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 on emergent excitations and exotic fractionalized quasi-particles in quantum spin ice and quantum spin liquid systems, high-resolution neutron spectroscopy plays a very important role in this field. Inspired by an earlier theory prediction of emergent gauge photons in quantum spin ice by O. Benton *et al*. (see Phys. Rev. B **86**, 075154 (2012).), we have very recently obtained strong experimental evidence on the existence of this exotic quasi-particle in the dipolar–octupolar quantum spin ice pyrochlore compound $Ce_2Zr_2O_7$, via polarized inelastic neutron scattering performed at the cold-neutron TAS instrument ThALES at ILL (see B. Gao, *et al*., Nat. Phys. **21**, 1203 (2025).). However, even with the highest energy resolution achievable at ThALES, we failed to resolve the predicted linear dispersion of gapless photon excitation, but were only able to observe an emergent excitation band near zero energy. I believe that KVASIR combined with its polarized neutrons option would provide the much-needed energy resolution to finally allow to tackle one of the most challenging questions in quantum condensed matte, *Seeing the artificial light*

and its dispersion in quantum spin ice, which would in turn tremendously advance our ability to manipulate this emergent phenomenon for future quantum science and technologies.

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.

Best regards

Yours sincerely,

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31.03.2026, Garching