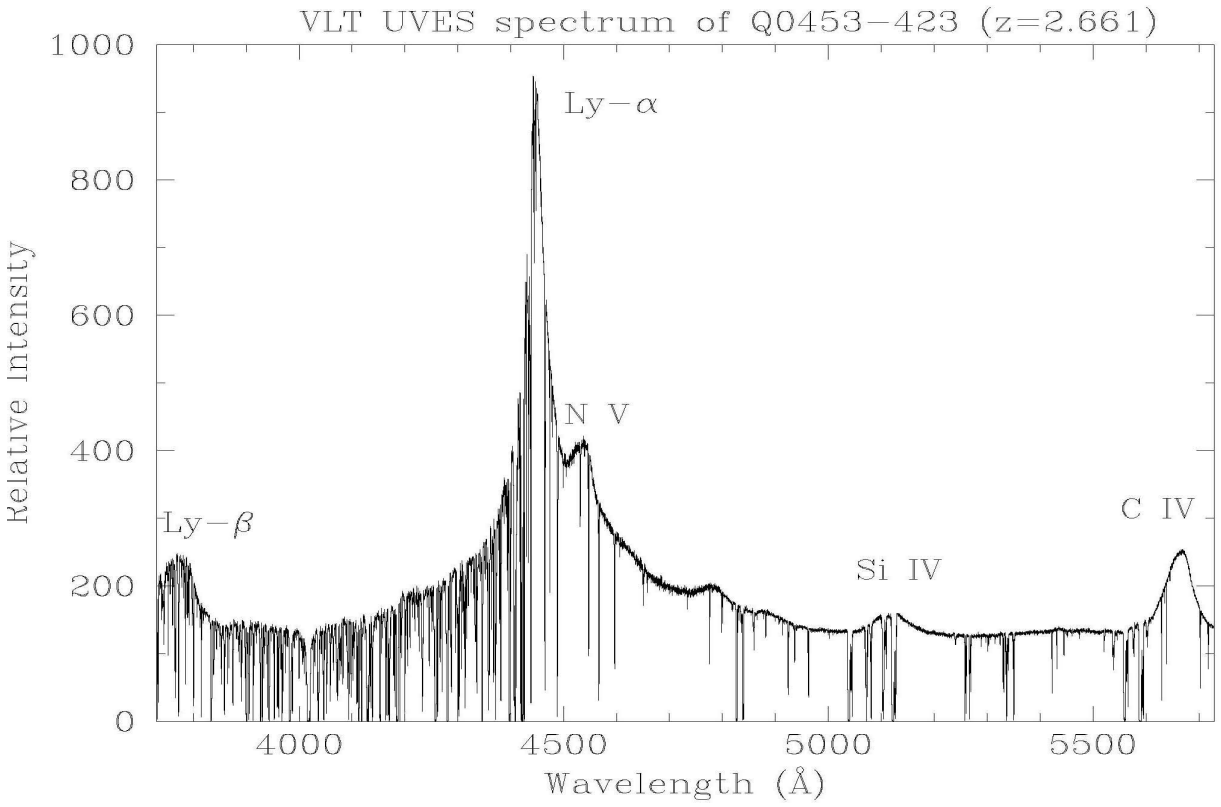
THESIS – LAUREA MAGISTRALIS

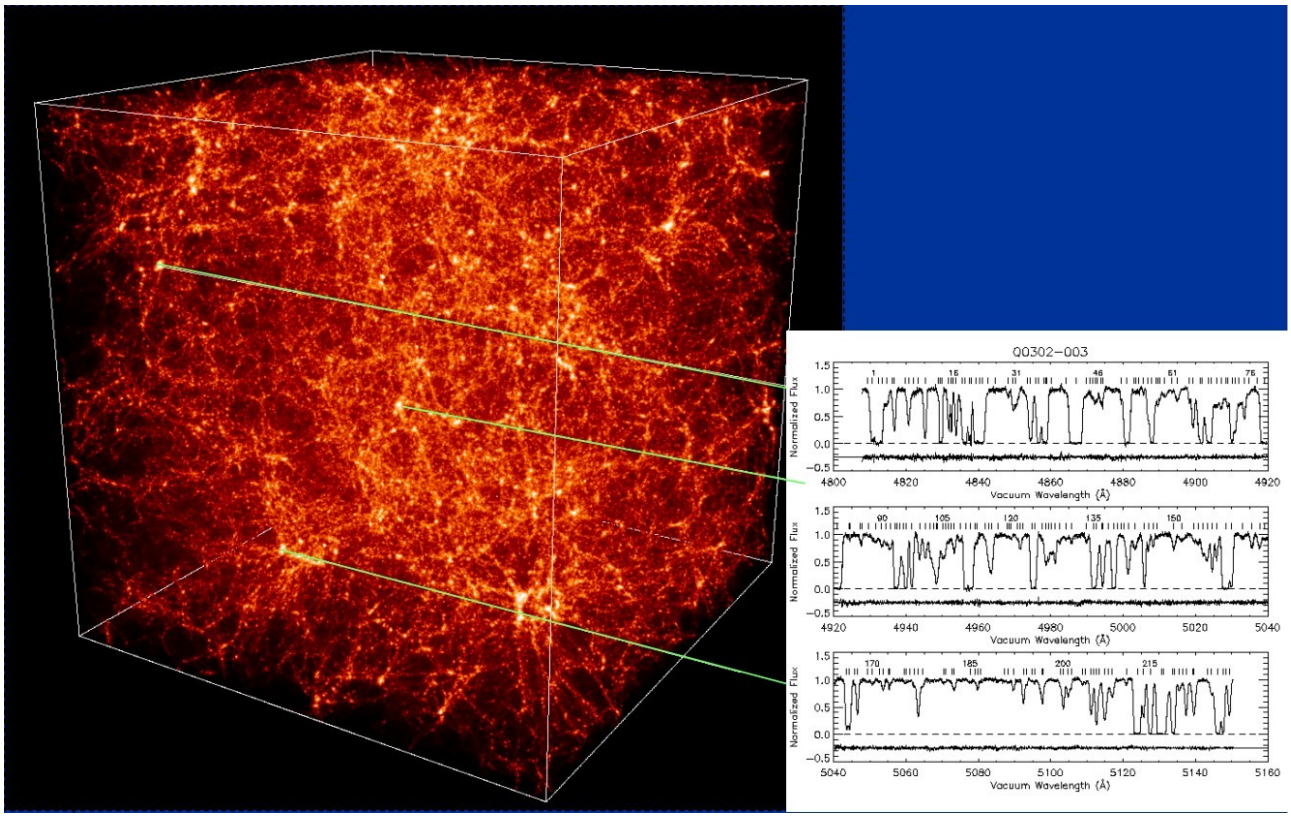
THE INTERGALACTIC MEDIUM AS A COSMOLOGICAL TOOL

(Supervisors: S.Cristiani, V.D'Odorico, M.Viel @ INAF-OATs)

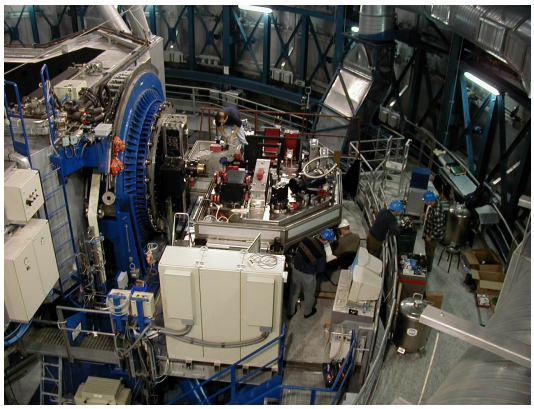
Along the line of sight to a distant source - a quasar, a galaxy, a gamma-ray burst - every parcel of gas selectively absorbs certain wavelengths of light due to the presence of the various chemical elements in it. The observation and interpretation of absorption lines in QSO spectra has become a major topic of modern cosmology. QSO absorption lines, in fact, allow to probe the Universe up to large redshifts, when it was only few percent of its present age. This represents a unique and independent source of information, between the cosmic microwave background (CMB) data, at z~1000, and the large scale distribution of galaxies, at relatively low redshift.



The understanding of the ``forest'' of absorption lines, observed in the region bluewards of the Lyman-alpha emission of high-redshift quasars, has dramatically improved in the recent decade, both on the theoretical and observational side. For redshifts accessible to ground observations, Lyman-alpha clouds outnumber any other known object and constitute an invaluable probe of the matter distribution in the universe. Most of the absorption arises in low density un-shocked gas, characterized by moderate over-densities and in ionization equilibrium with the metagalactic UV background. The interplay between the evolution of this medium and the galaxies is close: at z>1 most of the baryons reside in the Lyman forest, acting as a reservoir for galaxy formation, while star formation influences the physical state of the IGM through metal enrichment and emission of ionizing radiation. It is therefore of fundamental cosmological interest study the spatial distribution, motions, chemical enrichment, temperature and ionization histories of gaseous structures.



Hydrodynamic cosmological simulations have been remarkably successful in reproducing the observed characteristics of the Lyman forest: from the column density and Doppler parameter distribution to the number density and effective opacity evolution. Relatively simple physical processes govern the thermal state of the gas, which effectively traces the underlying distribution of dark matter. In this way it is possible, for example, to recover the mass power spectrum – another fundamental piece of cosmological information - from inversion of the observed Lyman-alpha forest spectra.



The specific aim of the thesis is to analyze state-of-the-art spectra obtained with the ESO-VLT and Keck telescopes and compare them with hydrodynamical simulations computed with the GADGET code in order to assess the physical and chemical properties of the IGM and compare them with cosmological scenarios, in particular the temperature-overdensity and the metallicity-overdensity relations as a function of the redshift.

Contact: S. Cristiani – email: cristiani_at_oats.inaf.it

In the framework of this thesis it is foreseen the following

Stage/Tirocinio: Reduction and Analysis of High-Resolution Spectroscopic Data

- SW packages for visualizing and handling data
- Reduction pipeline
- Continuum fitting
- Line fitting tools
- Line Systems identification
- System interpretation (e.g. the Cloudy package)
- Physical and chemical properties

Supervisors: S.Cristiani (cristiani_at_oats.inaf.it), G. Cupani, V. D'Odorico.