To the ESS Instrument Proposal Committee,

I am writing to express my enthusiastic support for the proposed KVASIR backscattering neutron spectrometer at the European Spallation Source (ESS). The KVASIR concept addresses a critical gap in current neutron instrumentation by providing simultaneous high resolution in both energy and momentum transfer, specifically optimized for small single-crystal samples.

The uniqueness of KVASIR lies in its ability to achieve energy resolutions on the order of a few μeV alongside a momentum resolution of approximately 0.03 $Å^{-1}$. This capability is transformative for functional materials research. By enabling the precise observation of low-energy excitations within complex crystal lattices, KVASIR will allow researchers to disentangle intricate dynamic processes that are currently overlapping or inaccessible. Its design facilitates the study of subtle atomic-scale motions and long-period structural dynamics, which are fundamental to understanding the macroscopic properties of advanced materials.

My own research focuses on the dynamics of energy-related materials, specifically Li-ion conductors. In these systems, the μeV to sub-meV energy range contains crucial information regarding both the hopping mechanisms of mobile ions and the underlying lattice dynamics of the framework. KVASIR will provide the unprecedented experimental capability required to resolve these features across a wide range of momentum transfer. This high-resolution data is essential for developing a microscopic understanding of ionic diffusion pathways, which directly informs the design of next-generation solid-state batteries.

I believe KVASIR will become an indispensable tool for the international condensed matter community. I strongly urge the committee to support its construction as a flagship instrument for the ESS.

Sincerely,

Masato Matsuura

Research and Development Division, Neutron Science and Technology Center

Comprehensive Research Organization for Science and Society (CROSS), Japan

Laboratory for Quantum Magnetism - LQM
Faculty of Basic Sciences - FSB

ESS Instrument Proposal Committee

Lausanne, March 24, 2026

To the ESS Instrument Proposal Committee,

I would like to express my strong support for the proposed **KVASIR** backscattering spectrometer at the European Spallation Source.

The KVASIR concept fills a clear and important niche within the ESS instrument suite. Its combination of µeV energy resolution with well-defined momentum resolution represents a capability that is presently only accessible in a very limited way worldwide, and not for small single-crystal samples under realistic experimental conditions. The targeted performance—energy resolution in the few µeV range and momentum resolution on the order of 0.03 $Å^{-1}$—together with compatibility with complex sample environments, will substantially extend what can be measured in practice, rather than merely improving existing benchmarks.

From a scientific perspective, KVASIR will enable direct access to low-energy excitations that are central to a wide range of problems in condensed matter physics. This includes quantum magnets, strongly correlated electron systems, and functional materials where the relevant dynamics occur on µeV to sub-meV energy scales and over finite momentum ranges. These regimes are currently difficult to probe in a unified manner, and the ability to do so with a single instrument will open qualitatively new experimental approaches. In particular, the possibility to combine high resolution in both energy and momentum with external tuning parameters such as magnetic field, pressure, or temperature is likely to be transformative for the study of emergent phenomena.

Besides many experiments on quantum spin models, strongly correlated electron materials and unconventional superconductors, my research collaborators and I would use KVASIR to study coherent entanglement between localized spin qubits and collective excitations.

Localized rare-earth spin states—whether electronic, nuclear, or electronuclear in nature—are increasingly recognized as promising building blocks for quantum technologies, both for quantum memory and for transduction between microwave and optical domains. Rare-earth ions provide a unique platform due to their narrow optical transitions and long-lived spin degrees of freedom. More recently, the prospect of universal quantum computing based on erbium ions has been articulated, highlighting the potential of rare-earth systems as scalable quantum platforms. A key limitation, however, remains the weak coupling strength and low quantum efficiency of individual ions. This has led to growing interest in hybrid approaches where localized spin qubits are coupled to collective excitations—such as magnons or electronuclear spin waves—which can act as coherent mediators and amplifiers. In systems with strong hyperfine interactions, this gives rise to entangled electron–nuclear spin excitations with characteristic energies in the µeV (GHz) range. A detailed understanding of these collective electronuclear modes, including their dispersion, coherence, and response to external microwave or optical driving, is currently limited by experimental constraints. KVASIR, with its combination of µeV energy resolution and finite momentum resolution, will provide precisely the capability needed to map these excitations in reciprocal space and to establish their role in quantum-coherent phenomena.

École polytechnique fédérale de Lausanne

LQM - Laboratory for Quantum Magnetism

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In this sense, KVASIR is not only a natural addition to the ESS instrument portfolio, but a necessary one. It will provide access to a regime of energy and length scales that is central to many contemporary research directions, and which is presently underexplored due to instrumental constraints.

I therefore strongly support the realization of KVASIR and am convinced that it will become a key instrument for the international user community.

Do not hesitate to contact me should any further information be desired.

Prof. Henrik M. Rønnow
Head of Laboratory for Quantum Magnetism
Director of Institute of Physics – IPHYS
École Polytechnique Fédérale de Lausanne

To the ESS Instrument Proposal Committee,

I, Frederic Bourdarot, scientific director at Commissariat à l'Energie Atomique et aux Energies Alternatives and scientific manager of IN22, thermal triple-axis at ILL, am writing to express my strong support for the proposed KVASIR backscattering neutron spectrometer for the European Spallation Source (ESS).

The KVASIR concept will bring a new instrumental element to the study of low- and medium-energy transfer excitations with high q and energy resolution, making it particularly unique. As described in the instrument concept paper, KVASIR aims to study small single crystals with energy resolutions on the order of a few μeV together with a momentum resolution of approximately 0.03 $\text{Å}^{-1}$, while maintaining the flexibility to accommodate demanding sample environments. These capabilities will enable unprecedented studies of low-lying excitations in single hard condensed matter systems.

In particular, the instrument will be uniquely suited for investigating quantum magnetic materials, correlated electron systems, and functional materials for which key dynamics occur in the μeV to sub-meV energy range, the spatial scale of which are very difficult to access with current instrumentation. The combination of high energy and spatial resolution and the possibility to perform experiments under strong magnetic fields or other extreme conditions will open new avenues for exploring emergent quantum phenomena.

From the perspective of my scientific interestest in the study of unconventional superconductivity, strongly correlated electron systems or magnon-phonon coupling in thermoelectric compounds, KVASIR would provide exactly the type of experimental capability required to address these challenges at ESS.

I therefore strongly support the development of the KVASIR instrument and believe it will become an essential tool for the international condensed matter physics community.

Sincerely,

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Grenoble, March 27th, 2026

To the ESS Instrument Proposal Committee,

Support to the KVASIR instrument project

I am writing to express my strong support for the proposed KVASIR backscattering neutron spectrometer for the European Spallation Source (ESS).

The KVASIR concept addresses an important gap in the current instrumentation landscape by providing simultaneous high resolution in both energy and momentum transfer. As described in the instrument concept paper, KVASIR aims to study small single crystals with energy resolutions on the order of a few μeV together with a momentum resolution of approximately 0.03 $Å^{-1}$, while maintaining the flexibility to accommodate demanding sample environments. These capabilities will enable unprecedented studies of low-lying excitations in single hard condensed matter systems.

In particular, the instrument will be uniquely suited for investigating quantum magnetic materials, correlated electron systems, and functional materials for which key dynamics occur in the μeV to sub-meV energy range, the spatial scale of which are very difficult to access with current instrumentation. The combination of high energy and spatial resolution and the possibility to perform experiments under strong magnetic fields or other extreme conditions, also including the possible use of polarized neutrons, will open new avenues for exploring emergent quantum phenomena.

From the perspective of my scientific interests, I am studying magnetic materials, in the fields of quantum magnetism, multiferroism, frustrated magnetism, topological matter. In these materials, the understanding of their unique properties is elucidated in particular through their peculiar excitations (standard magnons but also fractional excitations such as spinons or magnetic monopoles). Those often appear in the low energy range and their measurements using inelastic neutron scattering and their analysis as a function of wavevector and energy is a fundamental step to identify the ingredients at the origin of quantum matter peculiar properties.

KVASIR would provide exactly the type of experimental capability required to address these challenges at ESS.

I therefore strongly support the development of the KVASIR instrument and believe it will become an essential tool for the international condensed matter physics community.

Sincerely,

Virginie SIMONET

**Prof. Tatiana Guidi**
Physics Division,
School of Science and Technology,
University of Camerino,
Camerino (MC) I-62032, Italy
*Direct line*: +39 0737402509
*Email*: tatiana.guidi@unicam.it

To the ESS Instrument Proposal Committee,

I am writing to express my strong support for the proposed KVASIR backscattering neutron spectrometer for the European Spallation Source (ESS).

The KVASIR concept addresses an important gap in the current instrumentation landscape by providing simultaneous high resolution in both energy and momentum transfer. As described in the instrument concept paper, KVASIR aims to study small single crystals with energy resolutions on the order of a few μeV together with a momentum resolution of approximately 0.03 $Å^{-1}$, while maintaining the flexibility to accommodate demanding sample environments. These capabilities will enable unprecedented studies of low-lying excitations in single hard condensed matter systems.

In particular, the instrument will be uniquely suited for investigating quantum magnetic materials, correlated electron systems, and functional materials for which key dynamics occur in the μeV to sub-meV energy range, the spatial scale of which are very difficult to access with current instrumentation. The combination of high energy and spatial resolution and the possibility to perform experiments under strong magnetic fields or other extreme conditions will open new avenues for exploring emergent quantum phenomena.

From the perspective of my research on spin excitations in molecular magnets, KVASIR provides the ideal energy range and resolution to investigate the low-lying, non-dispersive excitations typical of transition-metal clusters. The instrument's broad Q-range will allow for a detailed mapping of the Q-dependence of well-resolved spin excitations, providing a unique 'fingerprint' of the spin Hamiltonian wavefunctions. Furthermore, the availability of high magnetic fields will enable to drive the system into coherent superpositions or entangled states, allowing for a precise study of their evolution. This combination of high field and high resolution offers a new exciting opportunity for our community. Furthermore, the synthesis of large single crystals of molecular magnets is generally a challenge and often in experiments the resolution has been sacrificed for flux. KVASIR would provide exactly the type of experimental capability required to address these challenges at ESS.

I therefore strongly support the development of the KVASIR instrument and believe it will become an essential tool for the international condensed matter physics community.

Sincerely,

Tatiana Guidi

**Prof. Tatiana Guidi**
School of Science and Technology,
University of Camerino

INSTITUT MAX VON LAUE - PAUL LANGEVIN

NEUTRONS FOR SCIENCE

Dr. Martin Boehm
Institut Laue-Langevin
Science Division/ Head of the Spectroscopy Group
boehm@ill.fr
+33 4 76 20 71 10

27 March 2026 in Grenoble, France

**Subject:** Letter of support for the ESS instrument project Kvasir

To the ESS Instrument Proposal Committee,

I am writing to express my strong support for the proposed KVASIR backscattering neutron spectrometer for the European Spallation Source (ESS).

The KVASIR concept addresses an important gap in the current instrumentation landscape by providing simultaneous high resolution in both energy and momentum transfer. As described in the instrument concept paper, KVASIR aims to study small single crystals with energy resolutions on the order of a few μeV together with a momentum resolution of approximately 0.03 $Å^{-1}$, while maintaining the flexibility to accommodate demanding sample environments. These capabilities will enable unprecedented studies of low-lying excitations in single-crystal systems.

In particular, single-crystal neutron spectroscopy combining very high energy resolution with medium momentum resolution is expected to have a strong impact in the study of quantum and functional materials. This includes systems such as magnetic skyrmions, where collective excitations occur at very low energies, as well as investigations of magnetic anisotropies, softening of excitation spectra, and other subtle features of emergent behavior. Access to this regime is essential for understanding the microscopic dynamics governing these systems.

I strongly support the KVASIR project and believe it will become a key instrument for the international neutron scattering community.

Yours sincerely

Martin Boehm

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SPECTROSCO...

**Dr Siân Dutton**
*Professor in Physics and Solid State Chemistry,*
*Director Winton Programme for the Physics of Sustainability*
*Department of Physics*

UNIVERSITY OF CAMBRIDGE
Cavendish Laboratory

13 March 2026

**Letter in support of KVASIR Instrument**
**ESS Instrument Proposal Committee**

To the ESS Instrument Proposal Committee,

I am writing to express my strong support for the proposed KVASIR backscattering neutron spectrometer for the European Spallation Source (ESS).

The KVASIR concept addresses an important gap in the current instrumentation landscape by providing simultaneous high resolution in both energy and momentum transfer. As described in the instrument concept paper, KVASIR aims to study small single crystals with energy resolutions on the order of a few μeV together with a momentum resolution of approximately 0.03 $Å^{-1}$, while maintaining the flexibility to accommodate demanding sample environments. These capabilities will enable unprecedented studies of low-lying excitations in single hard condensed matter systems.

In particular, the instrument will be uniquely suited for investigating quantum magnetic materials, correlated electron systems, and functional materials for which key dynamics occur in the μeV to sub-meV energy range, the spatial scale of which are very difficult to access with current instrumentation. The combination of high energy and spatial resolution and the possibility to perform experiments under strong magnetic fields or other extreme conditions will open new avenues for exploring emergent quantum phenomena.

From the perspective of my scientific interest the concept is very exciting and would greatly expand the range of materials that can be studied. My own work focuses primarily on the study of polycrystalline powders since preparation of large crystals suitable for neutron studies is challenging and time consuming. The KVANSIR concept with the ability to measure small samples will allow us to explore in more detail multiple systems. Coupling this with high magnetic fields is opens opportunities for our work on magnetocaloric as we would be able to directly observe the changes in magnetism which give rise to the magnetocaloric effect allowing for a more detailed understanding of the phenomena. The possibility of measurements under pressure or in-situ electrochemical

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measurements are also of interest for ongoing projects on magnetoelectric coupling and next generation battery cathodes.

KVASIR would provide exactly the type of experimental capability required to address these challenges at ESS.

I therefore strongly support the development of the KVASIR instrument and believe it will become an essential tool for the international condensed matter physics community.

Sincerely,

Siân Dutton



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26 March 2026

**To the ESS Instrument Proposal Committee**,

I am writing to express my strong support for the proposed KVASIR backscattering neutron spectrometer for the European Spallation Source (ESS).

The KVASIR concept addresses an important gap in the current instrumentation landscape by providing simultaneous high resolution in both energy and momentum transfer. As described in the instrument concept paper, KVASIR aims to study small single crystal samples with energy resolutions on the order of a few μeV together with a momentum resolution of approximately 0.03 $Å^{-1}$, while maintaining the flexibility to accommodate demanding sample environments. These capabilities will enable unprecedented studies of low-energy excitations of single crystals of hard condensed matter systems.

In particular, the instrument will be uniquely suited for investigating quantum magnetic materials, correlated electron systems, and functional materials for which key dynamics occur in the μeV to sub-meV energy range, the spatial scale of which are very difficult to access with current instrumentation. The combination of high energy and spatial resolution and the possibility to perform experiments under strong magnetic fields or other extreme conditions will open new avenues for exploring emergent quantum phenomena.

Over the years I have extensively used time-of-flight cold neutron spectroscopy for research projects in quantum magnetism, including the first experimental realization in the laboratory of quantum criticality in an Ising chain in transverse field and observation of its universal E8 spectrum near criticality, development of a generic method combing neutron spectroscopy and high magnetic fields to quantitatively determine spin Hamiltonians -- now widely used in the quantum magnetism community, studies of spinon excitations and bound state formation in quantum magnets, studies of spin-orbital quantum criticality, order-by-disorder induced by spin-orbital fluctuations and the experimental manifestation of topological magnetic quasiparticles.

I am particularly excited by the prospect of the KVASIR spectrometer being able to explore the spectrum of small single crystals with really fantastic resolution in both momentum and energy and in the presence of extreme sample environments, requirements which have been a major limiting factor in my selection of scientific projects that I have developed in my career so far. Many projects that I had deemed very promising scientifically in quantum criticality and frustrated quantum magnetism I had to in the end not pursue due to a combination of 1) the momentum and/or energy resolution of available spectrometers was not sufficient to permit access to the region of interest, 2) it was technically not feasible to obtain large enough single crystals to get a strong enough signal with current instruments to allow a detailed quantitative study (all our quantitative studies so far have required single crystal samples of more than 5 grams, which is a very tall order !), 3) accessing high resolution conditions and extreme sample environment has not been feasible. From this perspective KVASIR would provide exactly the type of experimental capability required to fill this gap and address these challenges at ESS.

Therefore, I strongly support the development of the KVASIR instrument and believe it will become an essential tool for the international condensed matter physics community and I look forward to be among the first users of this exciting new instrument at the ESS.

Sincerely,

Radu Coldea
Professor of Physics
Fellow of the American Physical Society

Technische Universität München | Am Coulombwall 3A | 85748 Garching b. München | School of Natural Sciences | Department of Physics

Morges, 23rd of March 2026

Dear Evaluation Committe,

I am excited about the neutron backscattering spectrometer, KVASIR, proposed for the next round of instruments at the ESS.

This instrument provides not only excellent energy resolution but also very high resolution in Q, a combination which is currently not offered at the ESS. This comes together with an optimized signal-to-noise ratio and the flexibility to employ different kinds of sample environments such as pressure cells, magnets and dilution refrigerators.

KVASIR is therefore a very interesting concept in my line of research, in particular with respect to high-pressure and high-magnetic-field studies of quantum spin-liquid candidate materials. They typically display complex magnetic excitation spectra at very low energy transfers. This together with their weak magnetic moments and disordered nature calls for high energy and Q resolutions as well as low background. To control their magnetic ground state and to compare with model predictions, extreme conditions of low temperatures, high pressures and high magnetic fields are needed. All of this is provided by KVASIR.

For these reasons, I believe that KVASIR will be a gamechanger in the field of quantum magnetism and I truly hope to see this instrument built at the ESS.

Yours sincerely,

Prof. Dr. Ellen Fogh

Chair of Quantum Magnetism
Center for QuantumEngineering
Department of Physics
School of Natural Sciences
Technical University of Munich

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Grenoble, FRANCE
March 27, 2026

To the ESS Instrument Proposal Committee

**Subject: LETTER OF SUPPORT for the KVASIR backscattering neutron spectrometer**

I am writing to express my strong support for the proposed KVASIR backscattering neutron spectrometer for the European Spallation Source (ESS).

The KVASIR concept addresses an important gap in the current instrumentation landscape by providing simultaneous high resolution in both energy and momentum transfer. As described in the instrument concept paper, KVASIR aims to study small single crystals with energy resolutions on the order of a few µeV together with a momentum resolution of approximately 0.03 $Å^{-1}$, while maintaining the flexibility to accommodate demanding sample environments. These capabilities will enable unprecedented studies of low-lying excitations in single hard condensed matter systems.

In particular, the instrument will be uniquely suited for investigating quantum magnetic materials, correlated electron systems, and functional materials for which key dynamics occur in the µeV to sub-meV energy range, the spatial scale of which are very difficult to access with current instrumentation. The combination of high energy and spatial resolution and the possibility to perform experiments under strong magnetic fields or other extreme conditions will open new avenues for exploring emergent quantum phenomena.

This is especially true from the perspective of my scientific interest in quantum frustrated magnetism, where we are looking for emergent excitations in quantum spin liquids which are characterized by very low energy and can be observed only at very low temperatures, a prominent example being the emergent photon on quantum spin ice. A very high resolution is thus crucial to detect these excitations, and validate the quantum condensed matter theories that predict them. KVASIR would provide exactly the type of experimental capability required to address these challenges at ESS.

I therefore strongly support the development of the KVASIR instrument and believe it will become an essential tool for the international condensed matter physics community.

Yours sincerely,

Elsa LHOTEL

*Montpellier/Saclay, 25th of March 2026*

[*federation.neutron@neel.cnrs.fr*](mailto:federation.neutron@neel.cnrs.fr)
[*https://2fdn.cnrs.fr/en*](https://2fdn.cnrs.fr/en)

To the European Spallation Source Instrument Proposal Committee:

The French Federation for Neutron Scattering (2FDN) strongly supports the proposed KVASIR backscattering neutron spectrometer as a new instrument for the user community within the upcoming ESS instrument suite.

Owing to its innovative concept, KVASIR is expected to hold a leading position at the international level and play a pivotal role in advancing investigations of hard condensed matter and inorganic chemistry. Indeed, KVASIR addresses a critical gap in the current instrumentation landscape by delivering simultaneously excellent resolution in both energy and momentum transfer, surpassing current state-of-the-art capabilities.

As described in the instrument concept paper, KVASIR aims to study millimeter-sized single crystals with high energy resolution on the order of a few μeV, combined with a momentum resolution of approximately 0.03 $Å^{-1}$. This unique combination represents a major breakthrough in neutron spectroscopy. At the same time, the instrument will maintain the flexibility to accommodate extreme sample environments such as high magnetic fields, high pressure, dilution fridges, and will offer prospects for polarization analysis. These capabilities will enable unprecedented studies of low-lying excitations in hard condensed matter systems, while also allowing investigations of higher energy transfers with resolutions on the order of tens of μeV.

KVASIR will be uniquely suited for investigating quantum magnetic materials, correlated electron systems, energy and functional materials for which key dynamics occur in the μeV to sub-meV energy range while offering high Q-resolution, a dynamic range which remains largely unexplored due to technical challenges with current instrumentation. The combination of high energy and spatial resolution, and the possibility to perform experiments under external perturbations, such as strong magnetic fields or other extreme conditions will open new avenues for exploring emergent quantum phenomena.

The research conducted by the French hard matter neutron community covers a wide range of scientific cases that fall into the scope of the capabilities offered by KVASIR. The scientific cases include: low-dimensional magnets, quantum spin liquids, frustrated magnets, altermagnetism, high temperature superconductivity, topological materials, molecular magnets, skyrmionics lattices and other topological textures, multiferroics and a variety of functional materials such as magnetocalorics, and magnetic heat conductors. In many of these examples, magnetic anisotropies, dipolar interactions, exotic magnetic states involving higher order multipoles, peculiar symmetry properties, or doping induce low-energy features such as slow dynamics, sub-meV magnetic excitations (pseudo)gaps, as well as magnon splittings that require pushing the limits of existing instruments. KVASIR will overcome these limitations, enabling detailed exploration of the μeV to sub-meV energy range across a wide Q-range, providing a more complete description of the magnetic spectrum and subtle interactions and their evolutions under external perturbations, which will likely lead to the discovery of new phenomena that have so far remained hidden due to experimental constraints.

For all these reasons, the 2FDN thus strongly supports the implementation of KVASIR in the upcoming ESS instrumental suite.

Sincerely yours,

Julian Oberdisse　　　　Dalila Bounoua
*Directors of the French « Fédération Française de Diffusion Neutronique » (2FDN)*

To the ESS Instrument Proposal Committee,

I am writing to express my strong support for the proposed KVASIR backscattering neutron spectrometer for the European Spallation Source (ESS).

The KVASIR concept addresses an important gap in the current instrumentation landscape by providing simultaneous high resolution in both energy and momentum transfer. As described in the instrument concept paper, KVASIR aims to study small single crystals with energy resolutions on the order of a few μeV together with a momentum resolution of approximately 0.03 $\text{Å}^{-1}$, while maintaining the flexibility to accommodate demanding sample environments. These capabilities will enable unprecedented studies of low-lying excitations in single hard condensed matter systems.

In particular, the instrument will be uniquely suited for investigating quantum magnetic materials, correlated electron systems, and functional materials for which key dynamics occur in the μeV to sub-meV energy range, the spatial scale of which are very difficult to access with current instrumentation. The combination of high energy and spatial resolution and the possibility to perform experiments under strong magnetic fields or other extreme conditions will open new avenues for exploring emergent quantum phenomena.

From the perspective of my scientific interest there are several design aspects of the proposed instrument that would make this an extremely useful avenue for providing a unique view into the physics of strongly correlated electron systems. The simultaneous high resolutions in energy and momentum transfer will, -in my experience, place this instrument in a league of its own. The capability to study small single crystals is going to make this an attractive instrument in a field where limited physical dimensions and tiny single-crystal sample material is all too often a fact of life in the synthesis and procurement of research samples. Further, the targeted very low-energy dynamic range is going to be an extremely valuable attribute in the study of quantum criticality which has been a subject at the bleeding edge of condensed matter physics, and is sure to remain so for the foreseeable future. I envisage that the proposed KVASIR is going to be an instrument that sets the pace at the ESS and as a leading example for neutron facilities other than the ESS as well, for research into phenomena at and near equilibrium of phase formation and transition.

KVASIR at ESS would provide precisely the design of experimental capability required to address many of the experimental challenges posed by my field of research.

I therefore strongly support the development of the KVASIR instrument and believe it will become an essential tool for the international condensed matter physics community.

Sincerely,

André M. Strydom.
Professor of Physics, University of Johannesburg, South Africa.
March 25, 2026.

OKINAWA INSTITUTE
OF SCIENCE AND TECHNOLOGY
GRADUATE UNIVERSITY

Prof. Nic Shannon
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27th March 2026

To the ESS Instrument Proposal Committee,

**Proposal to build KVASIR backscattering neutron spectrometer at ESS**

I am writing to express my strong support for for the proposal to build the KVASIR backscattering neutron spectrometer at ESS.

Much of the most exciting science of our times revolves around the attempt to characterize and manipulate quantum states. Quantum processors have now reached the point where it is possible to contemplate entangling hundreds of qubits. In quantum magnets, at comparable temperatures, billions of spins may be entangled, making them a precious resource as we seek to learn how to build a quantum computer.

Inelastic neutron scattering remains the tool of choice for unlocking the secrets of the entanglement found in quantum magnets. And in recent years, back-scattering spectrometers, capable of charaterizing spin dynamics at low energies, have played a crucial role in rolling back this frontier. The many successes of this approach include the first hints of the emergent photons of quantum spin ice, and the ability to resolve the $\omega/T$ scaling associated with quantum criticality.

The proposed KVASIR backscattering neutron spectrometer would be an invaluable addition to the instruments already available, extending capabilities in momentum resolution and sample environment. It also speaks to the particular strengths of ESS, since high neutron flux makes it practical to use polarization analysis on a routine basis, to separate quantum signal from incoherent, classical noise. The ability to study samples in applied magnetic field also enhances the value of the instrument, since this makes it possible to tune between different quantum phases, and through quantum critical points.

For all of these reasons, KVASIR could be a game-changing instrument, and it would be exciting to see it built at ESS. Please feel free to contact me if you wish to discuss the related science further.

sincerely,

nic shannon

Helmholtz-Zentrum Berlin für Materialien und Energie GmbH | Hahn-Meitner-Platz 1 | 14109 Berlin

**European Spallation**
**Source Instrument**
**Proposal Committee**

**Prof Bella Lake**
**Quantum Phenomena in Novel**
**Materials QM-IQM**
Hahn-Meitner-Platz 1
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Berlin 19th March 2026

**Letter of support for the KVASIR backscattering neutron spectrometer**

To the ESS Instrument Proposal Committee,

Please accept this letter of support for the KVASIR backscattering neutron spectrometer proposed for the European Spallation Source. KVASIR is a exceptional instrument in that it is able to simultaneously provide both ultra high energy resolution (3-6 μeV) and a good wavevector resolution (0.03 $Å^{-1}$) achieving a truly unique capability and thus occupying a currently unfilled niche within the suite of neutron instruments. It is ideally matched to the study of low energy excitations in single crystal samples. At the same time the sample space has been designed to accommodate complex and bulky sample environments providing the possibility to explore multi-dimensional phase diagrams.

From the perspective of my scientific interest which is quantum magnetism, I am very excited by KVASIR. Quantum magnets typically have low energy scales requiring high energy resolution and milliKelvin temperatures (dilution refrigerator) while their spectra form complex and distinctive patterns as a function of wavevector requiring good wavevector resolution. Furthermore, the states of quantum magnets can be manipulated by magnetic field and pressure thus combinations of sample environments are needed. KVASIR would provide exactly the type of experimental capability required to address these challenges.

I strongly support the development of the KVASIR instrument and believe it will become an essential tool for the international condensed matter physics community.

Sincerely,

Bella Lake

Bella Lake

To the ESS Instrument Proposal Committee,

I am writing to express my strong support for the proposed KVASIR backscattering neutron spectrometer for the European Spallation Source (ESS).

The KVASIR concept addresses an important gap in the current instrumentation landscape by providing simultaneous high resolution in both energy and momentum transfer. As described in the instrument concept paper, KVASIR aims to study small single crystals with energy resolutions on the order of a few μeV together with a momentum resolution of approximately 0.03 $Å^{-1}$, while maintaining the flexibility to accommodate demanding sample environments. These capabilities will enable unprecedented studies of low-lying excitations in single hard condensed matter systems.

In particular, the instrument will be uniquely suited for investigating quantum magnetic materials, correlated electron systems, and functional materials for which key dynamics occur in the μeV to sub-meV energy range, the spatial scale of which are very difficult to access with current instrumentation. The combination of high energy and spatial resolution and the possibility to perform experiments under strong magnetic fields or other extreme conditions will open new avenues for exploring emergent quantum phenomena.

From the perspective of my scientific interestest, i.e. studies of local structure and dynamics in functional – mostly energy relevant materials, such as solid-state ionic conductors, KVASIR will, for example, allow for studies of low-energy dynamics, such as overdamped and anharmoic vibrational dynamics and its relationship to even-lower-energy dynamics such as ion diffusion. Crucially, KVASIR will be designed for studies of single crystal samples, for which there is a lack of neutron scattering studies (and understanding) of solid-state ionic conductors. Hence, KVASIR shows to potential to advance the field of these types of technologically important materials, and I therefore support this application strongly.

Sincerely,

Maths Karlsson

2026-03-25

Maths Karlsson, Professor
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To the
**ESS Instrument Proposal Committee**

Dresden, 16th March 2026

**Letter of support for the ESS instrument concept KVASIR**

I am writing to express my strongest support for the proposed KVASIR backscattering neutron spectrometer for the European Spallation Source (ESS). The KVASIR concept addresses an important gap in the current instrumentation landscape by simultaneously providing high resolution in both energy and momentum transfer. As described in the instrument concept paper, KVASIR aims to study small single crystals with energy resolutions on the order of 5 μeV together with a momentum resolution of approximately 0.03 Å$^{-1}$, while maintaining the flexibility to accommodate demanding sample environments. These capabilities will enable unprecedented studies of low-lying excitations in single crystals. In particular, the instrument will be uniquely suited for investigating quantum magnetic materials, correlated electron systems, and functional materials for which key dynamics occur in the μeV to sub-meV energy range, the spatial scale of which are very difficult to access with current instrumentation. The combination of high energy and spatial resolution and the possibility to perform experiments under strong magnetic fields or other extreme conditions will open new avenues for exploring emergent quantum phenomena.

From the perspective of my scientific interests, this instrument would enable us to measure very small anisotropy gaps in magnetic materials close to the Heisenberg limit, as well as help resolve helimagnon bands in systems with chiral order or multi-**q** textures such as skyrmion lattices. Up to now, our attempts to resolve these excitations using existing backscattering instruments such as IN16B at ILL proved unfeasible because of insufficient momentum resolution. Furthermore, this instrument would allow us to measure very small (a few μeV) splittings of localized excitations, such as crystal electric field lines, and thereby directly evidence minute structural distortions or hidden order parameters that may lead to slightly nonequivalent environment of the magnetic ions [see, for example, T. Han *et al.*, arXiv:2511.07606]. Furthermore, research in the current hot topic of altermagnetism with neutron spectroscopy heavily relies on the observation of a small "chiral" splitting of magnon bands, resolving which at low energies should also be facilitated by an instrument such as KVASIR. Last but not least, KVASIR in combination with a dilution refrigerator should enable access to spin-wave dispersions in very weakly interacting materials such as Tutton salts, which order at subkelvin temperatures and possess sub-meV magnon band widths. Measurements of their dispersions are not feasible with existing instruments, yet probing spin-wave excitations in such systems would enable us to quantitatively estimate weak super-super-exchange interactions that act between magnetic ions via long superexchange paths and over long distances, possibly revealing new physics. An improvement of energy resolution is also strongly desirable for studies of quantum-critical phenomena. Dilution refrigerators routinely available as sample environment for neutron scattering can cool samples down to $\sim$20 mK, which corresponds to 1.7 µeV in energy units, yet none of the existing spectrometers can match this energy in terms of the resolution in energy transfer without sacrificing resolution in momentum space. KVASIR would essentially close this gap and thereby provide exactly the type of experimental capability required to address all of the mentioned challenges at ESS.

I therefore strongly support the development of the KVASIR instrument and believe it will become an essential tool for the international condensed matter physics community.

Sincerely,

Prof. Dr. Dmytro Inosov.

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MODÉLISATION,
EXPLORATION DES MATÉRIAUX

Direction de la Recherche Fondamentale

IRIG / MEM / Laboratoire de Magnétisme et Diffraction Neutronique

UNIVERSITÉ Grenoble Alpes

Dr. Stéphane Raymond, research director at CEA

Grenoble, March 27th 2026

**Support letter for the backscattering instrument KVASIR at ESS**

I am expressing my strong support for the KVASIR backscattering neutron spectrometer project at the European Spallation Source. The instrument will cover a wide range of energies and momentum transfers with very good energy resolution. This new combination of experimental conditions, together with the high flux of ESS will allow new routes for single crystal investigations of quantum and functional materials and especially for small samples of new materials.

In the field of study of 4*f* and 5*f* correlated electron systems ("heavy fermions" compounds), where the characteristic energy scale is inversely proportional to the correlations strength, the access to lower energies and resolution than the usually investigated ones by more than an order of magnitude could lead to significant new developments. For quantum critical systems, increasing the investigated dynamical range will allow to test scaling hypothesis in new regimes, and more generally to address changes of the spin dynamics at different cross-overs in the quantum critical phase diagram. In unconventional superconductors, it will allow to study the resonance (feedback of the superconductivity on the magnetic excitation spectrum) in systems with much lower superconducting transition temperatures (around 300 mK versus 600 mK nowadays) with promising systems (e.g. non-centrosymmetric cerium-based superconductors).

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MODÉLISATION,
EXPLORATION DES MATÉRIAUX

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Direction de la Recherche Fondamentale

IRIG / MEM / Laboratoire de Magnétisme et Diffraction Neutronique

Access to high magnetic field and high pressure will allow to tune the competition/collaboration between magnetism and superconductivity in such *f*-electron systems that are very responsive to field of about 10 T and pressure of about 1 GPa, thanks to their low energy scales of a few Kelvin at most. Of particular interest are the fascinating uranium-based triplet superconductors, where superconductivity is enhanced under magnetic field.

More generally, the KVASIR instrument will be essential for the community working on quantum materials where fundamental physics meet recent applications in quantum computing and spintronics. In this emerging ecosystem of quantum sciences and technology, neutron scattering should have a key role for addressing the microscopic mechanisms at play in quantum materials through innovative instruments like KVASIR.

Stéphane Raymond

IRIG, CEA-Université Grenoble Alpes, MEM, Laboratoire Magnétisme et Diffraction Neutronique
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March 20th, 2026

To the ESS Instrument Proposal Committee,

I am writing to express my strong support for the proposed KVASIR backscattering neutron spectrometer for the European Spallation Source (ESS). I am Associate Professor in Mechanical Engineering and Materials Science at Duke University, with secondary appointments in Physics and Chemistry. My research group at Duke University investigates the microscopic structure and dynamics of condensed matter and energy materials, using an array of experimental characterization methods (neutron and x-ray scattering), combined with large-scale first-principles computer simulations. Using these techniques, we investigate microscopic degrees of freedom in solids, and rationalize their roles in both nanoscale and macroscale material properties, ranging from quantum & classical thermodynamics and nanoscale thermal transport, to functional properties (neuromorphic computing, optoelectronics and spintronics, thermoelectrics, solid-state batteries).

The KVASIR concept addresses an important gap in the current instrumentation landscape by providing simultaneous high resolution in both energy and momentum transfer. This is critical to enable our studies to reach a deeper understanding of structural fluctuations and correlated dynamics of ions, crystal lattice and spins in a wide range of material. As described in the instrument concept paper, KVASIR will unlock studies of small single crystals with energy resolutions on the order of a few μeV together with a momentum resolution of approximately 0.03 $Å^{-1}$, while maintaining the flexibility to accommodate demanding sample environments. Such capabilities for much smaller sample sizes than is currently practical to study with neutrons will be transformative for our field. The KVASIR instrument will be uniquely suited for investigating a host of cutting-edge materials with applications ranging from neuromorphic computing to solid-state batteries, optoelectronics and spintronics. For instance, in our investigations of cooperative diffusion solid-state batteries and ionotronics, dynamical fluctuations modulating electron-phonon coupling in halide perovskites, and correlated dynamics of electrons, ions and spins across metal-insulator transitions, the relevant phenomena critically involve correlated dynamics and structural fluctuations that occur in the μeV to sub-meV energy range, across reciprocal space. We are currently partially blind to the critical spatial and temporal scales of relevance, having to resort to an inefficient and clumsy combination of techniques (backscattering spectroscopy, cold time-of-flight direct spectrometry, neutron-resonant spin-echo on triple-axis, and diffuse neutron/x-ray scattering), but struggling to pull together a cohesive microscopic picture. The combination, in a single instrument, of high energy and spatial resolution and the possibility to perform experiments under a wide range of external fields, stimuli and extreme conditions will open the floodgates to unravel the microscopic mechanisms enabling materials for transformative future technologies.

KVASIR would provide exactly the type of experimental capability required to address these challenges at ESS. I therefore strongly support the development of the KVASIR instrument and believe it will become an essential tool for the international condensed matter physics community.

Sincerely,

Olivier Delaire
Associate Professor, Thomas Lord Department of Mechanical Engineering and Materials Science,
Department of Physics and Department of Chemistry
Duke University
Email: olivier.delaire@duke.edu

Science and Technology Facilities Council

27th March 2026

Re: **Letter of support for KVASIR**

To the ESS Instrument Proposal Committee,

I am writing to lend my strong support to the KVASIR instrument proposal for the second round of instruments at the European Spallation Source.

KVASIR combines excellent energy resolution with good ***Q***-resolution, making it ideally suited for studying the excitations of quantum magnets and other quantum materials. Furthermore, its high count-rate (thanks to its efficient secondary spectrometer design), means that it should allow measurements on very small single crystals; this is especially important given the difficulty of growing crystals of many of these materials. One example of a material from my own research that would benefit from KVASIR is the one-dimensional frustrated magnet $KTi(SO_4)_2(H_2O)$ (KTi). KTi has been proposed to be the potential host of a spontaneously dimerized state predicted by Haldane (Nobel Prize 2016) in 1982 but never before confirmed experimentally. This state is associated with the opening of a small gap in the spin excitation spectrum at low temperatures that should be observable by inelastic neutron scattering. On the other hand, KTi is metastable, and therefore difficult to synthesize in quantities sufficient for these experiments; doing so required over a year of synthesis effort, and the experiment could only be carried by combining hundreds of unaligned crystals, entailing a significant loss of information. With KVASIR, measurements on the small single crystals of KTi would be possible, and the full details of the excitation spectrum could be resolved for the first time.

Beyond its applications in quantum matter, KVASIR also shows great potential for the study of crystalline energy materials like battery solid electrolytes, where good energy and ***Q***-resolution are required to observe diffusion and other stochastic motions and to distinguish them from *e.g.* lattice vibrations. Its high count-rate is also needed to detect the weak signals from mobile ions like $Na^+$ and $Li^+$. KVASIR thus makes an excellent complement to the MIRACLES, BIFROST, and CSPEC instruments, filling gaps in resolution and count-rate between them and thus bringing the ESS spectroscopy suite closer to completion.

To conclude, I wish to restate my strong support for KVASIR, and to add that I believe it will revolutionize the study of a broad range of materials in condensed matter physics and beyond.

Sincerely,

**Dr. Gøran J. Nilsen**

Polarized Neutrons Scientist
Neutron and Muon Instrument Development Group
ISIS Neutron and Muon Source

Adjunct Associate Professor of Materials Physics
University of Stavanger

DTU

**To the ESS Instrument Proposal Committee,**

27-03-2026
nbch

I am writing to express my support for the proposed KVASIR backscattering neutron spectrometer for the European Spallation Source. With a simulated white beam flux of upwards of $10^8$ n/cm$^2$/s across a 1.7 Å band, KVASIR will allow studies of low-energy excitations with excellent resolution in both momentum and energy. The two modes of operation outlined in the instrument concept paper by A. F. Davidsen *et al* allow access to energy transfers up to 0.6 meV (PG002) and 6.5 meV (PG004), respectively.

In combination with the promised energy resolution, $\delta E \simeq 0.006$ meV, the former range will be of particularly high interest to the quantum and frustrated magnetism community, e.g. in relation to the study of "zero-energy modes" lifted off the elastic line by subdominant terms in the spin Hamiltonian, or the dispersion of very low-energy spin waves that are beyond the resolving powers of BIFROST, T-REX and CSPEC. Another obvious science case is quantum phase transitions where the ultra-high energy-resolution and excellent Q-resolution of KVASIR promises exciting opportunities to explore the quantum spin dynamics upon approaching field and pressure-induced gap-closure quantum critical points. The prototypical example in this case is $TlCuCl_3$ where a spin gap $\Delta_{\text{gap}}(H = 0, P = 0) \simeq 0.7$ meV can be closed by application of a readily available magnetic field of about 6 T or by the application of about 1 kbar hydrostatic pressure. The advantage of KVASIR in this context is that its resolution allows a closer approach to the quantum critical point than is possible by triple axis spectrometry. A related science case is the exploration of quantum critical spin dynamics and its relation to superconductivity in heavy fermion metals where the low-energy gaps/resonances are typically also in the sub-meV regime, e.g. $E_{res} \simeq 0.6$ meV in $CeCoIn_5$ and $\Delta_{gap} \simeq 0.2$ meV in $CeCu_2Si_2$.

Beyond the sub-meV operational mode of KVASIR, the ability to explore a larger regime of momentum and energy transfer using the PG(004) reflection potentially caters to an even larger research community. For example, the ever-topical cuprate and Fe-based superconductors exhibit superconducting spin gaps in this energy range. Likewise, several magnetoelectric and multiferroic compounds have spin wave bandwidths fully or partially overlapping with the energy range, which is furthermore well-matched with the (sample-dependent) Zeeman energy in a 10T magnetic field.

Finally, I'd like to point out in passing that the study of crystal electric field (CEF) excitations - typically in powder samples - is an important activity that is not well-covered by the existing ESS instruments. CEF-modes are mentioned once in the 2020 ESS instrument paper by Andersen *et al* (in the science case for MIRACLES), even if

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their elucidation is an absolute prerequisite in studies of rare-earth based magnetic materials such as spin-ice compounds. Here KVASIR would be able to cover the lowest-energy crystal field levels, their splitting with field or upon magnetic ordering, as well as their possible mixing with coherent low-energy phonons or magnons, while higher energy CEF-modes would need T-REX or a future dedicated powder spectroscopy instrument.

To summarize, KVASIR will impact several topical research fields, including those (superconductivity and magnetoelectricity) of current interest in my research. The instrument will be an important addition to the ESS spectroscopy suite, with unique capabilities in relation to studies of sub-meV magnetic excitations. I therefore support the conceptual and technical development of the KVASIR instrument, and believe it will become an essential tool for the international condensed matter physics community.

**Sincerely,**

Niels B Christensen 27 march 2026

**Niels Bech Christensen**
Associate Professor
Department of Physics, Technical University of Denmark

Stockholm 2026-03-26

## Support for the KVASIR Instrument Proposal for the European Spallation Source (ESS)

To the ESS Instrument Proposal Committee,

We are writing to express our strong support for the proposed KVASIR backscattering neutron spectrometer for the European Spallation Source (ESS).

The KVASIR concept addresses a critical gap in the current neutron scattering instrumentation landscape by combining ultra-high energy resolution in the μeV range with meaningful momentum resolution for single-crystal studies. This unique combination is essential for advancing our understanding of low-energy excitations in quantum, functional, and energy materials, where key physical phenomena occur on extremely small energy scales and require precise momentum-resolved measurements.

Our research focuses broadly on quantum materials, including frustrated and low-dimensional magnetic systems, as well as correlated and functional materials. In these systems, subtle spin dynamics, low-energy excitations, and field-induced phenomena play a central role. The relevant energy scales often lie in the μeV to sub-meV range, making them difficult to access with existing spectrometers that either lack sufficient energy resolution or do not provide adequate Q-resolution for single-crystal measurements.

From this perspective, KVASIR would enable several important research directions that are currently challenging to address. First, it would allow detailed momentum-resolved studies of low-energy excitations, such as small spin gaps, weakly dispersive modes, and slow magnetic dynamics in quantum magnets. Second, it would provide a powerful platform for investigating the evolution of such excitations under extreme conditions, including high magnetic fields and ultra-low temperatures, which are often essential for stabilizing and tuning emergent quantum phases. Third, the combination of neutron spectroscopy with complementary probes, such as muon spin rotation (μSR), would open new opportunities for connecting dynamics across timescales, from quasi-static to μeV regimes.

From a neutron scattering and instrumentation perspective, the KVASIR design is particularly compelling. The combination of backscattering geometry with an optimized prismatic analyser concept and compatibility with polarisation analysis represents a significant step forward compared to existing instruments. In particular, the ability to achieve both high energy resolution and meaningful Q-resolution for single crystals—while maintaining flexibility for complex sample environments—would provide capabilities that are currently not available at neutron facilities. This will be especially important for experiments where resolving subtle features in S(Q,ω) requires both precision and versatility.

**KTH**
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In addition, the ability to work with small single crystals is a significant advantage for many modern materials systems, where sample size is often a limiting factor. The proposed instrument would therefore be highly relevant for a wide range of current and emerging materials, including van der Waals magnets , frustrated systems, and energy-related functional materials.

Beyond our own research programs, we believe KVASIR would provide a unique and much-needed capability for the broader condensed matter community. It would complement existing and planned ESS instruments by opening access to a regime of energy and momentum space that is currently difficult to probe, particularly for single-crystal systems. This will be crucial for addressing a wide range of problems in quantum magnetism, correlated electron systems, and functional materials.

We therefore strongly support the development of the KVASIR instrument and are confident it will become an essential tool for the international neutron scattering community.

Sincerely,

**Assoc. Prof. Yasmine Sassa**
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To the
ESS Instrument Proposal Committee

**Prof. Dr. Christian Pfleiderer**

Scientific Director
Research Neutron Source
Heinz Maier-Leibnitz (FRM II)

Phone: +49 89 289 14704
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Garching, 26 March 2026

**Letter of Support for the KVASIR backscattering neutron spectrometer for the European Spallation Source (ESS)**

To the ESS Instrument Proposal Committee,

I am writing to express my strong support for the proposed KVASIR backscattering neutron spectrometer for the European Spallation Source (ESS).

The KVASIR concept addresses an important gap in the current instrumentation landscape by providing simultaneous high resolution in both energy and momentum transfer. As described in the instrument concept paper, KVASIR aims to study small single crystals with energy resolutions on the order of a few μeV together with a momentum resolution of approximately 0.03 $Å^{-1}$, while maintaining the flexibility to accommodate demanding sample environments. These capabilities will enable unprecedented studies of low-lying excitations in single hard condensed matter systems.

In particular, the instrument will be uniquely suited for investigating quantum magnetic materials, correlated electron systems, and functional materials for which key dynamics occur in the μeV to sub-meV energy range, the spatial scale of which are very difficult to access with current instrumentation. The combination of high energy and spatial resolution and the possibility to perform experiments under strong magnetic fields or other extreme conditions will open new avenues for exploring emergent quantum phenomena.

From the perspective of my scientific interest in topological quantum materials, KVASIR will be an important addition to the existing neutron instrumentation at ESS and other world leading facilities.

I therefore strongly support the development of the KVASIR instrument and believe it will become an essential tool for the international condensed matter physics community.

Yours sincerely,

Prof. Dr. Christian Pfleiderer
Scientific Director FRM II