



Contribution ID: 19

Type: Poster

MIRACLES, the new backscattering spectrometer at ESS

MIRACLES is the neutron time-of-flight backscattering spectrometer at the European Spallation Source (ESS), which will provide the highest energy resolution among the current instrument suite [1]. Key features of MIRACLES will be: a) high and tuneable energy resolution, allowing to disentangle complex dynamics in a single experiment; b) versatile sample environment, aimed to investigate kinetic processes and reproduce *in situ/in operando* conditions; c) future polarization analysis capabilities, whose importance is increasingly recognized e.g. in the liquid and soft matter community [2]. This contribution reports the design and development of MIRACLES key components during construction and approaching commissioning phase. Perspective on how such capabilities will open new scientific possibilities will be also presented, demonstrating how MIRACLES will be configured as a groundbreaking neutron scientific instrument.

[1] F. Villacorta *et al.*, *Rev. Sci. Instrum.* **96**, 045101 (2025). N. Tsapatsaris *et al.*, *Rev. Sci. Instrum.* **87**, 085118 (2016).

[2] B. Rosi *et al.*, *J. Chem. Phys.* **162**, 214902 (2025). J. Maiz *et al.*, *Macromolecules* **55**, 2320–2332 (2022). M. Golub *et al.*, *Crystals* **14** (8), 743 (2024).

Session

Instrumentation

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Session Classification: Instrumentation