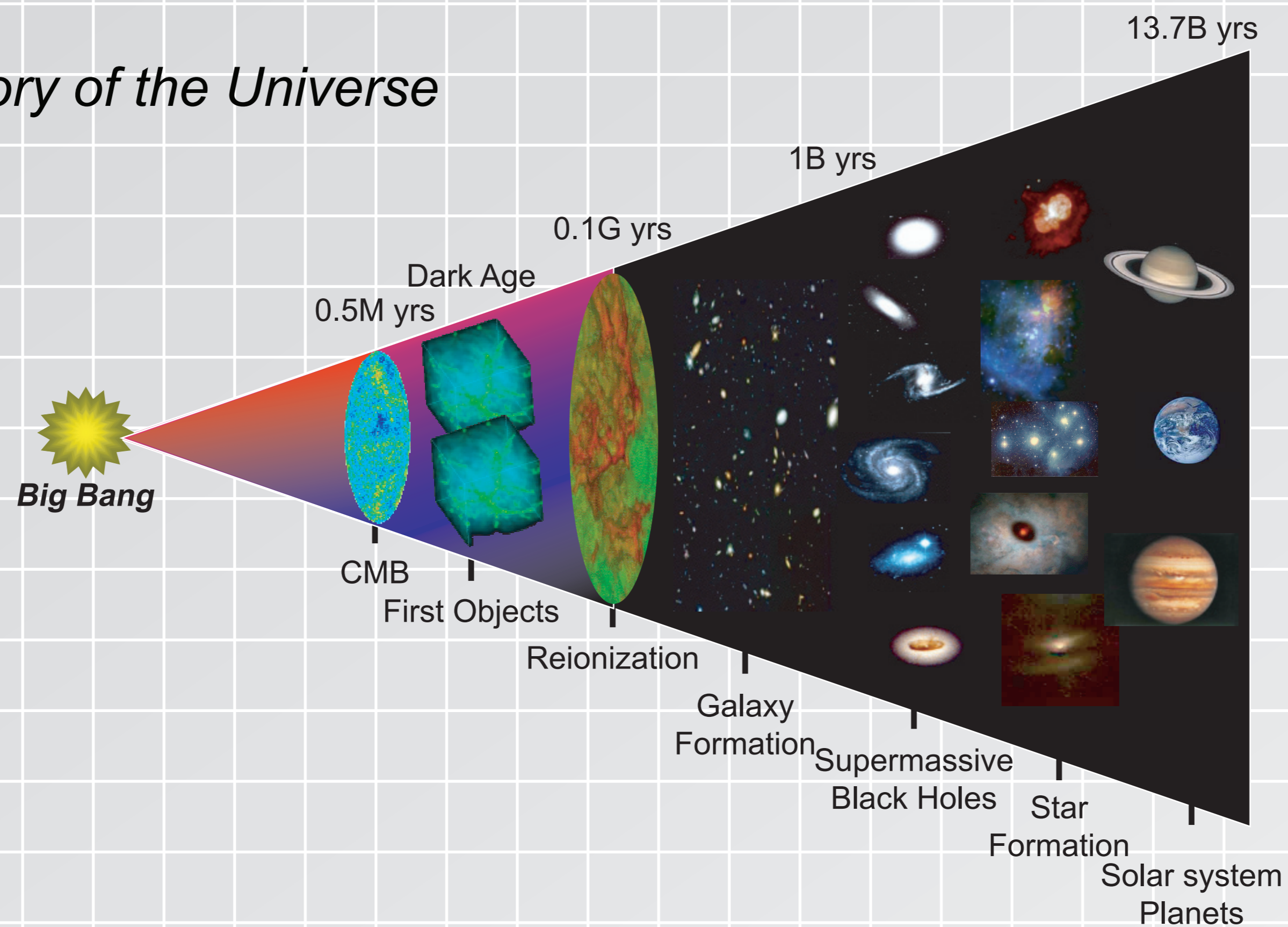**FIRST**
The Origin of FIRST Generation Objects

Computational Astrophysics

In the computational astrophysics group, we are exploring structure formation in the universe, concentrating on the coupling effects of radiation and matter. We have performed a wide variety of simulations of the cosmic structure, using a hybrid cosmo-simulator *FIRST* and a large-scale PC cluster, *T2K-Tsukuba*.

History of the Universe

Big Bang · CMB · First Objects · Reionization · Galaxy Formation · Supermassive Black Holes · Star Formation · Solar system Planets · Dark Age · 0.5M yrs · 0.1G yrs · 1B yrs · 13.7B yrs

FIRST Project

FIRST simulator (256 nodes, 36.1 TFLOPS)

The simulator *FIRST* was constructed collaboration with astrophysicists and computer scientists. The project is funded by a Specially Promoted Research in Grants-in-Aid for Scientific Research since 2004 with a budget of JPY428 million (US$4.7 million), approved by MEXT in Japan. *FIRST* is a new type of hybrid computer dedicated to astrophysical simulations.
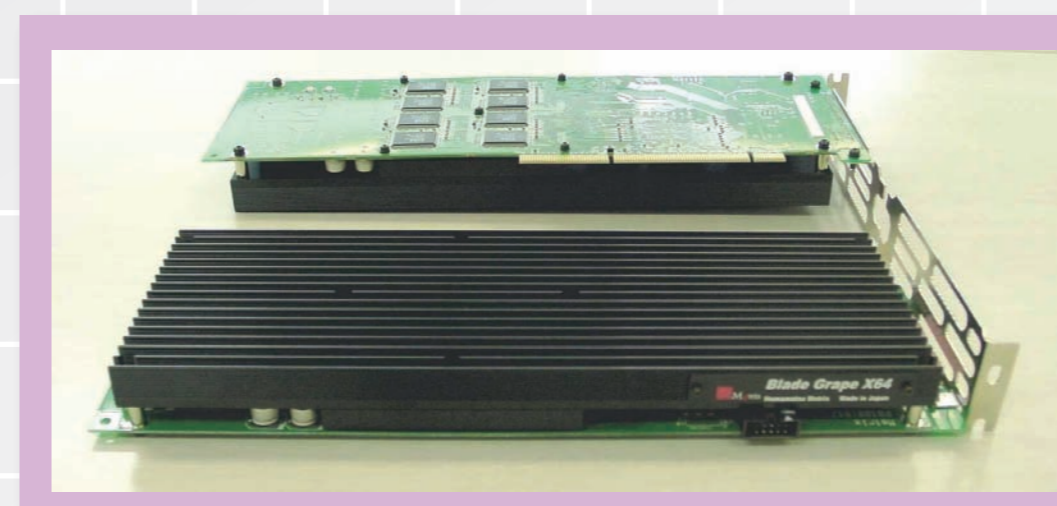
Blade-GRAPE X64 (136.8 GFLOPS)

FIRST is a hybrid PC cluster, where a newly-developed board for gravity calculations, Blade-GRAPE X64, is embedded in each node using the PCI-X bus. The theoretical peak performance of Blade-GRAPE is 136.8 GFLOPS. Each board has 16 MB memory and can calculate the self-gravity of 260,000 particles simultaneously. Using Blade-GRAPEs, we have constructed a 256 node hybrid PC cluster system called the *FIRST* simulator. Each node of the cluster consists of a 2U-size rack-mounted PC (HP ProLiant DL380 G4) that has dual Xeon processors. The peak performance of the *FIRST* simulator is 36.1 TFLOPS, the PC cluster's peak performance is 3.1 TFLOPS and the Blade-GRAPEs are 33 TFLOPS. All nodes are connected uniformly with each other via multi-port Gbit ethernet interconnect switches. The total memory of the *FIRST* simulator is 1.6 TB. The simulator uses the *Gfarm* Grid file system, a commodity-based distributed file system, to federate the local disk of each node into a seamless file system. The total storage capacity is 89.2 TB.

The Blade-GRAPE boards were manufactured by the Hamamatsu Metrics Co. and the 2U servers were procured from Nihon Hewlett-Packard Co. Best-Systems Inc. and Sumi-Sho Computer Systems Co. also assisted in the development of the system.