Abstract Submitted
for the PSF12 Meeting of
The American Physical Society

Average Energy Approximation of the Ideal Bose-Einstein Gas and Condensate DON LEMONS, Bethel College of North Newton, Kansas — I introduce and use the average energy approximation according to which the particles of an ideal quantum gas all have the average energy of the system. For instance, if the N bosons that compose an ideal Bose-Einstein gas with energy E and volume V are each assumed to have the average energy E/N, the entropy is easily expressed in terms of the number of bosons N and the number of single-particle microstates n they can occupy. Because the entropy derived is a function of only N and n, and the latter is a function of the extensive variables, E, V, and N, this entropy describes all that can be known of the thermodynamics of this fluid system. In particular, the entropy recovers the Sakur-Tetrode entropy in the classical limit and at sufficiently low temperatures describes an unstable system. A thermodynamic stability analysis recovers the Bose-Einstein condensate and a two-phase region. Apart from numerical factors of order one, results are identical with those derived via standard, probabilistic methods.

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Date submitted: 04 Oct 2012 Electronic form version 1.4