VESUVIO supercluster project

Plans and Prospects Theory and Simulation

The Vesuvio program, with its focus on a few typical superclusters in combination with one of the most extreme specimens of its kind, the Horologium supercluster, will enable a systematic and detailed study of their formation and evolution. The detailed study of a variety of aspects/characteristics of the observed superclusters should provide new insights into the dynamically active phase marking the transition from primordial linear circumstances to advanced nonlinear stages of cosmic structure formation and evolution. This involves a wide range of environments and evolutionary phases, providing an ideal testbed for a detailed and systematic study of the dependence of galaxy formation and evolution on cosmic environment.

The theoretical effort is directed towards, amongst others, the following science goals:

- Expanding our insight into the details of the processes connected with the emergence and the early nonlinear evolution of supercluster structures.
- The dynamical (nonlinear) evolution of the dark matter distribution and the evolution and state of the corresponding gas distribution.
- Understanding the highly complex processes involved in forming and transforming the galaxy population in clusters, filaments, walls and voids.
- The effect galaxies have on their local neighbourhood.

A key item in the toolbox of the theory group will be the capacity to carry out large N-body/hydro simulations of (nonlinear) cosmic structure formation in conjunction with semi-analytical modelling of galaxy formation and evolution to obtain mock samples of the expected galaxy distribution. The latter includes the modelling of physical and observable properties of the galaxies and will be specifically related to the optical and radio wavelength bands covered by the Vesuvio program. The theory group will see it as its task to implement and develop a variety of (statistical) tests for interpreting the various observations. This will also facilitate the interpretation of photometric and spectroscopic data on the galaxy/stellar populations from the optical surveys, in particular with respect to environmental effects. A major point of attention will be the development of a feedback mechanism for predicting and identifying the most interesting regions for the observational programs. This will be based upon the production of a cosmographic (environmental) reference of the dark matter distribution, on the basis of which we will model the galaxy and intergalactic gas distribution.

In summary, we may list some of the relevant topics which will figure in our theoretical studies:

- **Formation and evolution of the cosmic web**
- **Dynamical evolution of clusters,
their interaction with the immediate large scale surroundings and
their role within the cosmic web**
- **Intracluster Gas and Intergalactic Medium**
- **Environmental Influences Galaxy Evolution**
- **Cosmography: Reconstruction Cosmic Web and Supercluster structure**
- **(Statistical) Analysis Tools – Development and Interpretation**
- **Visualization Tools**

Our interests will be organized into four different, yet mutually complementary, tracks:

- **Theoretical modelling of cosmic web formation**.
- **Theoretical modelling of galaxy evolution & Environment**.
- **“Adaptive” observing.**
- **Statistical analysis, interpretation and visualization**