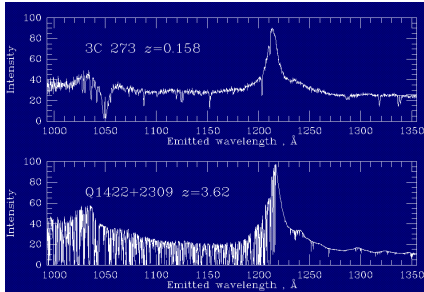


Spectrograph(s) for the Lyman-alpha Forest

Spectral analysis of the Lyman-alpha forest



credit: keel@bildad.astr.ua.edu

The study of spectra of distant quasars is essential to the understanding of the evolution of the universe, its large-scale structure and the properties of the intergalactic medium (IGM). The Gunn-Peterson effect also provides a way to measure the neutral fraction of the IGM. To study the Lyman-alpha forest the spectra should be recorded with a high resolution and a high efficiency and dedicated spectrographs shall be developed. image

Theory

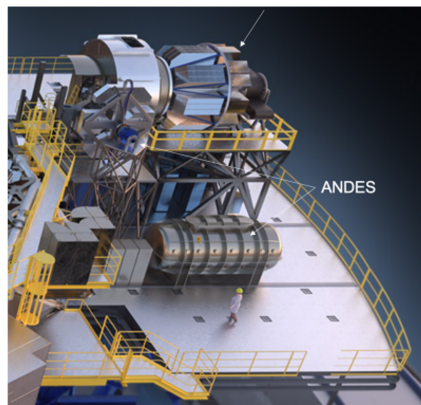
by PHILIPP HUKÉ

The basics principles of observations, telescopes and spectrograph-design are discussed. The spectra of Quasars and thus the Lyman-alpha forest are studied to learn about the application and to derive requirements to the spectrograph(s). A Matlab (or Python)-based approach is used to model the spectrograph(s) and estimate their efficiency. Laboratory experiments will be carried out to learn about optical components.

Applications

by PHILIPP HUKÉ

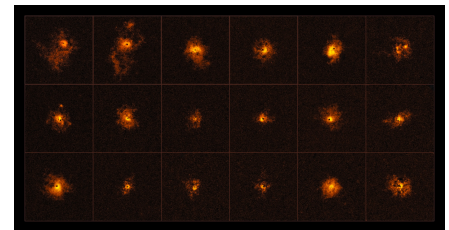
With the Extremely Large Telescope (ELT) being built right now (www.elt.eso.org) a deeper exploration of the universe and a deeper understanding of cosmic objects comes into reality. The ELT and its instruments will be the work horse for many scientific discoveries in the next decade. One of these instruments is a spectrograph which is built by the ANDES consortium. This background allows students to get into contact with a huge network of instrumentation developing institutes and researchers.



ANDES will reach a resolution of 100.000 and cover a bandwidth from 400 nm - 1800 nm. One of its science cases is the Sandage-test, which uses the Lyman-alpha forest to measure the acceleration of the expansion of the universe. However, distant quasars are very dim and a lot of photons need to be collected to provide good spectra. Unfortunately, the efficiency of the overall instrument (telescope+ANDES) is very low in the targeted bandwidth. The aim of this project is to develop spectrograph(s) that are solely dedicated to the measurement of the Lyman-alpha forest. In this project scientific data of Quasars observed with UVES will be studied to understand the application. This includes spectral analysis of the Lyman-alpha forest. The line positions and depth tell about how

many clouds at which red shifts were traversed by the Quasar's light. The "quality" and "quantity" of spectra will be regarded as well, in order to identify a suitable set of quasars observable with available telescopes and spectrographs.

Based on this a design of spectrograph(s) that may be used with the Very Large Telescope (VLT) allowing for the same accuracy in the scientific observations will be derived.



18 Quasars observed by a team of observers of the ETH Zürich. Each quasar comes with a bright gaseous halo. Credits: ESO/Borisova et. al.

See also

[Philipp Huké](#)

Contact

☎ +49 4921 807 1457 (Philipp Huké)

✉ philipp.huke@hs-empden-leer.de