50 Years of Neutron Backscattering Spectroscopy



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Backscattering spectroscopy does miracles

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I will present the conceptual design for the backscattering time-of-flight spectrometer MIRACLES approved for construction at the ESS and discuss on the avenues that it will open for neutron backscattering spectroscopy.

MIRACLES's remarkable flexibility - variable resolution, high flux and extended energy and momentum transfer range - is attributed to:

- 1. The long-pulse time structure and low repetition rate of the ESS source,
- 2. The chopper cascade that tailors the moderator pulse in the primary part of the spectrometer and
- 3. The bent Si(111) analyser crystals arranged in near-backscattering geometry in the secondary spectrometer.

Analytical calculations and Monte-Carlo simulations show that MIRACLES will provide variable elastic energy resolution between 2 and 32 µeV, when using $\lambda \approx 6.267$ Å, with an energy transfer range centred at the elastic line from –600 to +600 µeV. In addition, when selecting $\lambda \approx 2.08$ Å (Si(333)), $\delta(\hbar\omega)$ can be relaxed to 300 µeV and $\hbar\omega$ from 10 meV in energy gain to –40 meV in energy loss. Measurements of low-energy excitations will be possible by shifting the dynamic wavelength range between 2 and 20 Å.

[1] N. Tsapatsaris et al. EPJ Web of Conferences, 83 (2015) 03015.

[2] N. Tsapatsaris et al. submitted.

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