



The Horizon Project Database

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The Horizon project

The HORIZON Project federates numerical simulation activities with a program focused on Galaxy and Large Scale Structure Formation. This project was built by several French research teams from different institutes. The main objectives are :

- Carry out numerical study of galaxy formation in a cosmological framework.
- Develop advanced techniques in parallel computing and in applied mathematics to model galaxy formation and predict their observational signatures, as a function of physical parameters.
- Gather experts in computational astrophysics, share their software products and expertise, and optimize their access to national and international supercomputing facilities.
- Provide the scientific community, and in particular the AstroParticle, Cosmological and Extragalactic communities (both observers and theoreticians), with a friendly access to state-of-the-art numerical simulations.

The Horizon context

Box sizes : 500, 100 and 20 Mpc/h.
Unique set of initial conditions : 4096³, 2048³, 1024³, 512³ particles.

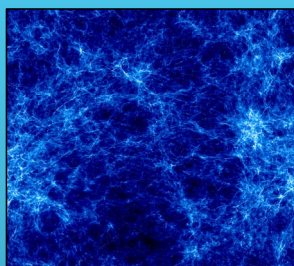
Types of simulation : periodic box, zoom on identified halos, idealized on identified halos.

Types of models : pure N-body + semi-analytics post-processing, N-body and gas dynamics, isolated halos with boundary conditions.

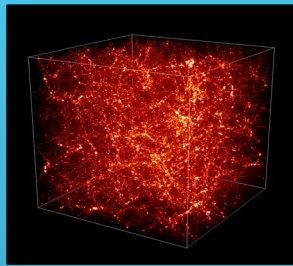
Types of code : PM-AMR (Ramses, Enzo, Pmcoll) TREE-SPH (Gadget, Multizoom)

Outputs which will be available on line :

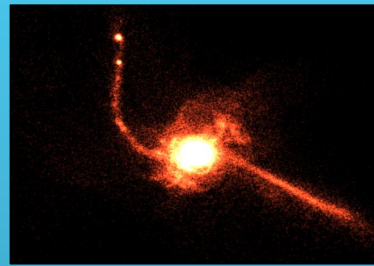
- Halos, sub-halos and galaxy catalogs, merging trees.
- All-sky or patch virtual images (y, X, visible, IR, mm, radio).
- Mock spectra and spectro-images.
- Raw data with images and movies.



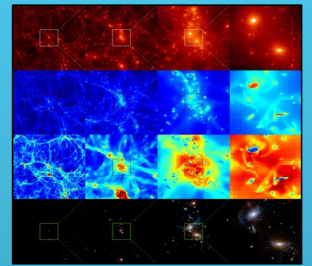
MareNostrum simulation at redshift 5.7



N-body simulation (red temperature)

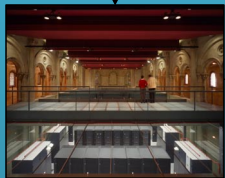


Merging of a small group of 5 disc galaxies



Two galaxies in the cosmological context :
Zooming sequence showing dark matter density, gas density, gas temperature, star age and distribution.

The computing infrastructure



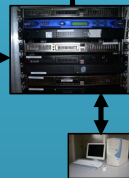
MareNostrum Computing Center

Horizon has been selected by the Barcelona Supercomputing Center for the "Mare Nostrum Galaxy Formation Project".



Horizon MesoMachine @ HPC1

Located in HPC1 at Bruyère le Châtel.
3 quadri AMD64, 64 GB RAM + more on demand.
Post-Processing, heavy-weight storage.



Horizon MiniGrid

6 nodes located in each main lab : Paris, IAP, Meudon, Saclay, Lyon, Marseille.
Visualization, post-processing, light-weight storage.



Personal Computer

Software clients.

Other computing centers : IDRIS (Centre national de la recherche scientifique), CINES (Ministère de la recherche), CCRT (Commissariat à l'énergie atomique).

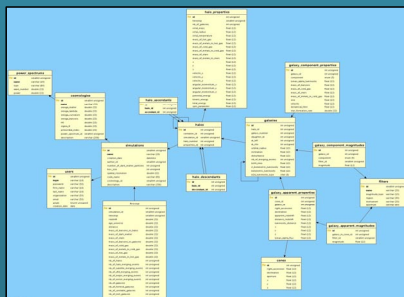
The challenge

For the MareNostrum simulation :
1 million hours CPU
25 Terabytes output
150 millions halos
3 millions merging trees
75 millions galaxies

The Horizon project plans to carry out several other simulations.

The database has been designed to Enable data sharing as much as possible.

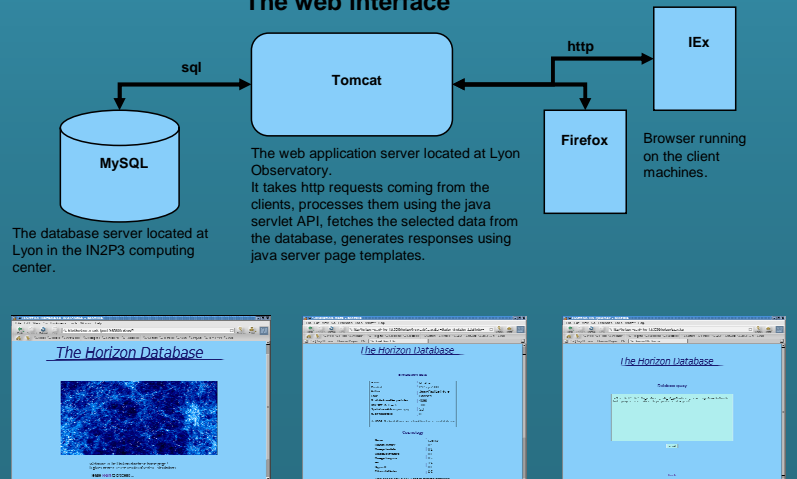
The database architecture



The mapping between tables and java objects in the web application is managed by the Cayenne library.

Parameters describing simulations and their results are stored in a relational database management system. The schema specifying the content of the tables and their relationships is now implemented. It is a new version inspired by the structure of the GallCs database. It has been reworked to better represent the simulations while satisfying the principles of the database normalization. To describe the galaxy genealogy the nested set model has been adopted. As far as the halos are concerned a adjacency list model will be tested.

The web interface



References

The Horizon project main site : <http://www.projet-horizon.fr/>
The Gavo <http://www.g-vo.org/portal/> Exploring Simulation Catalogues Online
The Virgo consortium <http://www.virgo.dur.ac.uk/>
The GallCS project : <http://galics.cosmologie.fr/>
The Apache Cayenne framework : <http://incubator.apache.org/cayenne/>

The html pages display input forms and results from the queries. They are dynamically generated using JSP technology