Selected potential applications

Slow and fast sound in binary fluid mixtures: the case of He-Ne

The measurement of the low-Q region of the dynamic structure factor in the gaseous He-Ne binary mixtures allowed to study the departure from hydrodynamic behaviour, which is expected to be characterised by the splitting of inelastic contributions into a slow and fast sound peaks. Contrary to such predictions, no fast sound mode (550 ms$^{-1}$, right arrow in figure 1) was experimentally detected. Further investigations may clarify whether such a mode appears at different thermodynamic conditions and/or different relative concentrations of the two components.

Acoustic and optic vibrations in heavy water

The determination of the dispersion curves of heavy water has allowed the association of the low and high frequency modes already observed in water (1500 and 3000 ms$^{-1}$ respectively), with the presence of an optic-like mode interacting with an acoustic-like mode (lines in the figure 3).

Collective excitations in liquid metals: the case of Hg

The study of the collective excitations in the mesoscopic region close to the hydrodynamic regime was performed by measuring the dynamic response of liquid Hg on the three-axis spectrometer IN1. A strongly anomalous sound dispersion (2100 ms$^{-1}$), 30% higher than hydrodynamic prediction, is observed. As for alkali metals, in a high electron-density metal such as Hg, the screened Coulomb force appears to be the interaction that mainly drives the ion dynamics (see figure 2).
BRISP is a thermal neutron Brillouin scattering spectrometer which exploits the time-of-flight technique and is optimised to operate at small scattering angles with good energy resolution.

Instrument description
BRISP is a new concept thermal neutron Brillouin scattering spectrometer which exploits the time-of-flight technique and is optimised to operate at small scattering angles with good energy resolution. The technical design of the spectrometer BRISP is developed to match with the following demands:

- a) energy transfer range 0.5 - 30 meV
- b) as small as possible momentum transfer
- c) good energy and momentum transfer resolution
- d) good signal-to-background ratio
- e) as high as possible counting rate

This will enable investigations of the dynamics of collective excitations, mainly in disordered systems, when the velocity associated to the propagating fluctuations ranges from 500 m/s to 3500 m/s.

Primary spectrometer
The main components are the double focusing monochromator, the background chopper, the converging collimator and the Fermi chopper. The monochromator consists of 20 crystal pieces mounted on a mechanical support which allows for an adjustable curvature in the scattering plane (vertical) and for a fixed horizontal (normal to the scattering plane) curvature. The monochromator concentrates the divergent incident beam onto a small area at the chosen distance, either at the detector or at the sample. The background chopper is a steel disk with 8 slots which rotates in the vertical plane. The converging collimator is a set of 4 masks with appropriate holes in order to guide the neutrons from the monochromator to the sample along fixed paths. The Fermi chopper is a standard device which transmits short neutron pulses to the sample. The whole neutron flight path, from the background chopper to the sample, is under vacuum to minimise the scattering from air.

Secondary spectrometer
The sample environment is designed to accommodate standard cryostats and furnaces. The PSD detector, composed of 100 tubes, 1 m long and filled with $^3$He aligned to cover approximately a 1 m width, is mounted on an XYZ stage for accurate alignment of the detector with respect to the incoming beam. The detector position can be optimised to analyse each portion of the sample scattering law. The detector is contained inside a long evacuated tube.

Instrument layout

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**Instrument Data**

**Reactor hall, thermal beam IH3**
inclined by 32° from the horizontal. beam size: 6 cm diameter

**monochromator**
vertical scattering plane double focusing with variable vertical focusing focusing at the detector or the sample position incident beam area at the monochromator: 6 x 6 cm$^2$

4 faces
20.8 x 8.6 cm$^2$ face size
4 x 2 cm$^2$ crystal size
crystal \(d\)-spacing (Å) \(L_i\) (Å) \(E_o\) (meV)
Cu(220) 1.278 0.77 138.5
PG(004) 1.677 1.01 81.1
Cu(200) 1.807 1.09 69.3
Cu(111) 2.095 1.26 51.5
PG(002) 3.355 2.02 20.1

**collimation**

- **soller collimator** \(\alpha_s\) = 0.4°
- **honeycomb collimator** \(\alpha_h\) (adjustable) = 0.2-1°

- 2 m length - A rotating 4-sector cylinder: one sector open, three sectors with Gd coated Al converging collimator each, for different focusing and collimation needs
- **Honeycomb section pattern for each collimator**

- **choppers**

- **background chopper** 5 000 rpm max.
- **Fermi chopper** 20 000 rpm max.

**sample**
beam area at the sample depending on the monochromator and honeycomb collimator adjustment sample environment dimensions: 550 mm diameter, 300 mm height vacuum level in the sample chamber: 10$^{-7}$ mbar

**detectors**
PSD Reuter-Stokes detector $^3$He filled (15 bar) tubes, 1.25 cm diameter, 1 m length overall dimensions: 150 x 100 cm$^2$ vertical spatial resolution: 5-7 mm

**distances**

- monochromator - sample 485 cm
- sample - detector (variable) 150-600 cm angular range 0-15° (depending on the sample-detector distance)

web: www.ill.fr/YellowBook/BRISP/