Global Thermodynamic Functions of a Trapped Bose Gas

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In recent years, the global variable thermodynamics formalism has been developed to describe ultracold gas systems trapped in inhomogeneous potentials. In this work, we present the results obtained from the study of the global thermodynamics of a Bose-Einstein condensate through the phase transition. To achieve this, we propose an experimental model to fit the virial coefficients with a first order deviation from the ideal gas. Through a set of global pressure measurements as a function of the global volume and the number of particles, we were able to fit these coefficients. And therefore, we obtain the equation of state, global pressure as a function of global volume, number of particles and temperature. This equation allows us to describe all the thermodynamics of the system, it is of particular interest to obtain the thermodynamic susceptibilities. We study the specific heat capacity global at constant volume and the global isothermal compressibility to obtain the critical exponents of the transition and, finally, the universality class. The critical coefficients obtained α and β, turn out to be novel in the literature since they had not been previously measured and fall within the universality class of the XY model in which the Bose-Einstein transition has been framed.