hESC is, or is not, in your opinion, necessary to achieve the scientific objectives of the proposal and the reasons why. Alternatively, please state if it cannot be assessed whether the use of hESC is necessary or not, because of a lack of information.

Not provided

Use of human embryos

Status: **No**

If YES, please explain how the human embryos will be used in the project.

Not provided

Activities excluded from funding

Status: **No**

If YES, please explain.
Not provided

Do no significant harm principle

Status: **Not applicable**

If Partially/No/Cannot be assessed please explain
Not provided

Exclusive focus on civil applications

Status: **Yes**

If NO, please explain.
Not provided

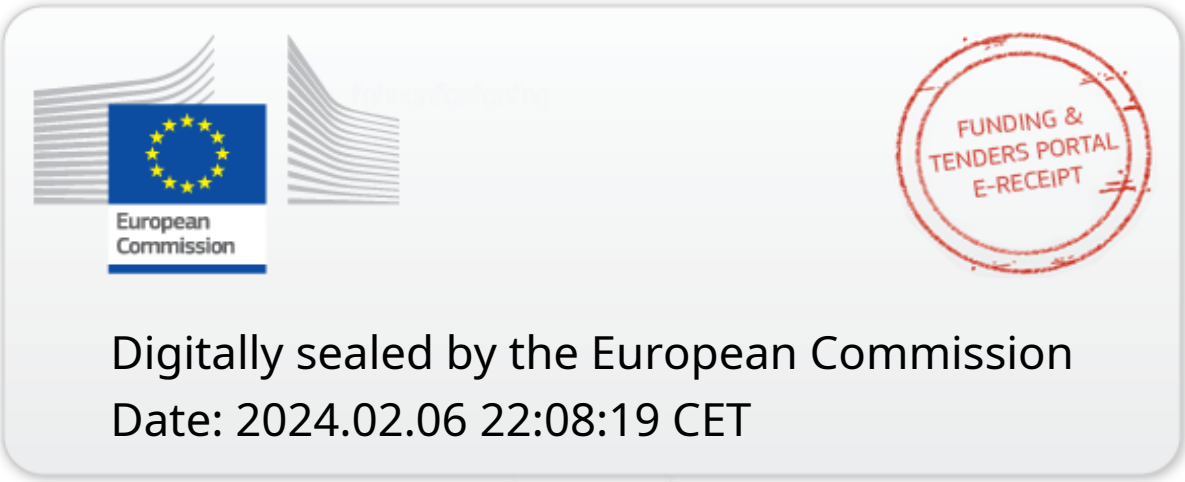
Artificial Intelligence

Status: **No**

If YES, the technical robustness of the proposed system must be evaluated under the appropriate criterion.

Overall comments

Not provided



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