

Cosmological simulations - state-of-the-art codes and analysing packages

Here we will focus on an overview of the current state-of-the-art codes and packages used in computational cosmology community. We will describe codes like GADGET2/3 and RAMSES and their modifications. We will also present some approximate methods like PICOLA that are currently becoming more popular. Next, I will introduce the common dark matter halo finding techniques. We will also describe basic statistics (like power spectrum, halo mass function, etc.) that one can compute from a cosmological simulations and how they help us compare different model and learn about the physics of LSS and galaxy formation. Next we will show on some examples how simulations are used to conduct research in modern cosmology.

Recommended prerequisites: *general knowledge of numerical methods used in physics. Some astronomy background knowledge on galaxies and DM haloes would be a plus.*

Useful materials and references for the course:

- Lecture-notes on our older lecture on this subject can be downloaded from here: <http://adsabs.harvard.edu/abs/2015pta..conf...58H>
- GD2 Galactic dynamics (2nd edition): Binney & Tremaine, Princeton series in Astrophysics
- LH Formation and Evolution of Galaxies: Lectures given at Les Houches, Simon White, arXiv:astro-ph/9410043
- HE Computer simulation using particles, Hockney&Eastwood
- BH Barnes and Hut, 1986, Nature, 324, 446
- J10 Jenkins 2010, MNRAS, 403, 1859
- FW Frenk & White, Annalen der Physik, 524, 9 (arXiv:1210.0544)
- S01 Springel, Ypshida and White, New Astronomy, 6, 79 (GADGET-1)
- S05 Springel 2005, MNRAS, 364, 1105 (GADGET-2)
- KK Knollman&Knebe, ApJS, 182, 2 (AMIGA Halo Finder)
- BWW Behroozi, Wechsler, Wu, 2013 ApJ, 762, 109 (ROCKSTAR Halo Finder, arXiv:1110.4372)