ESRF	**Experiment title:** Probing the Earth core: Nuclear inelastic scattering on FeNi alloys at high P,T conditions	**Experiment number**: HE-2893
Beamline: ID18	**Date of experiment**: from: 12-11-08 to: 28-11-08 (concurrent with HE-2901; setup 12.-17.11.08)	**Date of report**: 01-03-09
Shifts: 12	**Local contact(s)**: Dr. Aleksandr CHUMAKOV	*Received at ESRF:*

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(includes both HE-2901 and HE-2893 experimentalists)

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Report:

Seismology and its associated parameters (density, compressional and shear wave velocities) is the primary method for directly probing the Earth's interior; therefore techniques such as nuclear inelastic scattering (NIS) which provide information on the sound velocities of relevant minerals are an important tool to determining the nature of the Earth's interior.

The aim of experiment HE-2893 was to measure elastic and thermodynamic parameters of high pressure FeNi alloy phases including compressional and shear velocities, at high pressures and high temperatures using nuclear inelastic scattering of synchrotron radiation (NIS) and nuclear forward scattering (NFS).

In our previous experiments on ID18 at ESRF (HE-2577), we used a diamond anvil cell (DAC) equipped with an external heater to achieve high temperatures but diamond failure prevented high temperature data collection for NIS. We therefore used a different approach for the current experiment which was performed at the same time as HE-2901, and used a prototype portable laser-heating system on ID18 which was installed at ID 18 by one of the coproposers (L. Dubrovinsky).

Experiment HE-2893 and HE-2901 used exactly the same setup, only different samples, and took place during operation in 7/8+1 mode (setup), hybrid mode (19.-25.11.08) and 16-bunch mode (27.-28.11.08). For all measurements the beam was focussed to ca. 4 µm × 20 µm using a K-B mirror, and a MAR CCD camera was installed on the beam line to enable collection of XRD data at the same P,T conditions as the NIS and NFS spectra. For NIS data collection the DAC was oriented with the gasket horizontal to the beam (i.e., both the beam and the incoherent signal passed through the gasket), while NFS data was collected in either horizontal or vertical geometry (or both). We discovered two problems associated with NIS data collection in horizontal geometry: (1) the beam excites resonance in iron contained in the Be gasket; and (2) the beam excites resonance in parts of the sample that were not heated. The first effect can be corrected for by subtraction of a "Fe in Be" signal from the NIS data, while the second effect simply results in an averaging of signals from the sample at different temperatures; in both cases data are still usable. However we are currently redesigning the laser heating system so that NIS data can be collected in vertical geometry, hence removing these two problems in future experiments.

During HE-2893 NIS spectra of $Fe_{0.9}Ni_{0.1}$ up to a pressure of 60 GPa and a temperature up to 850 K could be taken (Fig. 1). The temperature was determined from the intensities of the Stokes and anti-Stokes regions of the measured NIS spectra.

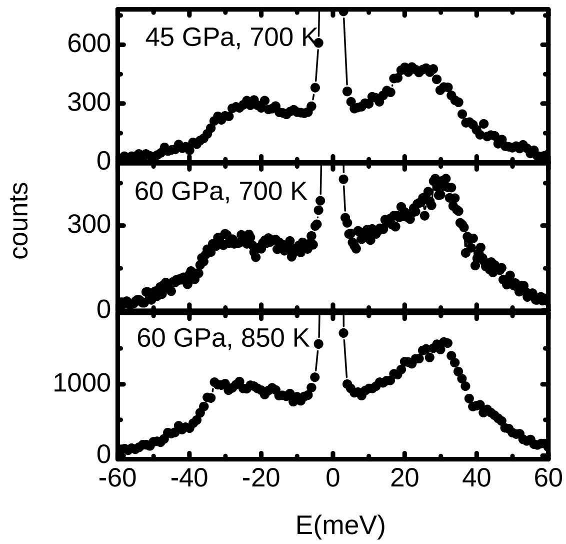

Figure 1. Nuclear inelastic scattering spectra of $Fe_{0.9}Ni_{0.1}$ as a function of indicated pressures and temperatures taken during HE-2893.

Thorough data analysis shows that the measured NIS signal of $Fe_{0.9}Ni_{0.1}$ shows a contribution of ~15 % from the iron impurity in the beryllium gasket used for the high p-T measurements. The determination of the mean velocity of sound and the corresponding compressional and shear velocities after the subtraction of the iron-beryllium contribution from the data displayed in Fig. 1 is in progress in our laboratory.