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ASSEMBLY BIAS: CLUES FROM A ΛCDM COSMOLOGY

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RESUMEN

Estudiamos el efecto llamado "assembly bias", que consiste en que el agrupamiento a gran escala de halos de materia oscura de igual masa virial (que se asume es un indicador del "peak height") varía significativamente con su historia de formación, aspecto que no es esperado a partir de los actuales modelos teóricos. Nuestros resultados indican que si se incluye el efecto global a gran escala en la estimación del "peak height" que da origen a la formación de estructuras, las regiones de sobredensidad con la misma masa no muestran diferencias significativas con respecto a propiedades como la edad en la amplitud del agrupamiento para grandes escalas.

ABSTRACT

We present a new proxy for the overdensity peak height for which the large-scale clustering of haloes of a given mass does *not* vary significantly with the assembly history. The peak height, usually taken to be well represented by the virial mass, can instead be approximated by the mass inside spheres of different radii, which in some cases can be larger than the virial radius and therefore include mass outside the individual host halo. At large scales, i.e. in the two-halo regime, this model properly recovers the simple prescription where the bias responds to the height of the mass peak alone, in contrast to the usual definition (virial mass) that shows a strong dependence on additional halo properties such as formation time. The population of galaxies whose "peak height" changes with this new definition consists mainly of old stellar populations and are preferentially hosted by low-mass haloes located near more massive objects. The latter is in agreement with recent results which indicate that old, low-mass haloes would suffer truncation of mass accretion by nearby larger haloes or simply due to the high density of their surroundings, thus showing an assembly bias effect. The change in mass is small enough that the Sheth et al. (2001) mass function is still a good fit to the resulting distribution of new masses.

Key Words: cosmology: theory — dark matter — galaxies: formation — galaxies: statistics — large-scale structure of Universe

1. INTRODUCTION

Many recent models of galaxy formation assume that galaxy properties are determined by the haloes in which they form and not by the surrounding larger-scale environment (e.g. Kauffmann et al. 1997; Berlind et al. 2003; Baugh et al. 2005). This is justified by the standard description of structure formation (Bond et al. 1991; Lacey & Cole 1993; Mo & White 1996) and by simulation results as recent as Percival et al. (2003) which indicated that the halo clustering should only depend on the mass.

However, Gao et al. (2005) found that haloes assembled at high redshift are more strongly correlated at large scales than those of the same mass that assembled recently. This effect, which is not expected from the excursion set theory, was termed "assembly bias" (Gao & White 2007).

The aim of this work, presented in full detail in Lacerna & Padilla (2011), is to understand the origin of the assembly bias and its role in the development of the large-scale structure and on the galaxy population, beyond the halo mass dependence.

2. DATA

We use the SAG2 model galaxies (Lagos, Cora, & Padilla 2008), which result from the combination of a cosmological N-body simulation of the concordance ΛCDM universe within a periodic box of 60 h^{-1} Mpc on a side, which contains 256^3 dark matter (DM) particles with a mass resolution of $\sim 10^9\ h^{-1}\ M_\odot$, and a semi-analytic model of galaxy formation generated using the merger histories of DM haloes.

3. REDEFINITION OF AN OVERDENSITY PEAK HEIGHT

We propose to extend the proxy for peak height to larger scales so that it does not show the as-

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