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Gravitational lensing, and stability properties of Bose-Einstein condensate dark matter halos

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The possibility that dark matter, whose existence is inferred from the study of the galactic rotation curves, and from the mass deficit in galaxy clusters, can be in a form of a Bose-Einstein Condensate, has been recently extensively investigated. In this talk, we consider a detailed analysis of the astrophysical properties of the Bose-Einstein Condensate dark matter halos that could provide clear observational signatures that help discriminate between different dark matter models. In the Bose-Einstein condensation model dark matter can be described as a non-relativistic, gravitationally confined Newtonian gas, whose density and pressure are related by a polytropic equation of state with index n=1. The mass and gravitational properties of the condensate halos are obtained in a systematic form, including the mean logarithmic slopes of the density and of the tangential velocity. The lensing properties of the condensate dark matter are investigated in detail. In particular, a general analytical formula for the surface density, an important quantity that defines the lensing properties of a dark matter halos, is obtained in the form of series expansions. This enables arbitrary-precision calculations of the surface mass density, deflection angle, deflection potential, and of the magnification factor, thus giving the possibility of the comparison of the predicted lensing properties of the condensate dark matter halos with observations. The stability properties of the condensate halos are also investigated by using the scalar and the tensor virial theorems, respectively, and the virial perturbation equation for condensate dark matter halos is derived.

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