

Massive galaxies and their central supermassive black holes, are thought to form most of their stars in the first few years of evolution of the Universe.

Some of the the most pressing questions in astrophysics today are related to the formation history of these early galaxies, such as understanding how their star formation history is tied to the growth history of their central black hole, or how their radiation contributes to the cosmic reionization, i.e. the process which heated and ionized the matter in the Universe during its first billion years.

I will present the first results from the PRACE-supported Obelisk project, a cosmological simulation of the first few billion years of a galaxy proto-cluster and its environment. The projects relies on a massive radiation-hydrodynamics simulations following the evolution of the gas, stars and dark matter in the Universe using Adaptive Mesh Refinement techniques with more almost 1.5 billion resolution elements in order to capture a wide range of scales.

The simulation has used 20 million core hours with the heavily parallel code RAMSES-RT, and is the first of its kind to describe the assembly of massive galaxies over two billion years while simultaneously following self-consistently the ionization history of the Universe.