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Density Profiles And Thermodynamics In Strongly Interacting Fermi Gases

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We study trapped Fermi gases near Feshbach resonances at general temperatures T to determine their density profiles and thermodynamics. The theoretical formalism (based on the concept of BCS-BEC crossover physics applied to the conventional mean field ground state) and the experimental comparisons are highlighted in this talk. That the profiles fit a Thomas-Fermi (TF) functional form is a key observation which derives from including the, generally ignored, non-condensed pair excitations (along with the usual gapped fermionic excitations, as well as condensed pairs). We demonstrate how a TF fit to experimental profiles can be used to extract a physical temperature scale, thus setting the groundwork for analyzing experimental thermodynamical data. We discuss the low temperature power laws in the entropy and energy $E(T)$ associated with both fermionic and non-condensed pair excitations of the condensate and demonstrate very good agreement with recent measurements of both the density profiles and $E(T)$ at all T.

This talk is based on the following two papers: Jelena Stajic, Qijin Chen and K. Levin, cond-mat/0408104 and Phys. Rev. Lett (to be published) and J. Kinast, A. Turlapov, J.E. Thomas, Qijin Chen, Jelena Stajic and K. Levin, published online in Science Express on January 27, 2005 [DOI:10.1126/science.1109220], to be published in Science.