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μ-Bose-Einstein condensate dark matter model

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It is known that the Bose-Einstein condensate (BEC) based Dark Matter (DM) model solves several problems of Cold Dark Matter model on the small scales, including core-cusp problem. In turn, there are some difficulties that arise in the framework of BEC DM, like overestimated a bit (up to 20%) prediction of halo mass in comparison with the values derived from observations. In ref. [1], the extended (via μ-deformation) μ-BEC DM model is proposed. The μ-deformed gas has the properties similar to ordinary Bose gas endowed with an additional attraction between its particles, incorporated [2] by the deformation parameter μ. We prove the possibility of BEC-like phase tran¬sition using the tools of thermodynamical (Ruppeiner) geometry, through analysis of singularities of scalar curvature in the thermodynamical parameters space. It is shown that the critical temperature of BEC-like transition is higher in the considered μ-Bose gas than in the ordinary Bose case. Moreover, dependence on the parameter μ gives us certain freedom enabling to treat the weak points of BEC DM model, e.g. the overestimated value of DM halo mass.

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[2] A.P. Rebesh, I.I. Kachurik, A.M. Gavrilik Elements of μ-calculus and thermodynamics of μ-Bose gas model, Ukr. J. Phys. V. 58, no.12, pp. 1182-1191 (2013)

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