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Large Scale Structure on very large scales: relativistic, wide-angle and the ‘finger of the observer’effects

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There are multiple reasons for which galaxy clustering requires a proper general relativistic description. (i) We observe events lying on our past light-cone. (ii) The propagation of light is affected by the presence of inhomogeneities in the matter distribution. (iii) In consequence, galaxy observables (i.e. redshift, flux in some wave-band and angular position on the sky) are influenced by the large-scale structure intervening between the source and the observer.
However, when we interpret observations we use an unperturbed FRW model to translate redshifts and fluxes into distances and absolute luminosities. This leads to redshift-space distortions, i.e. the reconstructed galaxy density does not coincide with the actual one. The most important source of the discrepancy is the correction due to the peculiar velocity gradient (Kaiser 1987) but it is long known that there are additional contributions and that they might become significant at large angular separations.
Robust models of galaxy clustering on large scales should thus include these modifications that, most likely, will be key to extracting unbiased information on the dark sector of the Universe (i.e. on the nature of dark energy and dark matter) and to improve constraints on primordial non-Gaussianity.
Recent studies based on analytical calculations and on the Fisher information matrix have concluded that signatures of these additional corrections should be detectable with the next generation of wide-angle surveys. These studies have demonstrated the existence of several additional corrections that, although suppressed on smaller scales, might generate observable signals on distances comparable with the Hubble radius
In this talk I will discuss the LIGER (LIght cones using GEneral Relativity) method, a numerical technique to build mock galaxy catalogues including all general relativistic corrections at linear order in the cosmological perturbations. LIGER post processes the output of a Newtonian simulation and combines its snapshots at constant background time to build the galaxy distribution in comoving redshift space
Finally I will discuss how the impact of observer velocity on the galaxy clustering measurements is often neglected or only corrected at the redshift level for spectroscopic surveys. In particular, using the LIGER method I will show the impact of the dipole on the monopole of the power spectrum and that it is possible to use the same dipole imprinted on the power spectrum of the galaxy to measure the expansion of the Universe.

Reasearch area

Cosmology

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