Zeno: Fluctuation Decay Rates in Microgravity Versus Reduced Wavevector

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The Zeno (Critical Fluid Light Scattering) experiment is the culmination of a long history of critical fluid light scattering in liquid-vapor systems. The major limitation to making accurate measurements closer to the critical point has been the density stratification which occurs in these extremely compressible fluids. The Zeno flights were to allow determination of the fluctuation decay rates at a pair of supplementary angles in the temperature range 100 mK to 100μK from Tc in a sample of xenon accurately loaded to the critical density.

This paper will summarize our experience in operating the instrument on its two flights (STS-62 and STS-75) making comparison with the data taken in earth's gravity. The greatest difficulty, and the reason for the second flight, was the extreme sensitivity of the local density to the way the temperature was changed in the experiment: it was possible to generate 1% density errors by moving the sample temperature too quickly while in low gravity. We are working to overcome the uncontrolled density in our flight data by using an Orstein-Zernike analysis of the scattered intensities at 12° and 168° angles to extract a correlation range for each temperature. In this way we can measure how close to the critical point we reached for each measurement. We will present the comparison of our measurements with theory in terms of the reduced wavevector, $q\xi$.