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Thermodynamics in an extended mean-field theory for the Bose-Hubbard model DARIO HUEGEL, Ludwig Maximilian University Munich, LODE POLLET, Department of Physics, Arnold Sommerfeld Center for Theoretical Physics and Center for NanoScience, Ludwig-Maximilians-University Munich — We derive an extended mean-field formalism to study the thermodynamical properties of the Bose-Hubbard model. The framework can be viewed as the zero-frequency limit of bosonic dynamical mean-field theory (B-DMFT), but equally well as an extension of the mean-field approximation in which pair creation and annihilation of depleted particles is taken into account. The self-energy is treated variationally, minimizing the grand potential. We find that the $T = 0$ phase diagrams of the 3d and 2d Bose-Hubbard model are reproduced with an accuracy of 1% with just 3 free (physical) parameters that are determined self-consistently. The superfluid to normal transition at finite temperature is reproduced well but less accurately than in B-DMFT.

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