

# Numerical Simulations of Cosmological Galaxy Formation

Stéphanie Courty, Gunnlaugur Björnsson, Einar H. Guðmundsson

Science Institute, University of Iceland  
courty@raunvis.hi.is

Over the last few years, considerable progress in cosmology has been made possible, thanks to the joint efforts of two complementary approaches: observations and numerical simulations. While the former observes galaxies at all wavelengths and in a wide range of redshifts, the latter attempts to reproduce a piece of the universe in a computational volume. The purpose is to understand how galaxies form and what is the role played by the complex and different physical processes involved in galaxy evolution. The observational and numerical data contribute in quantifying in a statistical way, the mass/luminosity distribution of galaxies, the spatial distribution of galaxies via the clustering properties, and how galaxies assemble their mass, for instance.

We investigate galaxy formation and evolution through numerical simulations which compute the cosmological evolution of the dark matter and baryonic matter and include a phenomenological description of galaxy formation. We are particularly interested in host galaxies of gamma-ray bursts (GRBs) as a tracer of galaxy formation. Indeed, GRBs are extremely bright events, some thought to be due to the collapse of short-lived, massive stars while others are presumably due to the merger of two neutron stars or a neutron star and a black hole. These bright events may therefore help to detect faint galaxies, not detectable in galaxy surveys, or galaxies that are at very high redshifts. Since the first detection of a GRB host galaxy in 1997, around 50 hosts have been observed. Although still limited, this sample tends to show that GRB hosts have particular properties: faint, blue objects with high star formation rates per unit luminosity. These are properties closely related to the star formation history of galaxies. Comparing these properties with the overall galaxy population and examining their cosmological evolution, should give insight into how galaxies evolve from the high-redshift universe into the populations we observe locally.