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L. Cambrésy, F. Martins, E. Nuss and A. Palacios (eds)

MASTER TRAINING COURSE FOR DETECTION TECHNIQUES

P. Kern[1]

Abstract. The LabEx FOCUS proposes a training course to the detection techniques. It will be proposed yearly to the students of master or of engineering school . This theoretical and practical training will be given during a full week at the Observatoire de Haute Provence. The teachers are members from the laboratories of the FOCUS consortium.

Keywords: Detection, education, instrumentation, Infrared, visible

1 Introduction

The LabEx FOCUS (FOCal plane arrays for Universe Sensing) is dedicated to the development of novel high technology matrix arrays detectors aimed to equip the next generation facilities for Universe Sciences. The LabEx is hosted by the Grenoble University PRES, and is supported by the local network of world-class industrial and academic partners that are specialists of the detection. A LabEx is a funding tools of the french government under the PIA program (Programme dInvestissement dAvenir), which gives support to local federation of researchers or that addresses a specific thematic through a suitable consortium.

FOCUS addresses three complementary research programs:

- Detectors for the far IR and (sub) millimeter direct imaging. It includes bolometers and KID developments.
- Detectors for the near and mid IR.
- Advanced detection systems, such as new photo-counting devices or curve detectors which can lead to a drastic simplification of the design of an instrument.This third theme is also aimed at leaving room for future researches not yet considered.

The partners' expertise ranges from technology to astrophysics, including instrumentation, signal processing and sensor science. The partners are:

- In Grenoble: IPAG, Institut Néel, LPSC, IRAM and IMEP
- in Paris area: SAp / CEA and ONERA
- in Marseille: LAM

in Grenoble, , and LAM in Marseille.

Funding is provided for a period of eight years and should support research, teaching and valorization activities. Throughout his teaching activity, FOCUS is organizing a week of training course dedicated to detection in astrophysics. Funding is also dedicated to supporting the educational experience, training, but also for existing training programs of the partner from the different universities. In this paper we describe the content of the training week to be held at the Observatoire de Haute Provence next November.

[1] IPAG, Observatoire de Grenoble, 38041 Grenoble, France

2 Contents of the course

This week of training is shared between theoretical lectures et practical works related to the detection in astrophysics. It is aimed at the training of students that consider for their PhD an observational or instrumental work, in order to provides them with the basics of the detection in astrophysics.

Theoretical lectures are given in the mornings or afternoons and experimental work will be held in the afternoon or during the nights. The experimental work used teaching or professional equipments, some of them funded by FOCUS.

For later versions of this training, lectures are scheduled in English to be able to accept students from foreign universities.

2.1 Theoretical program

The lectures address the following topics:

- Astrophysical introduction and general notions. What are the needs and the typical measurements in astrophysics (photometry, imagery, spectroscopy, and so on): what can be measured by a detector?
- Reminder of the required notions: photometry, image formation, sampling, image and pupil of an optical instrument ...)
- Physics of the detector, different types of detectors, detector characterization.
- Noise and signal processing: various contributions *which noise is dominating ?*).
- Instrumentation regarding to astrophysical applications (how is designed an instrument, specification of the detector, integration of the detector in the instrument) handling of the detector (electronics, optics, cryogeny).
- Current developments in detection and the next generation.

2.2 Experimental work

The experimental work will be done during the afternoons and evenings either in laboratories or on telescopes of the observatory.

- Practical activities by group of 3 students:
  - Detector characterization in laboratory (OHP and LAM support).
  - Transit observation on telescope (OHP support)
  - FTM Characterization in laboratory (ONERA support).
- Demonstration using research equipments
  - Operation of several IR camera, cooled or not, at various bandwidths. Application to nocturne imagery (ONERA support).
  - Radial Velocity observation using OHP facilities (OHP astronomer support)
  - Night glow observation (OH lines emission) in visible and NIR (ONERA support).

3 Participants

The course will receive up to fifteen french and foreign students from various Master (astrophysics, physics) and engineering schools.

The students will be proposed by their Masters. Some PhD students can be also proposed by their supervisors.

the selection of the students will take into account the following requests, mandatory to be able to follow the lectures of the week and to have the elements for the proposed experiments.

- Basic physics

- Geometrical Optics
- Physical optics (diffraction, spectroscopy, polarization)
- Signal processing (especially Fourier formalism, sampling principles

4 Organization

For the first year the training course will be from the 18th to the 22th of November 2013. The students arrive in OHP on the Sunday evening and leave on the Friday evening.

The LabEx insures the funding for the accommodation of the students and for the equipment for some of the experimental setup.

The team includes teachers, engineers and researchers from ONERA, CEA/LETI, CEA/SAp, IPAG and OHP. Isabelle Ribet from ONERA ensures the coordination of the program. Pascal Gallais from SAp and Gilles Duvert from IPAG coordinate all experimental work at OHP.