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Memorie della

DEMNUni Covariances

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Abstract. Covariance matrices of different cosmological observables, as galaxy clustering and weak lensing, are necessary for cosmological parameter inference via likelihood data analyses. The nonlinear evolution of the large scale structure of the Universe makes covariance matrices to become non-Gaussian. Moreover, covariance matrices are cosmology dependent and therefore need to be estimated for different underlying cosmological scenarios. The outcome of this project is a large set of Nbody simulations, in massless and massive neutrino cosmologies, with the aim of calibrating faster approximated methods for covariance production, and correctly include non-Gaussian and nonlinear effects, especially in view of forthcoming galaxy surveys, as the Euclid ESA mission.

1. Introduction

The PI has produced a large set of simulations, the so-called "DEMNUni-Covariance project, which is a set of 100 large N-body simulations to study the evolution of large scale structures in the presence of massive neutrinos. Non-linear modelling of structure formation is needed to fully exploit the current and future very large cosmological datasets.

The simulations are characterised by a box side $L = 1$ Gpc/h, a particle number $N = 2 \times 1024^3$ (the factor of 2 stands for CDM and neutrino particles), and a mass resolution for CDM particles of about $8 \times 10^{10} Msun/h$. There have been produced 50 simulations with massless neutrinos and 50 with a total neutrino mass $Mnu = 0.16eV$, using a modified version of the GADGET-3 code which includes massive neutrinos as a particle component. Post-processing these 100 simulations, a corresponding number of CMB- lensing maps, weak-lensing maps, ISW/Rees-Sciama maps, together with halo ad sub-halo catalogues have been produced. This effort aims at producing an adequate set of covariance matrices, for several kind of probes and their cross-correlations, and study a possible cosmology dependence of the covariance.

This not only represents, via off-diagonal elements, a measure of the non-linearity of the signal, but, most importantly, is necessary for cosmological parameter inference, entering data likelihood analyses. Below some plots showing the performed analysis which will be presented in a publication in the near future.

2. Preparation for larger projects, ISCRA or PRACE

The PI has just been awarded with a CPUH budget of 2 Million on Marconi-A1 BDW, via an ISCRA-B call, to continue the project on DEMNUni-Covariances, with the production of a further set of 100 new simulations, with same resolution and size as the previous hundred. This new set will be necessary to pursue the construction of cosmology dependent covariance matrices, according to the cosmologies covered by the large set of 14 DEMNUni

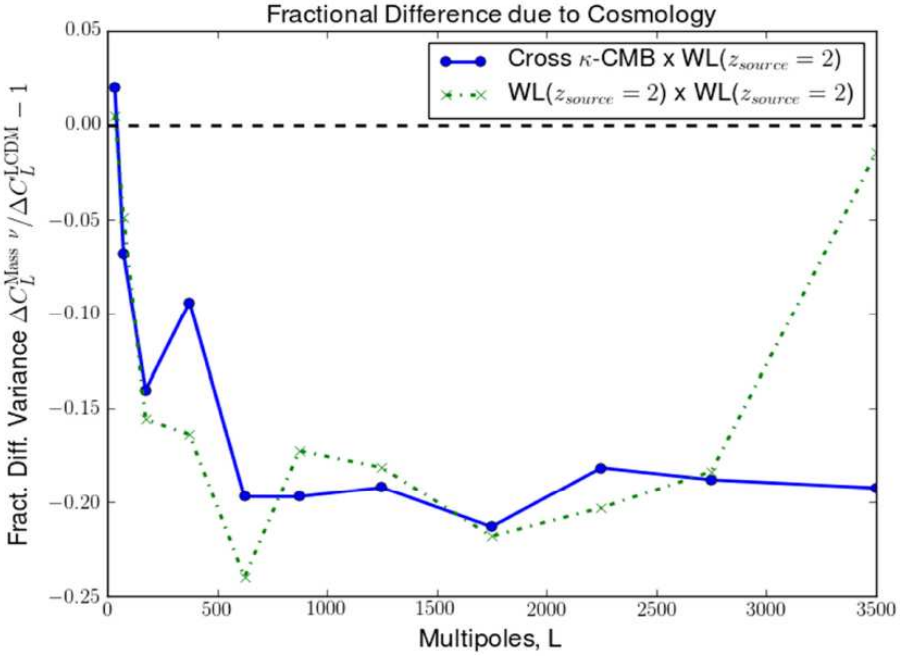

Fig. 1. Cosmology dependence of lensing covariance

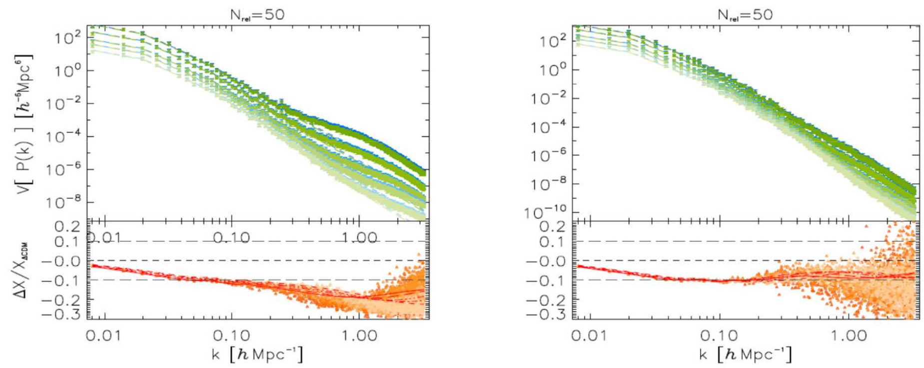

Fig. 2. On the left: Real space variance; on the right: redshift space variance.

simulations with same mass resolution but 8 times larger volume.

3. Advantages of the MoU CINECA-INAF

I think that MoU CINECA-INAF can help a lot researchers, working in the HPC field, to get more easily quite important amounts of computational resources, focused especially on project connected to INAF research areas. Calls as ISCA or Prace, are open to all the research fields, ad therefore more difficult to achieve for astrophysical purposes.

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