"Imaging and instrumentation for high angular resolution (HAR) and high contrast in Astronomy"

30h Theory + 30h Lab. + 20h TPE

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Pre-requisite: module M1S1 "Imaging and instrumentation in Astronomy", module M1S2 "Imaging through atmospherical turbulence", module M1S2 "Numerical signal processing", and module M1S2 "Imaging and interferometry".

A) "Fourier reminder and laboratory illustrations"
   Reminder of the different remarkable characteristics of the Fourier transforms and their usefulness. Illustations include Fourier filtering in

   optical laboratory. 2h Theory + 2h Lab. [ÉAr, MCa].

B) "Astronomical interferometry"
Foundations of optical interferometry in Astronomy, and laboratory

manipulations. 6h Theory + 5h Lab. + 7h TPE [FMa, LAb].

C) "High-contrast imaging and stellar coronagraphy"
   Course of imaging at high contrast and stellar coronography, with

   laboratory experiments. 6h Theory + 5h Lab. + 7h TPE [PMa, LAb].

D) "Automatics for astronomy"
   The first part of this course is a general introduction to the methods of automatics in the framework of astronomy. The second part is dedicated to the resolution of control problems in astronomy: (i) pointing of the telescope, (ii) control of the tip-tilt modes and higher

   modes in adaptive optics, (iii) fringe tracking in interferometry. 4h Theory + 2h Lab. [JPF].

E) "Detectors for astronomy and space"
Introduction to the different technologies of optical detectors. At the end

of this course the student will be able to comprehend the differences between detectors and to understand the performances and limitations

of each of them. 6h TPE [BVa].

F) "Modelling in astronomical adaptive optics (AO) & post-AO imaging" Scope of this course is first to carry out an introduction to the different concepts of AO and to the effects of them on the final data/images. Detailed numerical modelling will be used in order to go deeper into each of the concepts in details and in association with the instrumentation specific to the astrophysical cases at the beginning of each of these concepts. Image processing, in the generic case as in some particularly interesting specific cases such as the low-correction one (low Strehl ratios) and, on the opposite, the high-correction one (high Strehl ratios), will also be tackled. 12h Theory + 16h Numerical Lab. [MCa].

Detail:
+ Astronomical AO and post-AO imaging: 8h Theory.
+ Modelling of a generic AO system and optimisation of its imaging performances at HAR: 1h Theory + 4h Numerical Lab.
+ Modelling of an extreme AO system with a stellar coronagraph for imaging at high contrast: 1h Theory + 4h Numerical Lab.
+ Modelling of a ground-layer AO system for imaging at wide field of view: 1h Theory + 4h Numerical Lab.
+ Image processing of post-AO data, at both very low and very high Strehl: 1h Theory + 4h Data Analysis.