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Self-diffusion in Mercury investigated with quasi-elastic neutron scattering

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Diffusion is a fundamental property of liquid with a high importance to many aspects in physics and material science. Despite its technical relevance it's still not very well understood how atomic diffusion depends on properties, like the atomic mass, molar volume, and the melting point. The lack of internal degrees of freedom and the short-range, repulsive nature of metallic bonds make pure metals the closest analogy to a hard-sphere model system. Mercury has a rather high density and is the only metal, which is at room temperatures in the liquid state (Tl = 234 K). Hence, it is an ideal candidate to relate diffusion mechanisms over a wide temperature range when compared with other pure metals. We show QENS measurements of Mercury, carried out at the multi-disc chopper time-of-flight spectrometer TOFTOF at the research neutron source Heinz Maier-Leibnitz (FRM II). QENS probes atomic motion directly on a pico-second time scale, which allows reliable and precise in-situ observation of atomic transport processes on an absolute scale with rather small deviations. Thus, our QENS measurements can be compared with existing QENS data on metallic melts, which all exhibit considerable high melting points. This will contribute to a comprehensive understanding how atomic mass, molar volume, and the melting point affect the atomic motion of metallic melts.

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