Sound velocity of liquid Fe under high pressure

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The Earth has liquid outer and solid inner cores, which are composed predominantly of iron. Other terrestrial planets such as Mercury, Venus, and Mars also have metallic iron cores. Those planetary cores can be at least partially molten, as well as Earth’ s core. Therefore, the physical property of liquid Fe is fundamental to understand the nature and dynamics of the cores in terrestrial planets. However, our knowledge of its physical properties such as its density, sound wave velocity, and elasticity are still poor especially under high-pressure conditions relevant to inside of those planets. Previously reported equation of state (EoS) on liquid Fe was constructed based on limited density and velocity data at 1 bar and only above 260 GPa by shock compression experiments (e.g. [1]). Recently, sound wave velocity measurements on liquid Fe were performed using a large volume press, however, the pressure range was still limited at below 6 GPa [2,3]. Here, we report new experimental data on P-wave velocity of liquid Fe under high pressures based on inelastic X-ray scattering (IXS) measurements with a laser-heated diamond-anvil cell (LH-DAC) at the beamline BL43LXU [4] of the RIKEN SPring-8 Center in Japan. We measured the dispersion relation of longitudinal acoustic phonon mode of liquid Fe, and then determined the P-wave velocity up to 45 GPa. The obtained pressure and velocity data show a good consistency with an EoS previously reported by Anderson and Ahrens [1].

References

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Keywords: Planetary metallic core, Liquid Fe sound velocity, High pressure

