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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 $\lambda \approx 6.267 \text{ \AA}$, with an energy transfer range centred at the elastic line from -600 to $+600 \mu\text{eV}$. In addition, when selecting $\lambda \approx 2.08 \text{ \AA}$ (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 \AA .

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

[2] N. Tsapatsaris et al. *submitted*.

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