BECs with 1/r Long-Range Interatomic Interaction

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We consider the thermodynamic properties of a Bose-Einstein condensate with laser induced attractive $1/r$ interatomic interaction. Such a system is self-stabilizing and serves as a test laboratory for simulating gravitating objects with huge masses. Using the functional integral approach, we derive a Hartree-Fock mean-field theory and investigate as two special cases the region around absolute zero and around the critical temperature. At first, we obtain an analytic solution of the Gross-Pitaevskii equation in Thomas-Fermi approximation and use a time-dependent variational approach in order to investigate the collective excitations. Then we determine the leading shift of the critical temperature which is due to the $1/r$ interaction and discuss its dependence upon the geometry of an additional harmonic confining potential.