Inelastic X-ray scattering measurements on high pressure fluids

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According to textbook definitions, there exists no physical observable able to distinguish a liquid from a gas beyond the critical point, and hence only a single fluid phase is defined. There are, however, some thermophysical quantities, having maxima that define a line emanating from the critical point, named 'the Widom line' in the case of the constant-pressure specific heat. We determined the velocity of nanometric acoustic waves in supercritical fluid argon at high pressures by inelastic X-ray scattering and molecular dynamics simulations. Our study reveals a sharp transition on crossing theWidom line demonstrating how the supercritical region is actually divided into two regions that, although not connected by a first-order singularity, can be identified by different dynamical regimes: gas-like and liquid-like, reminiscent of the subcritical domains. These findings will pave the way to a deeper understanding of hot dense fluids, which are of paramount importance in
fundamental and applied sciences.