ID de Contribution: **10** Type: **Non spécifié**

Non-ideal self gravity and cosmology: a possible solution to the dark mass and energy problems within the Newtonian limit?

Inspired by the statistical mechanics of an ensemble of interacting particles (BBGKY hierarchy), we propose to account for small-scale inhomogeneities in self-gravitating astrophysical fluids by using a non-ideal Virial theorem and non-ideal Navier-Stockes equations that involve the pair radial distribution function (similar to the correlation function), as for the interaction energy and equation of state in liquids. Within this framework, small-scale correlations lead to a non-ideal amplification of the gravitational interaction energy that can account for the missing mass problem in galaxies and galaxy clusters.
Based on this non-ideal Virial theorem, we also propose an extension of the Friedmann equations in the non-ideal regime. We estimate the non-ideal amplification factor of the gravitational interaction energy of the baryons to lie between 5 and 20, potentially explaining the observed value of the Hubble parameter (since the uncorrelated energy account for ~ 5%). Within this framework, the acceleration of the expansion emerges naturally because of the increasing number of sub-structures induced by gravitational collapse, which increases the gravitational interaction energy. A simple estimate predicts a non-ideal deceleration parameter qni ⊠ -1 which may be the first determination of the observed value based on an intuitively physical argument.
We also show that a transition to a viscous regime induced by the gravitational interactions at small scales in bound structures (spiral arms or local clustering) can lead to flat rotation curves, potentially explaining the dichotomy between spiral and LSB elliptical galaxy profiles. Overall, our results suggest that non-ideal effects need to be taken into account in order to properly determine the real "dark part" of our universe.

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