High-Pressure Phonon Spectroscopy of Oriented hcp Iron by NIS: Anisotropy of Sound Velocities

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This talk will first give a short introduction to the methodological aspects connected with nuclear inelastic scattering (NIS) of synchrotron radiation (SR) for phonon spectroscopy under high pressure, using the 14.413 keV Mössbauer resonance of ⁵⁷Fe, as exemplified in previous NIS studies of iron [1,2]. Then recent NIS studies of oriented hcp iron up to 130 GPa will presented, where the pressure-induced texture is used to derive the phonon density-of-states (DOS) as seen parallel and perpendicular to the hexagonal c-axis, as demonstrated in a previous study up to 40 GPa [3]. We observe a clear anisotropy in the elastic properties of hcp iron, indicating that the lattice is stiffer parallel than perpendicular to the c-axis. Of particular interest is the observed mean sound velocity v_D, from which the longitudinal and transversal sound velocities, v_p and v_s can be derived [2]. In accordance with the other elastic properties, the derived sound velocities are faster parallel than perpendicular to the c-axis. The derived values of v_p are of actual geophysical interest in conjunction with the observed anisotropy of v_p in the inner Earth's core and will be discussed in comparison with other experimental and theoretical results.

References:

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