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Where my DAEMON hides – Power-law mass density models from fundamental principles

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Mass density profiles are key ingredients of many astrophysical and cosmological data evaluations, for instance mapping the mass distribution in galaxies or galaxy clusters using strong gravitational lensing or kinematical information from spectroscopically inferred velocity dispersions. Yet, how accurate and precise are interpretations of such observations if their mass models are based on heuristically inferred functions fitted to simulated structures? More than 30 years have passed since the first N-body simulations were set up. But it is still unknown why almost universal fitting functions like the Navarro-Frenk-White mass density profile model the shape of dark matter halos over a large range of sizes so well.

In this talk I will introduce my idea to resolve this mystery and explain the mass density profiles of (broken) power-law type. The approach is called DAEMON (DArk Emergent Matter halO explanatioN) and can be applied to any ensemble of entities whose interactions are dominated by gravity. It employs the entities as sampling points in the continuous mass density to be reconstructed and only uses the prerequisite that Newtonian gravity is the dominant interaction between the entities. As one important result, the Navarro-Frenk-White profile can be derived from fundamental principles without encountering the issues commonly faced when trying to derive it from conventional ensemble theory in statistical mechanics.

Based on:
J. Wagner. Cosmic structures from a mathematical perspective 1: dark matter halo mass density profiles. General Relativity and Gravitation, 52(6), 2020
J. Wagner. Self-gravitating dark matter gets in shape. International Journal of Modern Physics D, 29(14), 2020

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