



Theory, Analysis, and Computing: Challenges for Large Surveys

Second workshop on shaping dark energy research over the next decade and beyond

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Disclaimer

Most of the content of this talk is based on the work of the tri-agency task force (NASA-DOE-NSF) to investigate the joint use of large-scale simulation for Euclid, WFIRST, LSST, and DESI.

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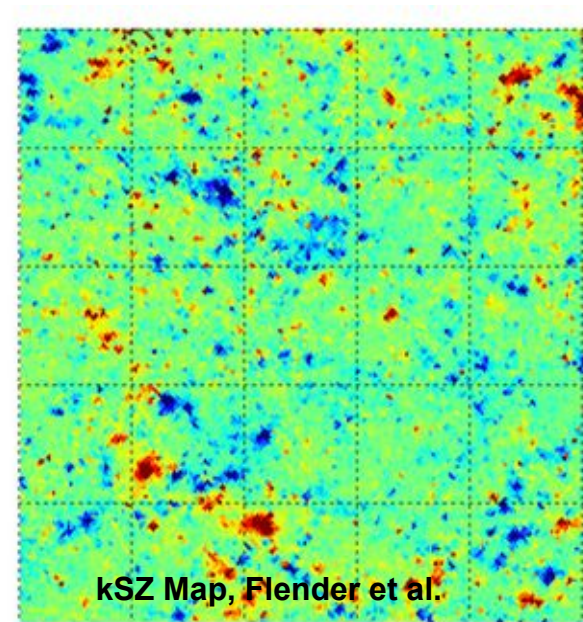
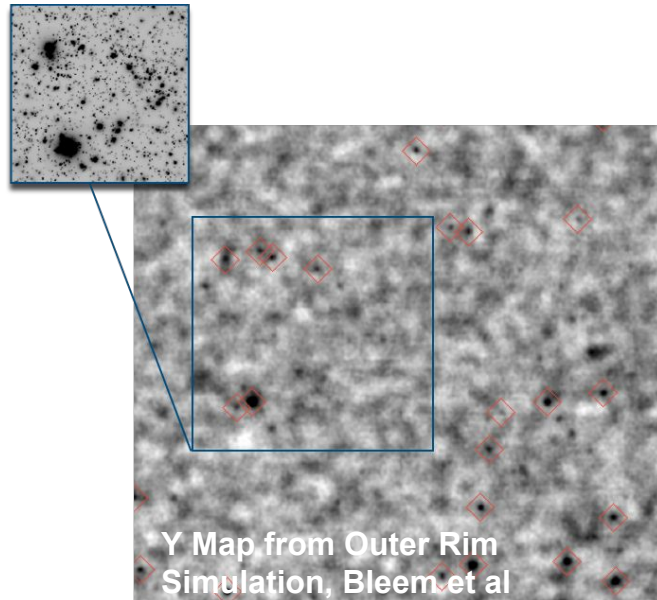
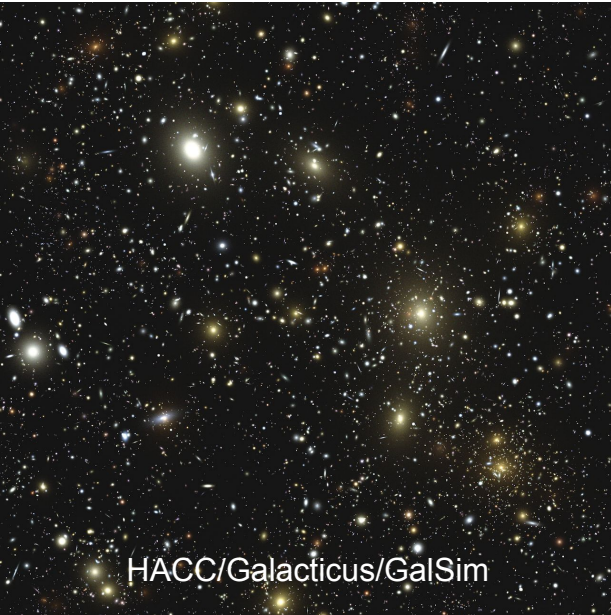


Introduction

- **Simulations play an important role in today's and tomorrow's cosmological surveys**
 - Investigating signatures of fundamental physics and new probes (see yesterday's examples)
 - Investigation of systematic effects, knowing the truth helps!
 - End-to-end simulations: from N-body to observed catalogs at all wavelength
 - Fast, accurate prediction tools (emulators etc)
- **Upcoming wide-field surveys require extensive numerical simulations for a range of tasks, sharing resources seems advisable:**
 - Carrying out simulations
 - Transforming them into synthetic sky maps and prediction tools
 - Validation programs
 - Serving the data



Simulated Maps





Areas of Consideration

- **Common infrastructure to share simulation products**
 - Hardware (storage space and data servers)
 - Common approach for data curation
 - Serving data (common access to flat files; database solutions; hardware for analysis)
- **Base-numerical simulations to generate synthetic sky maps**
 - “Grand challenge simulations”, either gravity-only or hydro simulations
 - High mass resolution and large volumes to enable synthetic sky generations via a range of methods
 - Focus on LCDM models and maybe one or two beyond
 - Require a lot of compute resources, can only do a handful of those, only few codes can do these



Areas of Consideration

- **Generation of synthetic sky maps**
 - Different methods, none “perfect”, needs more exploration
 - Validation: major task, need to assemble tests and data, DESCQA is a start for community wide tool
 - Develop common modeling and validation challenges, joint solutions and pipelines
- **Large-scale simulation campaigns**
 - Simulations covering different cosmologies
 - Campaigns for covariance estimates
- **Advanced statistical methods**
 - Study statistical methods that will help reduce number of required simulations, e.g., emulators, new modeling techniques for covariance estimates

What is needed ...

Support for a large-scale, coherent effort that provides support for code development and maintenance (for simulations and analysis tools), data serving and sharing, validation set ups, and recognition for junior people working in the field!



“The purpose of computing is insight not numbers”

- Richard Hamming