

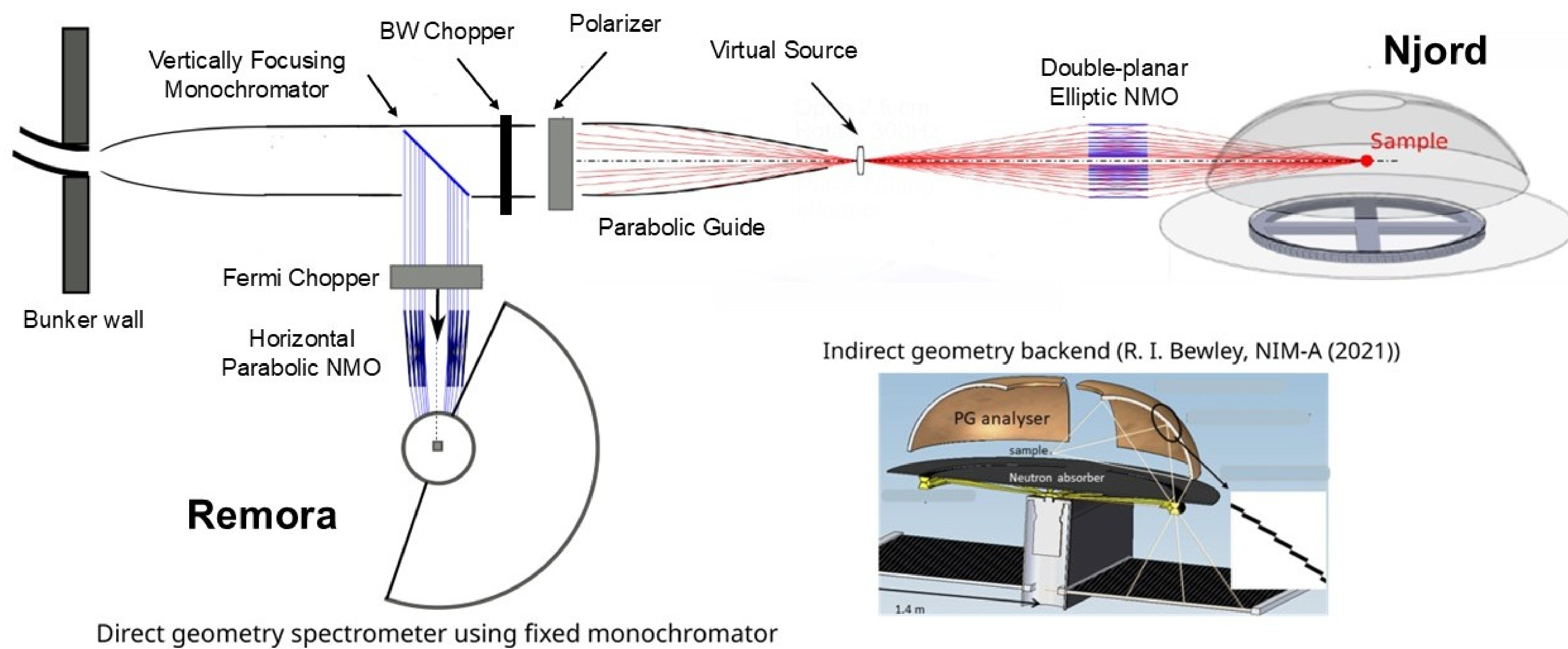
Symbiotic Spectrometers Njord & Remora

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njordremora.org



Direct geometry spectrometer using fixed monochromator

Indirect geometry backend (R. I. Bewley, NIM-A (2021))

Concept

Njord and Remora are a paired instrument concept proposed for the European Spallation Source: Njord is an indirect-geometry spectrometer pushing flux into a tightly focused beam for sub-mm³ samples; Remora is a symbiotic direct-geometry spectrometer on the same beamport, increasing user capacity via otherwise unused neutrons. Together they expand the reach of cold neutron spectroscopy and boost ESS throughput.

Extreme flux on tiny samples

Njord is an indirect-geometry ToF spectrometer designed for extreme flux on sub-mm³ samples in complex sample environments.

Key specifications

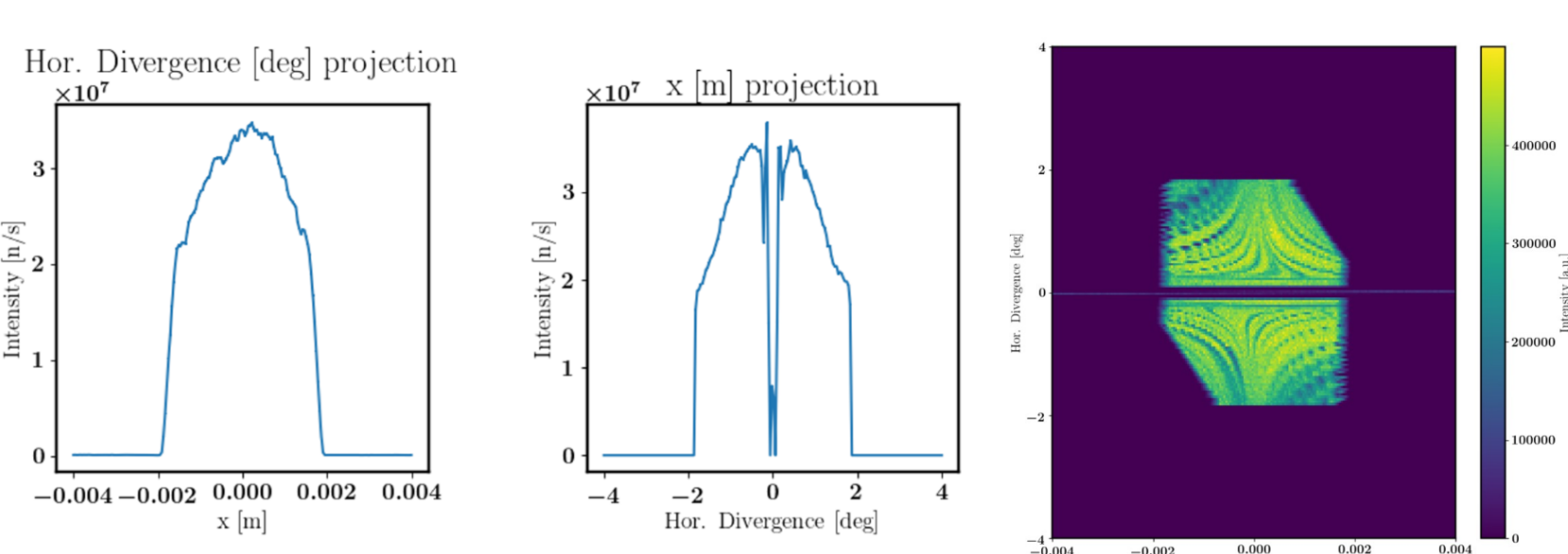
Beam spot	3 mm × 3 mm
Flux (PSC parked)	2.5×10^{10} n/s/cm ²
Divergence	±2°
Bandwidth	1.7 Å
E_f coverage	3.4 meV to 5 meV
Out-of-plane	15° to 2.5°
In-plane	±5° to ±140°
Analyser solid angle	1.4 sr

A MUSHROOM-type crystal-analyser array accepts a very large solid angle of scattered neutrons, covering the full scattering-angle range in a single setting. Energy resolution spans from 42 μeV (elastic, PSC Δt = 0.5ms) to 0.9 meV (ΔE = 10meV, PSC parked).

Nested Mirror Optics (NMO)

Njord achieves its extreme focusing through Nested Mirror Optics: compact, elliptically shaped, nested supermirrors that accept large divergence and refocus onto the sample with 72% brilliance transfer.

- Precisely defined illumination without close-optics
- Supports polarising supermirror coating upgrades
- Minimal background from sample environment



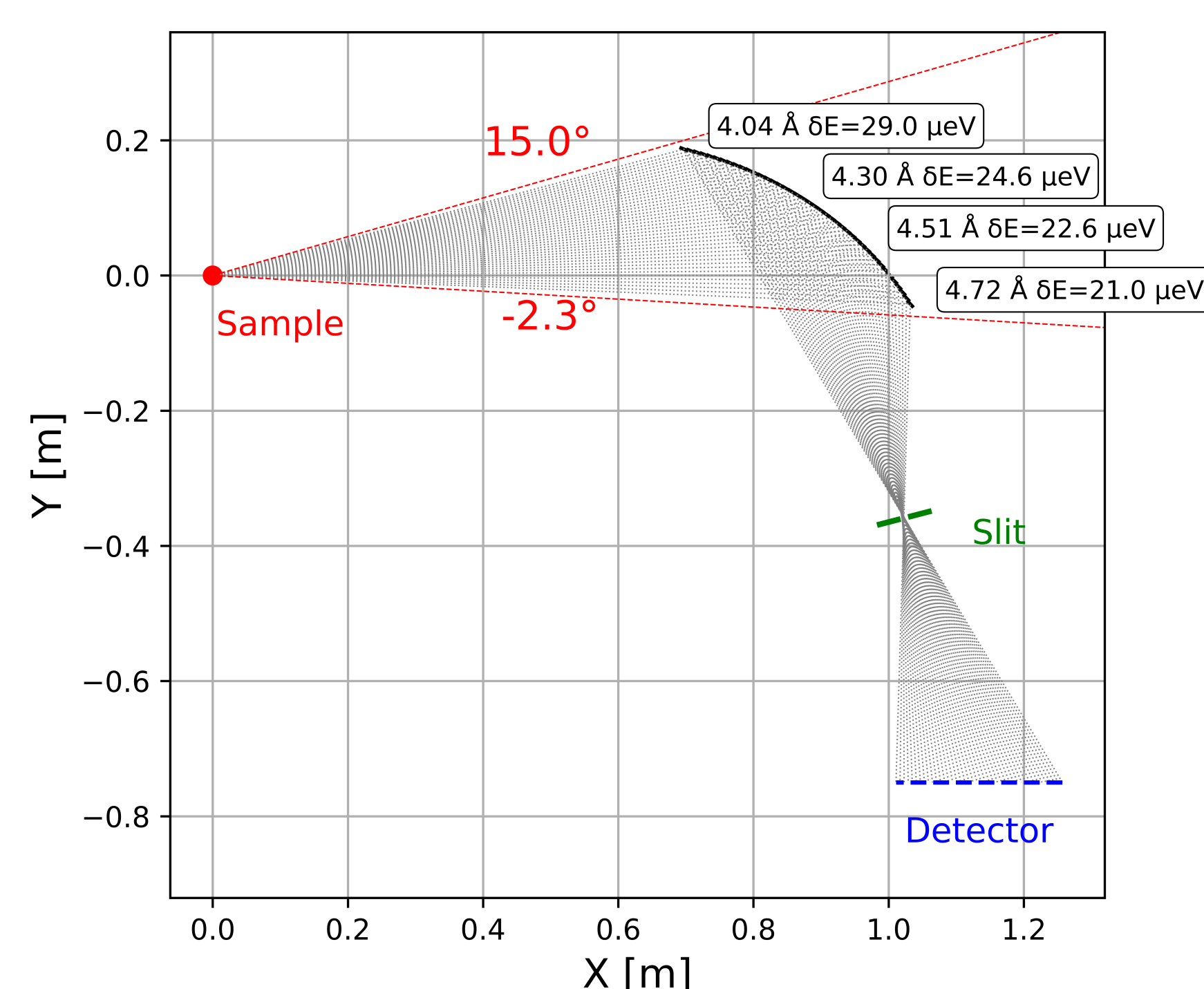
Want to know more?

References are available in the proposal
arXiv:2604.11383

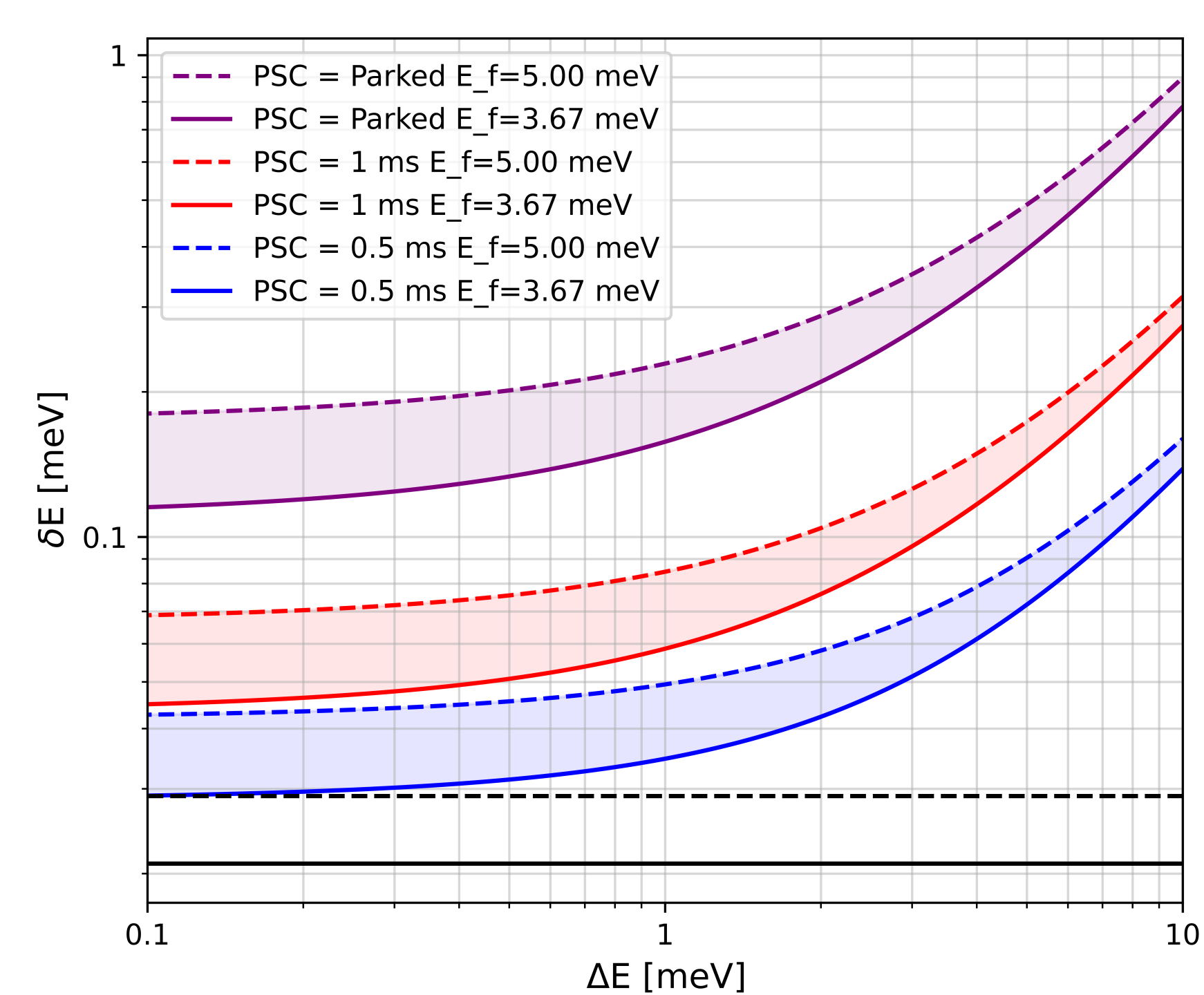
Get the proposal and add your endorsement at
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Njord secondary spectrometer

The MUSHROOM analyser provides continuous in-plane coverage with large out-of-plane acceptance for 4D (Q, E) volumes (Bewley, 2021).



The prismatic concept samples different final energies along radial detector tubes, improving energy resolution and allowing increased analyser acceptance. A Be filter with collimation suppresses higher-order analyser reflections.



Energy resolution for different PSC opening times, showing the range from relaxed (PSC parked) to high-resolution (0.5 ms PSC) modes.

Science enabled by Njord

Njord targets materials limited by sample size, weak signals, or extreme sample environments:

- Metal-organic framework phonon dynamics
- Organic superconductor excitation spectra under pressure
- mm-scale quantum spin liquid, supersolid crystals
- Ice & clathrates GPa scale phonon dispersions
- Barocaloric operando vibrational studies

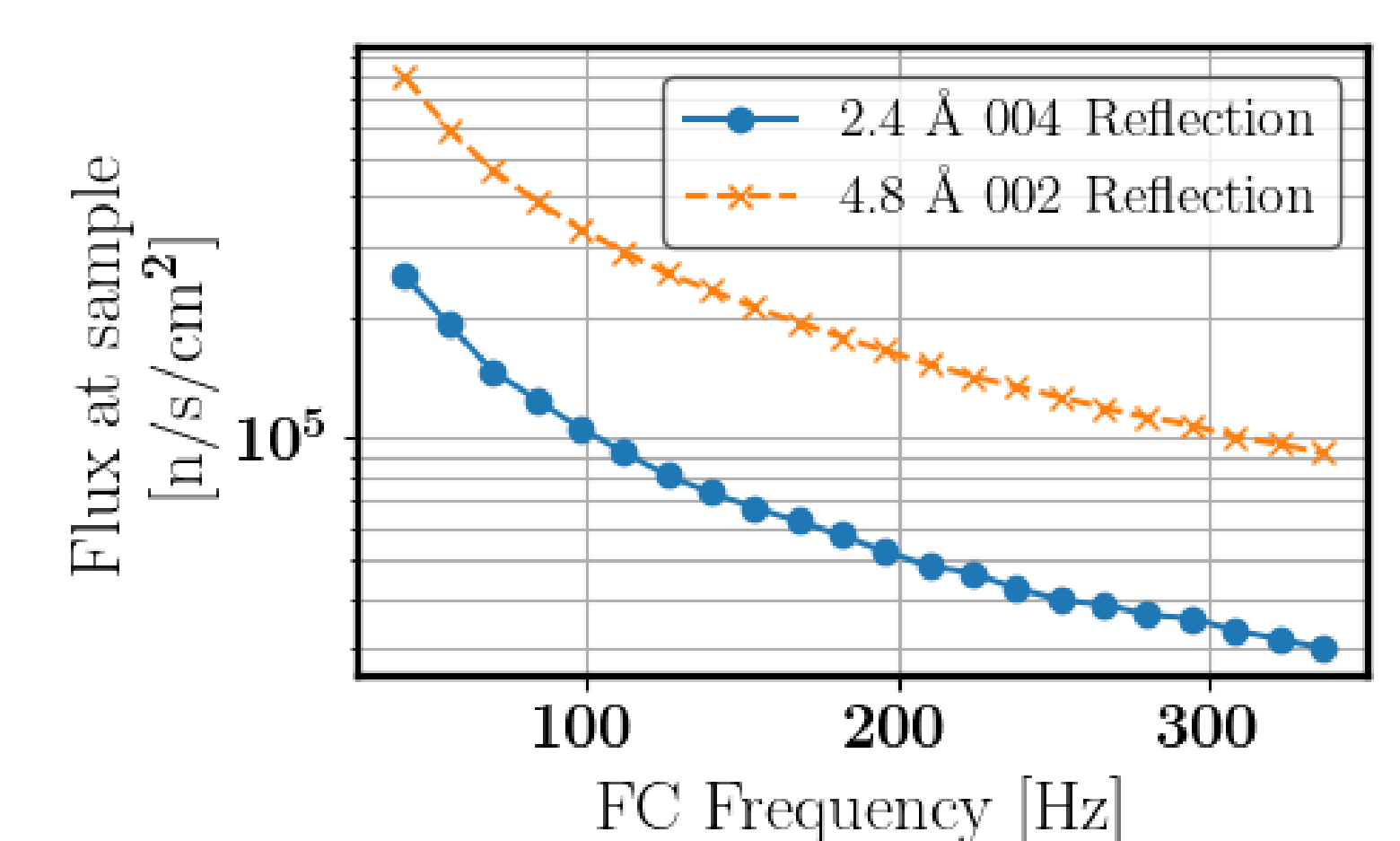
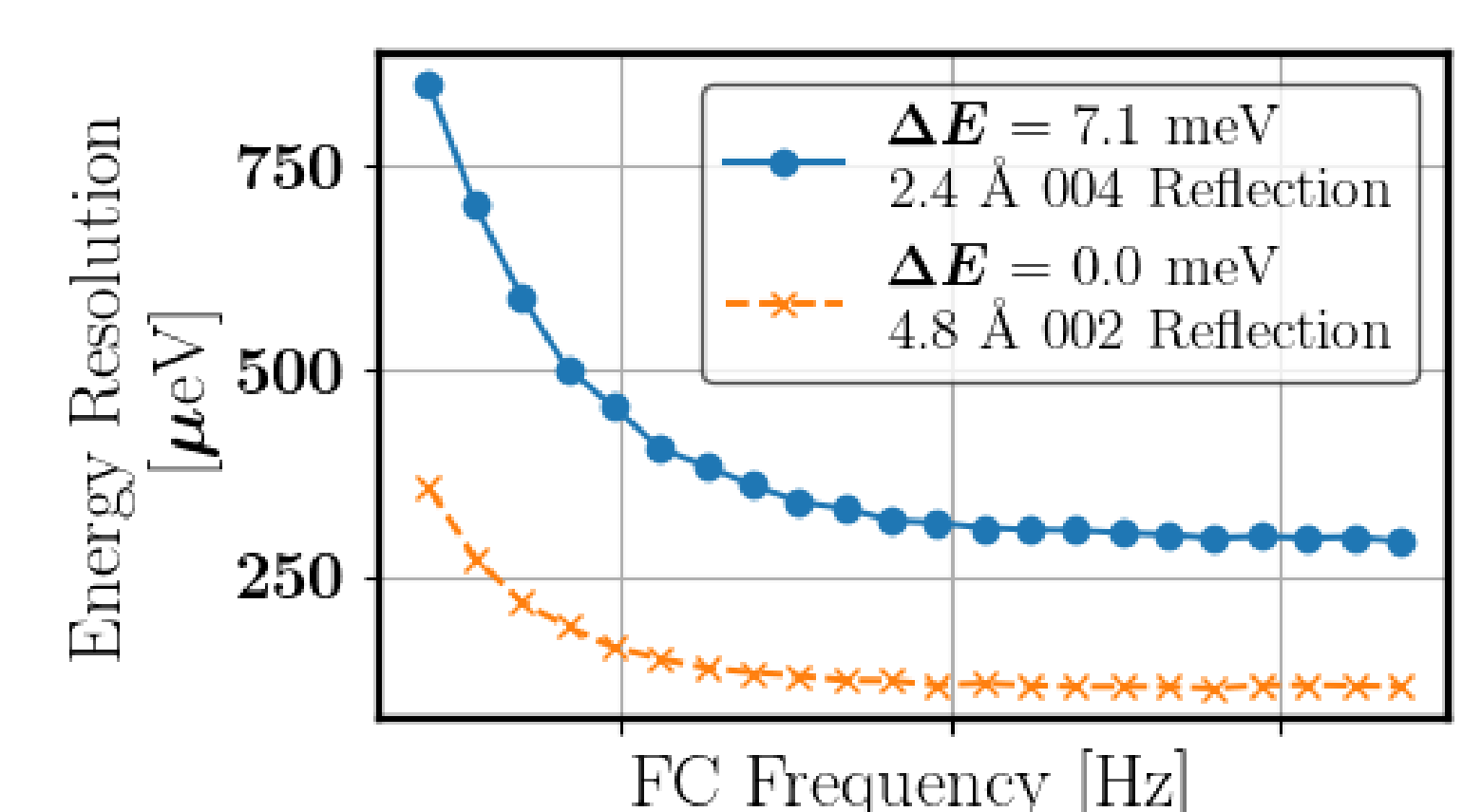
Symbiotic spectrometer

Remora is a direct-geometry ToF spectrometer positioned upstream of Njord on the same beamport, extracting neutrons via an HOPG monochromator that is mostly transparent off the Bragg condition.

Key specifications

Monochromator	HOPG (002), (004), (006)
Fundamental λ	4.8 Å
Flux @ 4.8 Å	3×10^5 n/s/cm ²
Flux @ 2.4 Å	9×10^4 n/s/cm ²
Sample-detector	2.5 m
Dynamic range	0.1 meV to 50 meV
Elastic ΔE	150 μeV

Multiple HOPG harmonics are separated in time by the ESS pulse structure, enabling simultaneous recording of spectra at different incident energies (repetition rate multiplication). A Fermi chopper controls sample illumination time and energy resolution.



Resolution and flux vs. Fermi chopper frequency.

Two instruments, one beamport

The long ESS pulse enables Njord and Remora to share a single beamport without significant mutual interference:

- Graphite transmits >85% of λ < 4.8 Å to Njord
- Remora extracts the complementary spectral window
- Independent pulse-shaping for Njord does not reduce Remora flux

Njord pushes the frontier for small-sample and extreme-conditions spectroscopy. Remora adds competitive user capacity comparable to LET and IN5.

Together, they maximise use of the ESS brightness.