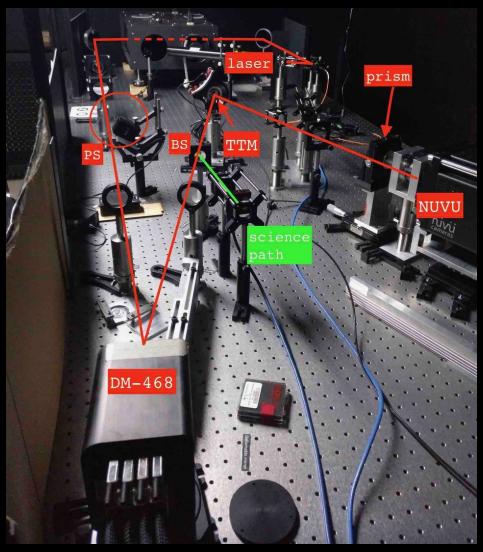
Adaptive Optics System On-sky Validation



SUMMARY.
A brand new adaptive optics system (left) is being installed in a new 4 m telescope (DAG project) in Eastern Anatolia (Turkey) by a team from the University of Applied Science Western Switzerland. The objective of the project is to participate with DAG scientists and enginners in the test of the AO system, in the laboratory and on sky data. This project is a first for Turkish astronomers, and the AO system will be dedicated to exo-planet resarch. The MAUCA student will help in the data acquisition and processing, as well as finalising the development of an end-to-end AO modelling tool.

OBJECTIVES

- Learning to work with an engineering and science team in the context of an astronomical instrument development. The student will learn about optics, optics laboratory and optical system modeling, all in collaboration and with the guidance of experts in the field of optics and instrumental astrophysics. The student will also have the opportunity to see how an instrument project is managed.
- From the many exchanges with the AO development team, the student will be able to gain independence and maturity in the development of a research program, by being able to make use of existing academic knowledge.

PREREQUISITES

- Fourier optics
- Numerical methods
- Data analysis

THEORY

Adaptive optics, basis of the control system theory, detectors.

APPLICATIONS

Adaptive optics is now a mature technique in astronomical instrumentation allowing to restore the ground telescopes angular resolution by compensating in real time the aberrations generated by atmospheric turbulence. While the method is mature in many ways, there are still lots of research directions aiming at improving the systems performance: the size of the corrected field-of-view, the sky coverage, the correction of shorter and shorter wavelengths up to the V and R photometric bands.

One of the hot topic at the moment is optimisation of AO systems based on a new type of wavefront sensor, the so-called Pyramid wavefront sensor (P-WFS). Coupled with a high order deformable mirror and a no noise WFS detector, it has the potential to significantly increases the correction performance for bright and faint natural guide stars, when compared with a classical Shack-Hartmann based WFS AO system.

A the University of Applied Science Western Switzerland (Haute Ecole Spécialisée de Suisse Occidentale) we have developed such a system for a new 4 m telescope being set up this summer 2022 on a high altitude site in Eastern Anatolia, near the city of Erzurum, Turkey (DAG observatory project). The system will be available for tests beginning of January 2022, with remote access from Switzerland.

The goal of the METEOR student would be to work in close collaboration with the AO team in Switzerland and in Turkey, from Switzerland (no travel is required), to test the system performance using many procedures - the goal is to verify how well the system behaves with respect to the specifications and the AO modelling. If weather and time permits, the system will be tested on-sky. Beside, the student will push further the development of the end-to-

end AO modelling tool that we are using as a reference to test the system.

A basic knowledge of optics and adaptive optics is required, and some confidence with data analysis using any data processing tools, as MATLAB, IDL or PYTHON.

MAIN PROGRESSION STEPS

- Getting to know the AO system to be tested
- Starting the development of the AO modelling tool
- Laboratory system (or on-sky) data acquisition and performance analysis.

EVALUATION

- Type of examinations: oral presentation, report.
- 25% oral exam, 75% report.

BIBLIOGRAPHY & RESSOURCES

DAG project Link
DAG AO system project documentation (on demand).

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