

# Global Thermodynamic Variables for a Charged Bose-Einstein Condensate

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The ultra-cold plasmas has raised interest in the fields of plasma physics and trapped atomic gases. At present, the quantum and ultra-cold gases are confined in inhomogeneous traps, thus in this kind systems we cannot define global thermodynamical quantities such as pressure and volume, and therefore the thermodynamic descriptions are established in local-variable approximation. In recent works [1,2] was demonstrated the possibility choice of a new set of conjugated macroscopic parameters, which are variables equivalent to volume and pressure, respectively [3,4]. In this work we present a formalism extension of global variables for a charged Bose gas, and we show an approach to charged systems near to temperature of BEC-transition. This study reveals a path to construct the phase diagrams as one of the first steps in the understanding of the phase transition nature.

[1] V. Romer-Rochín, et. al., *Physical Review A* **85**, 023632 (2012)

[2] R. F. Shiozaki, submitted to *Physical Review A*

[3] V. Romer-Rochín, and V.S. Bagnato, *Brazilian Journal of Physics* **35**, 607 (2005)

[4] V. Romer-Rochín, *Physical Review Letters* **94**, 130601 (2005)