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Angular momentum - mass relation for dark matter haloes SHIHONG LIAO, DALONG CHENG, MING-CHUNG CHU, JIAYU TANG, the Chinese University of Hong Kong — We study the empirical relation between an astronomical object's angular momentum J and mass M, $J = \beta M^{\alpha}$, the $J - M$ relation, using N-body simulations. In particular, we investigate the time evolution of the $J - M$ relation to study how the initial power spectrum and cosmological model affect this relation, and to test two popular models of its origin - mechanical equilibrium and tidal torque theory. We find that in the ΛCDM model, α starts with a value of 1.5 at high redshift z, increases monotonically, and finally reaches 5/3 near $z = 0$, whereas β evolves linearly with time in the beginning, reaches a maximum and decreases, and stabilizes finally. A three-regime scheme is proposed to understand this newly observed picture. We show that the tidal torque theory accounts for this time evolution behaviour in the linear regime, whereas $\alpha = 5/3$ comes from the virial equilibrium of haloes. The $J-M$ relation in the linear regime contains the information of the power spectrum and cosmological model. The $J - M$ relations for haloes in different environments and with different merging histories are also investigated to study the effects of a halo's non-linear evolution. An updated and more complete understanding of this relation is thus obtained.

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