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Nicholas Metropolis Award for Outstanding Doctoral Thesis Work in Computational Physics Talk: Equation of State of the Dilute Fermi Gases

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In the recent years, dilute Fermi gases have played the center stage role in the many-body physics. The gas of neutral alkali atoms such as Lithium-6 and Potassium-40 can be trapped at temperatures below the Fermi degeneracy. The most relevant feature of these gases is that the interaction is tunable and strongly interacting superfluid can be artificially created. I will discuss the recent progress in understanding the ground state properties of the dilute Fermi gases at different interaction regimes. First, I will present the case of the spin symmetric systems where the Fermi gas can smoothly crossover from the BCS regime to the BEC regime. Then, I will discuss the case of the spin polarized systems, where different quantum phases can occur as a function of the polarization. In the laboratory, the trapped Fermi gas shows spatial dependence of the different quantum phases. This can be understood in the context of the local variation of the chemical potential. I will present the most accurate quantum ab initio results and the relevant experiments.