

SNS-NSE

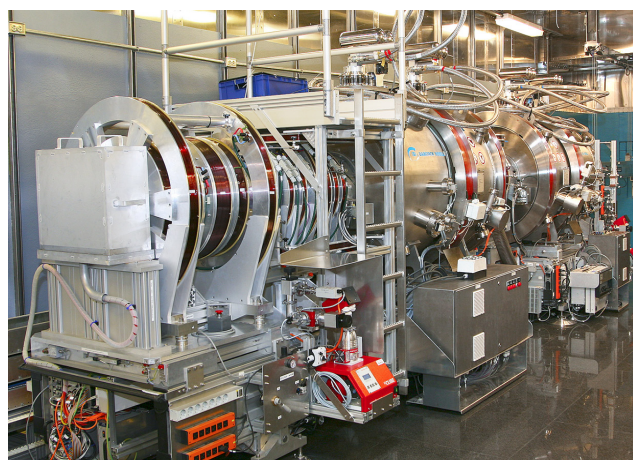
Neutron Spin Echo Spectrometer

Spallation Neutron Source

BEAMLINE

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Neutron Spin Echo spectrometers provide the highest energy resolution and the widest dynamical range achievable with neutron scattering. The manipulation of neutron spin allows the use of an intense beam of neutrons with a broad wavelength distribution at the same time sensitive to neutrons velocity changes of less than 10^{-4} . Exploiting superconducting technology with high-magnetic-field homogeneity, state-of-the-art field correction elements, novel polarizing benders and location at the Spallation Neutron Source, the SNS-NSE spectrometer achieves high data collection efficiency, allowing nearly gapless coverage of a broad wave-vector time range with only a few scattering angle settings. For a maximum wavelength span of $2 \text{ \AA} < \lambda < 17 \text{ \AA}$, the SNS-NSE spectrometer yields an unprecedented dynamical range of six decades, from $1 \text{ ps} < \tau < 300 \text{ ns}$. These values represent the maximum limits of the spectrometer and are achievable only under special experimental conditions. Routinely, the NSE



spectrometer at SNS operates over a wavelength span of $5 \text{ \AA} < \lambda < 11 \text{ \AA}$, in two operation modes, using a simultaneous wavelength frame of $2.4 \text{ \AA} - 3.1 \text{ \AA}$, and delivers Fourier times of over $1 \text{ ps} < \tau < 130 \text{ ns}$ for a wide q range of $0.05 \text{ \AA}^{-1} - 2.5 \text{ \AA}^{-1}$. Performance of the SNS-NSE is also extended by a position-sensitive, two-dimensional ^3He detector with a broad detection region.

APPLICATIONS

The SNS-NSE spectrometer is optimized for probing slow dynamics of molecular structures governed by thermal fluctuations. At SNS-NSE, materials can be selectively “labeled” via H/D contrast variation, allowing direct access to the characteristic timescales of targeted components. Applications in soft-matter research include relaxation processes in polymer melts, interfacial fluctuations in complex fluids and polyelectrolytes, and transport phenomena in polymer electrolytes and gel systems. In biophysics, the SNS-NSE enables studies of proteins and enzymes, dynamical properties of lipid assemblies and biological membranes, and transport processes across cell membranes.

The spectrometer can also grant access to slow magnetic fluctuations in spin glasses and topological spin structures supporting research in condensed matter physics and magnetism.

SPECIFICATIONS

Main precession	Superconducting coils
Shielding	μ -metal, shielding factor 137
Maximum field integral	$J = 0.56 \text{ Tm}$
Moderator	Cold-coupled hydrogen
Neutron guide h x b	Ni coated, $4 \times 8 \text{ cm}^2$
Wavelength selection	System of four choppers
Wavelength frame (routine operation)	$5 \text{ \AA} < \lambda < 11 \text{ \AA}$ $\Delta\lambda = (2.4 - 3.1) \text{ \AA}$
Dynamic range	$1 \text{ ps} < \tau < 130 \text{ ns}$
Scattering angle coverage	$3^\circ - 40^\circ / 79.5^\circ$ (configuration dependent)
Configuration	Four moderator-detector distances 18m, 21m, 24m, 27m
Window/sample size	$30 \times 30 \text{ mm}^2$
Analyzer	$m = 2.5$ rotatable supermirrors
Detector	He DENEX detector $30 \times 30 \text{ cm}$ active area
Temperature range	TFS: 5°C to 125°C Cryo-furnace: 3.5 K to 700 K

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