



Large-scale galaxy bias

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ABSTRACT

This review presents a comprehensive overview of galaxy bias, that is, the statistical relation between the distribution of galaxies and matter. We focus on large scales where cosmic density fields are quasi-linear. On these scales, the clustering of galaxies can be described by a perturbative bias expansion, and the complicated physics of galaxy formation is absorbed by a finite set of coefficients of the expansion, called *bias parameters*. The review begins with a detailed derivation of this very important result, which forms the basis of the rigorous perturbative description of galaxy clustering, under the assumptions of General Relativity and Gaussian, adiabatic initial conditions. Key components of the bias expansion are all leading local gravitational observables, which include the matter density but also tidal fields and their time derivatives. We hence expand the definition of *local bias* to encompass all these contributions. This derivation is followed by a presentation of the peak-background split in its general form, which elucidates the physical meaning of the bias parameters, and a detailed description of the connection between bias parameters and galaxy statistics. We then review the excursion-set formalism and peak theory which provide predictions for the values of the bias parameters. In the remainder of the review, we consider the generalizations of galaxy bias required in the presence of various types of cosmological physics that go beyond pressureless matter with adiabatic, Gaussian initial conditions: primordial non-Gaussianity, massive neutrinos, baryon-CDM isocurvature perturbations, dark energy, and modified gravity. Finally, we discuss how the description of galaxy bias in the galaxies' rest frame is related to clustering statistics measured from the observed angular positions and redshifts in actual galaxy catalogs.

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