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Associations of dwarf galaxies in a ΛCDM Universe

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Associations of dwarf galaxies are extended systems composed exclusively of dwarf galaxies. We study these particular systems in a Λ Cold Dark Matter cosmological model (ΛCDM), analyzing their intrinsic properties on the environment where they reside. We find that the velocity dispersion (σ) decreases systematically as the density of the environment decreases, ranging from $\sigma \sim 140$ km s^{-1} in knots to $\sigma \sim 20$ km s^{-1} in voids, provided that these systems are not gravitationally bound.

From the observational standpoint, associations of dwarf galaxies are identified in the Local Volume by Tully et al. (2006). In Yaryura et al. (2020), we investigate these systems within a ΛCDM model, finding that it effectively reproduces these systems and their main dynamical properties. As a continuation, in Yaryura et al. (2023), we characterize the environment where these systems reside using the eigenvalues estimated from the tidal tensor (e.g. Hahn et al., 2007) of the dark matter (DM) particle distribution. We conclude that associations located in more dense environments present significantly higher σ than those located in less dense environments, as long as these systems are not gravitational bound.

In this work, we extend Yaryura et al. (2023), but characterizing the environment using the eigenvalues estimated from the shear velocity (Hoffman et al., 2012) instead of from the tidal tensor. Figure 1 shows σ as a function of the total stellar mass of the dwarf galaxies association (M_{sys}). Coloured lines show median values while shaded regions cover from 25 to 75 per cent for each sample. Each colour corresponds to a different environment (knots, filament, walls and voids). Left panel shows that σ is highly influenced by the environment. When situated in voids, associations exhibit a low $\sigma \sim 20$ km s^{-1} , increasing up to $\sigma \sim 140$ km s^{-1} in knots. On the contrary, when we consider only gravitationally bound systems (Bound-Dwarf associations, right panel) the influence of the environment on σ is significantly reduced. It varies from $\sigma \sim 10$ km s^{-1} to $\sigma \sim 30$ km s^{-1}, with

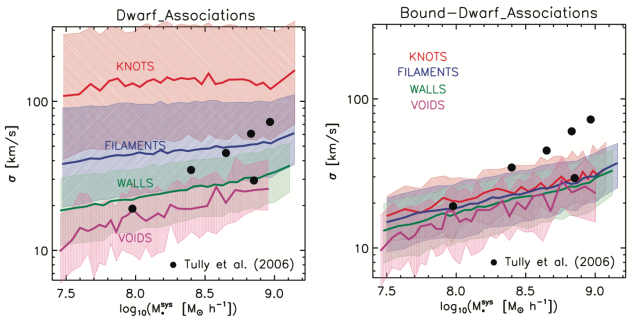

Figure 1. Left panel: Velocity dispersion (σ) as a function of the stellar mass of the association ($M_\star^{sys}$) for associations of dwarf galaxies. Right panel: Idem as left panel but considering only gravitationally bound systems. Black filled circles show observational results.

minimal variations based on the surrounding environment. Observed results presented by Tully et al. (2006) (black filled circles) are compatible with our results (left panel). Nevertheless, they are not compatible with our results when we consider only gravitationally bound systems (right panel). This would indicate that these observed associations could be non-gravitationally bound systems. These results are consistent with Yaryura et al. (2023), despite characterizing the environment in a substantially different way. In that case, we use the positions of the DM particles (tidal tensor), while in this work, we use their velocities (shear velocity).

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