Abstract Submitted
for the DAMOP10 Meeting of
The American Physical Society

Equation of State of the Unitary Gas: Theory and Experiment[1]
FELIX WERNER, UMass Amherst, KRIS VAN HOUCKE, Universiteit Gent, EVGENY KOZIK, ETH Zurich, NIKOLAY PROKOFEV, BORIS SVISTUNOV, UMass Amherst, ANDRE SCHIROTZEK, ARIEL SOMMER, MARK KU, MARTIN ZWIERLEIN, Massachusetts Institute of Technology — The equation of state of the balanced unitary gas is given by a dimensionless function of a single variable. We compute this function in the normal phase, from the high-temperature classical regime down to the quantum degenerate regime. We use a new Diagrammatic Monte-Carlo approach, where Feynman diagrams for the self-energy are sampled stochastically up to sufficiently high order so that the extrapolation to infinite order can be performed. The diagrammatic building blocks are bare propagators, and interaction lines that include the sum of all ladder diagrams. We will also present results obtained with the self-consistent 'bold' Monte-Carlo scheme, where the diagrammatic building blocks are dressed propagators and vertex functions. We will compare these theoretical predictions with our experimental results for the equation of state, which we extract from column-integrated density profiles using a new procedure, the temperature and chemical potential of a cloud being determined by fitting its outer region with the virial expansion. Then, we will use our Monte-Carlo results to fit the outer region of colder clouds, for which the central part gives access to the equation of state down into the superfluid phase.

[1]NSF, DARPA-OLE

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Date submitted: 25 Jan 2010 Electronic form version 1.4