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To the European Spallation Source Instrument Proposal Committee:

I am writing to express my full support for the **Njord** and **Remora** spectrometers submitted for the next selection round of instruments at the ESS.

These two instruments form a coherent and complementary pair. Remora will broaden access to neutron spectroscopy at the ESS, while Njord introduces a qualitatively new capability: by combining a MUSHROOM-type analyser with Nested Mirror Optics, it delivers a tightly focused beam of only $3\,\mathrm{mm} \times 3\,\mathrm{mm}$ at the sample position. This concentrated flux, maintained at an energy resolution competitive with triple-axis spectrometers, is the key that unlocks inelastic neutron scattering (INS) under extreme sample environments — a frontier that has remained largely inaccessible to date due to the inherently weak signals involved.

High-Pressure Environments

The 3 mm beam spot of Njord has immediate and far-reaching consequences for high-pressure INS. Paris–Edinburgh cells, currently the workhorse of high-pressure neutron centres worldwide, are well adapted to existing beam sizes but are limited to roughly 20 GPa. The reduced footprint enabled by Njord makes it possible to consider *large-volume diamond anvil cells*, which could push this limit to $\sim$60 GPa — a threefold improvement. Crucially, this gain extends not only to powder samples but also, and most importantly, to *single crystals*, which are indispensable for momentum-resolved measurements: only single-crystal data preserve the directional information needed to map phonon or magnon branches along specific crystallographic directions.

This extended pressure window opens fundamentally new ground in fields where collective excitations carry decisive information. Among multiferroic materials, rare-earth manganites such as $\mathrm{RMn_2O_5}$ are archetypal systems in which ferroelectricity and magnetic order are coupled through a subtle balance of competing exchange interactions. Pressure perturbs this balance, driving the system into successive magnetic phases whose excitation spectra remain largely unexplored. In the field of frustrated magnetism, pyrochlore oxides $\mathrm{R_2Ti_2O_7}$ are prominent quantum spin liquid candidates that are highly sensitive to lattice distortions: pressure-induced phases in these compounds provide a valuable window onto the nature of the ground state through the study of neighbouring ordered phases. This approach is equally applicable to frustrated one-dimensional systems, where pressure can tune competing interactions and reveal the underlying physics, while continuously increasing the system dimensionality.

High Magnetic Fields

The reduced sample volume required by Njord is equally decisive for high-field experiments. In a given magnet geometry, the maximum achievable field scales inversely with the bore size, which is itself set by the sample dimensions. Working with smaller crystals therefore directly translates into access to higher fields, enabling INS measurements in regimes that are currently out of reach. Several major scientific topics would benefit directly.

In the field of Kitaev physics, α-$RuCl_3$ is a prime example where a magnetic field is expected to destroy conventional magnetic order and stabilise a *quantum spin liquid* characterised by fractionalised Majorana excitations. Neutron spectroscopy in the field-induced regime is the key probe of this exotic state, and reaching the relevant field range requires precisely the kind of small-sample capability that Njord provides.

Unconventional superconductors offer another compelling case. In heavy-fermion systems, high magnetic fields reveal rich field-induced phase diagrams: in $CeCoIn_5$, a Q-phase with FFLO character has been identified at high field, while in UTe_2, a re-entrant “Lazarus” superconducting phase emerges at very high fields. Mapping the spin fluctuation spectrum across these transitions calls for INS in field conditions not yet accessible with current instrument geometries.

Finally, magnetisation plateau compounds and low-dimensional spin systems constitute a third frontier. The Shastry–Sutherland compound $SrCu_2(BO_3)_2$ displays a celebrated sequence of magnetisation plateaux whose microscopic origin remains debated. In one-dimensional systems, a longitudinal field can confine spinons — as demonstrated in $YbAlO_3$ — or drive a system through the quantum phase transitions of a spin Luttinger liquid, as in $(Hpip)_2CuBr_4$. In all these cases, reaching the relevant field scales requires precisely the sample-volume reduction that Njord affords.

Uniaxial Strain Environments

Beyond pressure cells and high-field magnets, the concentration of neutron flux onto a small volume also benefits a third class of rapidly emerging sample environment: uniaxial strain devices. The maximum strain achievable without sample fracture, as well as the mechanical efficiency of the setup, both improve as the sample cross-section decreases. Njord will therefore make it possible to perform INS under uniaxial strain in a range of applied stress that is currently inaccessible, adding this increasingly important tuning parameter to the toolkit of inelastic neutron scattering.

In summary, the combination of high neutron flux and a tightly focused 3 mm beam spot makes Njord a uniquely powerful instrument for probing collective excitations — phonons, magnons, and fractionalised modes — under extreme conditions. Together with Remora, it will grant access to a regime of INS experiments that is currently beyond reach, addressing topics as diverse as multiferroics, frustrated magnets, unconventional superconductors, Kitaev materials, and low-dimensional quantum systems. I therefore provide my full and enthusiastic support to both instruments for integration into the ESS suite.

Sincerely,

Victor Balédent
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