Spectrograph(s) for the Lyman-alpha Forest

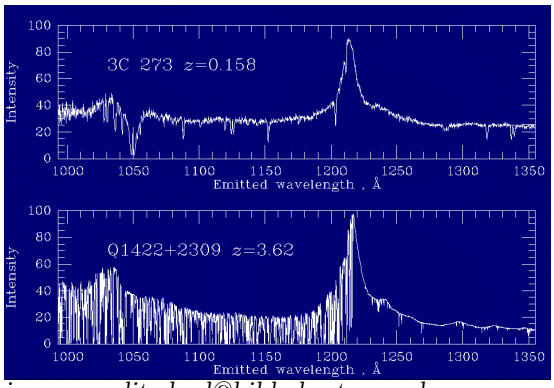

image credit: keel@bildad.astr.ua.edu

SUMMARY.

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 their spectra should be recorded with a high resolution and a high efficiency spectrograph. Dedicated spectrographs like ANDES are under development. Their need of observation time with extra-large telescopes impacts negatively the scientific development.

A possible approach would be to build a spectrograph dedicated to this sole task fulfilling only the requirements to this measurement.

OBJECTIVES

- *What will student learn?*
  - *Cosmology - Quasars, Age of the universe,Sandage-Test*
  - *Measurement - Theory of measurements and instruments*
  - *Management - Develop an instrument from a scientific question*
- *What will students learn to do?*
  - *Work in the laboratory, use optomechanical and electronical equipment*
  - *Set up measurement systems*
  - *Use telescopes (Hobby-class) scientifically*
  - *Understand control of measurement systems*
  - *Manage a design process*

INSTITUTE

- University of Applied sciences Emden / Leer
- Institute for Lasers and Optics
- https://ILO-Emden.de
- Constantiaplatz 4, 26725 Emden, Germany

The working group develops components for calibration of (astrophysical) spectrographs. Prof. Huke is responsible for the design and development of the Calibration Unit(s) for ANDES, the Armazones high Dispersion Echelle Spectrograph.

THEORY

by Philipp Huke

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. The basics principles of observations, telescopes and spectrograph-design are discussed.

APPLICATIONS

by Philipp Huke

The evolution of ANDES and its science cases will be described. During this process the derivation of requirements leading to a physical design will be explained and adapted to the development of the dedicated spectrographs. Based on this lectures about spectrograph-design and description of measurements will be taught to allow for an own design. To understand the problems arising during a design experimental work with spectrographs, optomechanics and light-source will be carried out.

MAIN PROGRESSION STEPS

- `Week 1-4`: courses Advanced Metrology and Advanced Laboratory and project
- `Weeks 5-8`: project
- `Weeks 9`: report + presentation

EVALUATION

- `Theory grade [30%]`
  - Report (70%): theoretical question, base calculus from lectures, Design derivation
  - Presentation of a design based on theoretical values (30%): Context, oral and slides quality
- `Practice grade [30%]`
  - Experimental work in the lab (30%): thought-process and results
  - Project (70%): initiative, progress, analysis, report
- `Defense grade [40%]`
  - Oral and slides quality
  - Context
  - Project / Personal work
  - Answers to questions

BIBLIOGRAPHY & RESOURCES

- ANDES
- Instrument Design former groups

CONTACT

ℹ Philipp Huke
☎ +49.4921.807.1457
✉ philipp.huke@hs-emden-leer.de