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Halo asymmetry and galaxy clustering

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Studies of galaxy clustering show that the relationship between luminous structures and the underlying dark matter distribution is not straightforward. It depends on various, often interrelated, elements, such as the properties of the galaxies or the properties of the environment which in these galaxies reside.

Crucial for these dark-luminous matter relations studies are estimates of the masses of the dark matter halos. However, in studies of galaxy clustering within the framework of the Halo Occupation Distribution (HOD), it is usually assumed that the dark matter halo is spherically symmetric. At the same time, both modern N-body simulations and observational data suggest that most dark matter halos are in fact either oblate or prolate. To account for this, we propose a new, modified HOD model that takes into account halo asymmetries and improves estimates of dark matter halo masses. Using simulations, we show that this model accurately retrieves the halo asymmetry along with other halo parameters. It can therefore be successfully applied in new works.

Using our model, we find that the shape of the dark matter halos depends on the halo masses and is therefore correlated with the stellar mass of the galaxies. Moreover, based on the observational results, we find 3 - 5% differences between the halo masses estimated using the HOD model, which assumes spherical symmetry, and our model.

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