Measurement of Isothermal Compressibility of $^3$He near its Critical Point * FANG ZHONG, INSEOB HAHN, MARTIN BARMATZ, Jet Propulsion Lab., Caltech - The isothermal compressibility $\chi_T$ of a fluid is conventionally derived from the measurement of density $\rho$ versus pressure $P$ along an isotherm or from $\rho$ measurements at two known vertical locations. For a fluid near its liquid-gas critical point $\chi_T$ diverges strongly. As a result, the application of the first method requires the development of a pressure sensor with resolution of $\delta P/P < 10^{-10}$ in order to measure $\chi_T$ at a reduced temperature $\epsilon < 10^{-6}$. The second method fails for $\epsilon < 10^{-4}$ due to the nonlinear density stratification induced by earth’s gravity. A technique using electrostriction has been developed to measure $\chi_T$ of $^3$He fluid near its critical point. The application of a DC electric field within a parallel plate capacitor induces a $\delta P$ in the gap. The resultant $\delta \rho$ is then measured with the same capacitor. $\chi_T$ can then be obtained from the ratio of the $\delta \rho$ to $\delta P$. Tests of this technique at low temperatures as well as the results of initial $\chi_T$ measurements near the $^3$He critical point will be presented. This $\chi_T$ measurement technique will be an integral part of a microgravity flight experiment that will also measure the divergence of the specific heat at constant volume in order to test the static scaling relations predicted by the Renormalization Group Theory.

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