

The Small-Angle Neutron Scattering Instrument SANS-1 at MLZ

Tuesday 29 July 2025 19:00 (1h 30m)

The Instrument

SANS-1, a joint project of the Technical University of Munich and the Helmholtz-Zentrum Hereon, is a classical pinhole-geometry small-angle neutron scattering (SANS) instrument optimized for a broad range of applications, particularly in strongly correlated electron systems and materials science. Designed as a general-purpose tool, SANS-1 offers a wide dynamic Q-range with tunable resolution and supports full polarization analysis.

A chopper-based TISANE (Time-Resolved Small-Angle Neutron Scattering) setup provides microsecond time resolution, enabling real-time kinetic studies. For in-situ and in-operando measurements under extreme conditions, SANS-1 features a spacious, modular sample area equipped with a heavy-duty six-axis goniometer. This setup accommodates a wide range of complex sample environments—including superconducting magnets, high-temperature furnaces, and a custom quenching dilatometer—handling loads up to 1000 kg and dimensions of up to 125 cm × 250 cm with sub-millimeter and sub-degree precision.

The detector system at SANS-1 is housed in a 22-meter-long vacuum tube with an inner diameter of approximately 2.4 meters. The main detector (1 m × 1 m), consisting of 128 position-sensitive ³He tubes (1 m active length, 8 mm × 8 mm resolution), is mounted off-center relative to the beam axis and can be laterally shifted by up to 0.5 meters. This, combined with the ability to tilt the detection plane, significantly extends the accessible Q-range—particularly beneficial for time-resolved and in-operando experiments—and reduces anisotropic solid-angle effects and parallax artifacts. Extensive shielding minimizes background noise and edge scattering, optimizing signal-to-noise ratios.

Scientific Applications and Industrial Relevance

SANS-1 probes structural inhomogeneities in bulk materials on mesoscopic length scales (10–3000 Å), making it a vital tool for materials science, soft matter, and magnetism research. Applications range from polymers, biological macromolecules, and colloids to porous materials, ceramics, and metallic alloys, including precipitates and composite structures. Its advanced capabilities and flexible design make SANS-1 highly relevant for both fundamental research and industrial applications, particularly in the context of energy materials and fusion-related studies.

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