Abstract Submitted
for the MAR17 Meeting of
The American Physical Society

Thermodynamics and renormalized quasi-particles in the vicinity of the dilute Bose gas quantum critical point in two dimensions JAN KRIEG, Universität Frankfurt, Germany, DOMINIK STRASSEL, University of Kaiserslautern, Germany, SIMON STREIB, Delft University of Technology, The Netherlands, SEBASTIAN EGGERT, University of Kaiserslautern, Germany, PETER KOPIETZ, Universität Frankfurt, Germany — We use the functional renormalization group (FRG) to derive analytical expressions for thermodynamic observables (density, pressure, entropy, and compressibility) as well as for single-particle properties (wavefunction renormalization and effective mass) of interacting bosons in two dimensions as a function of temperature T and chemical potential μ. We focus on the quantum disordered and the quantum critical regime close to the dilute Bose gas quantum critical point. Our approach is based on a truncated vertex expansion of the hierarchy of FRG flow equations and the decoupling of the two-body contact interaction in the particle-particle channel using a suitable Hubbard-Stratonovich transformation. To confirm the validity of our FRG approach, we have also performed quantum Monte Carlo simulations to obtain the magnetization, the susceptibility, and the correlation length of the two-dimensional spin-1/2 quantum XY model with coupling J in a regime where its quantum critical behavior is controlled by the dilute Bose gas quantum critical point. We find that our analytical results describe the Monte Carlo data for $\mu \leq 0$ rather accurately up to relatively high temperatures $T \leq 0.1J$.

Jan Krieg
Universitt Frankfurt

Date submitted: 20 Nov 2016 Electronic form version 1.4