Projects

Current projects

Project archive

Deep low-frequency radio observations of the NOAO Bootes field

With Reinout van Weeren (Leiden), Huub Rottgering (Leiden) and Dharam Vir Lal (MPIfR Bonn)
Published as Intema et al. (2011)
Radio image of the Bootes field (FITS; 28 Mb)
Radio source catalog via VizieR

We observed the NOAO Bootes field with the GMRT at 153 MHz. This yielded an 11.3 square degree field, with a 26“ x 22” resolution and a central background noise level of 1 mJy/beam, rising to 2-2.5 mJy/beam towards the edge of the field. The extracted source catalog contains 598 sources, for which the completeness is estimated at ~92 percent for sources >10 mJy, while the contamination is estimated at <1 percent. We have obtained a spectral index for 417 sources in the overlapping region with a WSRT 1.4 GHz map from de Vries et al. (2002), identifying 16 USS sources with a steep spectral index < -1.3.

Large Scale Structure at z = 4: Lyman Break Galaxies in a wide field around Radio Galaxy TN J1338-1942

With Bram Venemans (Leiden), Jaron Kurk (Leiden/Florence), and Huub Röttgering (Leiden)
Published as Intema et al. (2006)
Project report

The starting point for this undergraduate (master) project was a set of raw (unprocessed) images of a 25' x 25' field-of-view around a luminous, high redshift radio galaxy TN J1338-1942 at redshift z = 4.1. These images were taken with the Suprime-Cam on the Subaru telescope on Mauna Kea, Hawaii, part of a larger observing program to search the environment of high redshift radio galaxies for evidence of galaxy clustering. Luminous radio galaxies are found to be the most massive galaxies in the early universe. It is likely that these objects reside in the centres of proto-clusters, which are galaxy clusters undergoing formation. To map the structure of a galaxy cluster, it is necessary to measure the angular position and the distance (redshift) of large numbers of galaxies. While a moderately accurate method in terms of redshift values, a sensitive and efficient way of finding galaxies at higher redshift is by the use of colors, i.e. differences in wideband magnitudes. The Lyman break technique (Steidel et al. 1996) measures colors of relatively dust-free star-forming galaxies that emit strongly in rest-frame UV. Because a significant part of the redshifted UV flux is absorbed due to ionization of neutral hydrogen in the intergalactic medium, these galaxies are heavily dimmed (if not invisible) in shorter wavelength bands, while clearly visible in longer wavelength bands. By careful selection of wideband filters, one can define color criteria to select galaxies within a certain redshift range without having to do spectroscopy. The aim of this project was to reduce, calibrate and analyse the raw images, to extract a catalog of Lyman Break Galaxies from these images using color selection criteria by Ouchi et al. (2004) and to analyze the spatial distribution of these objects, especially in close proximity to TN J1338-1942.

Hydrodynamical Modeling of Spherical Gravitational Collapse

With Garrelt Mellema (Leiden) and Erik-Jan Rijkhorst (Leiden)
Project report

The aim of this MSc research project was to model the gravitational collapse of a cloud of gas in (empty) space. Gravitational collapse is the only known mechanism that is able to create structure in the universe, like stars, galaxies or galaxy clusters. Gravitational collapse can occur when local fluctuations in gas mass density appear. For gas clouds in a galaxy, this might be caused by shocks from supernova explosions. Areas with an high enough density contrast compared to the average density contract under self-gravity, making the contrast even higher. The contracting gas forms a cloud or breaks up in multiple smaller gas clouds. Eventually, the contraction of the gas clouds is slowed down due to gas pressure (also radiation pressure, centrifugal forces and magnetic fields can play a role). Depending on the mass and the size of the contracted local gas cloud, the contraction stops to form a cloud in hydrostatic (mechanic) equilibrium, or the contraction continues into a gravitational collapse to form a very dense point mass (like a star). For this project, I applied a hydrodynamical model developed by Eulderink & Mellema (1995), an extension of the model by Roe (1986), to numerically simulate the gravitational collapse of a spherical cloud of gas. By assuming initial spherical symmetry without rotation, magnetic fields, chemical reactions or radiation pressure, the collapse can be simulated in a relatively simple manner with only one spatial dimension, namely the radial distance. This reduces the needed computational power in such a way that the model can be easily run on a single PC. Although it seems that, in view of modern development of 3-dimensional hydrodynamic codes with adaptive mesh refinement (AMR), that 1-dimensional modeling is a trip back into history, there was still some relevance to this project. One of the most important motivations was the actual implementation of the hydrodynamical model by Eulderink & Mellema for gravitational collapse as a test case.
