The PAU Camera

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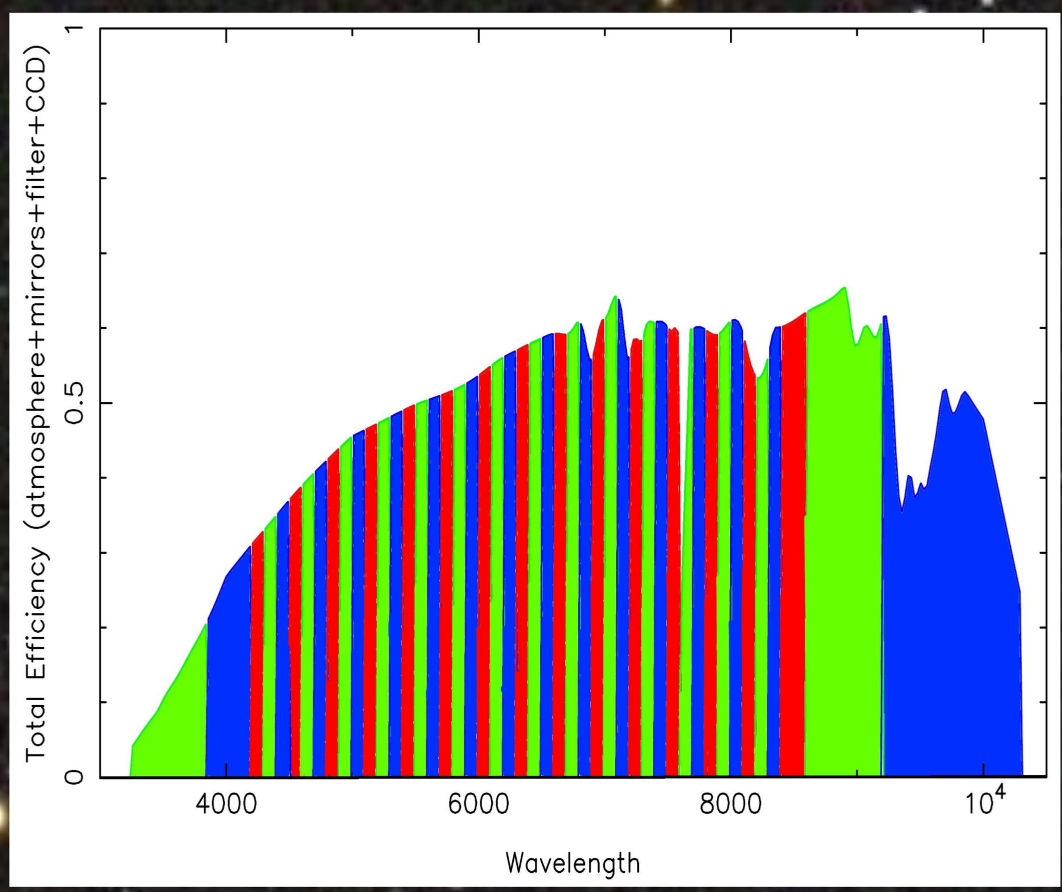
Motivation

Determining the spectral energy distribution (SED) of astronomical object provides information about their nature and properties. For galaxies, the spectral features in their SEDs allow us to measure their redshifts and properties such as their stellar mass, the age of their stellar populations, their metallicities, and their dust content. In order to study and properly sample the SED of a galaxy one needs to measure it with sufficient spectral resolution. Normally this is achieved with spectrographs. Cosmological studies require the study of large volumes sampling many galaxies out to large redshifts and faint limits. However, the multiplexing capabilities and the depth reached by spectrographs do not always allow these cosmological and evolutionary studies. Moreover, many cosmological applications do not require the resolution delivered by spectrographs. Another viable approach is to sample the galaxies SEDs with less resolution using narrow band filters photometry. This is the technique chosen for the PAU survey.

The PAU collaboration is building a large field of view camera equipped with ~40 narrow band filters in order to perform a large area survey for cosmological studies. The idea is to use ~100 Å wide filters to sample the galaxies SED to obtain accurate photometric redshifts.



Example of a possible filter set for the PAU Camera

Camera

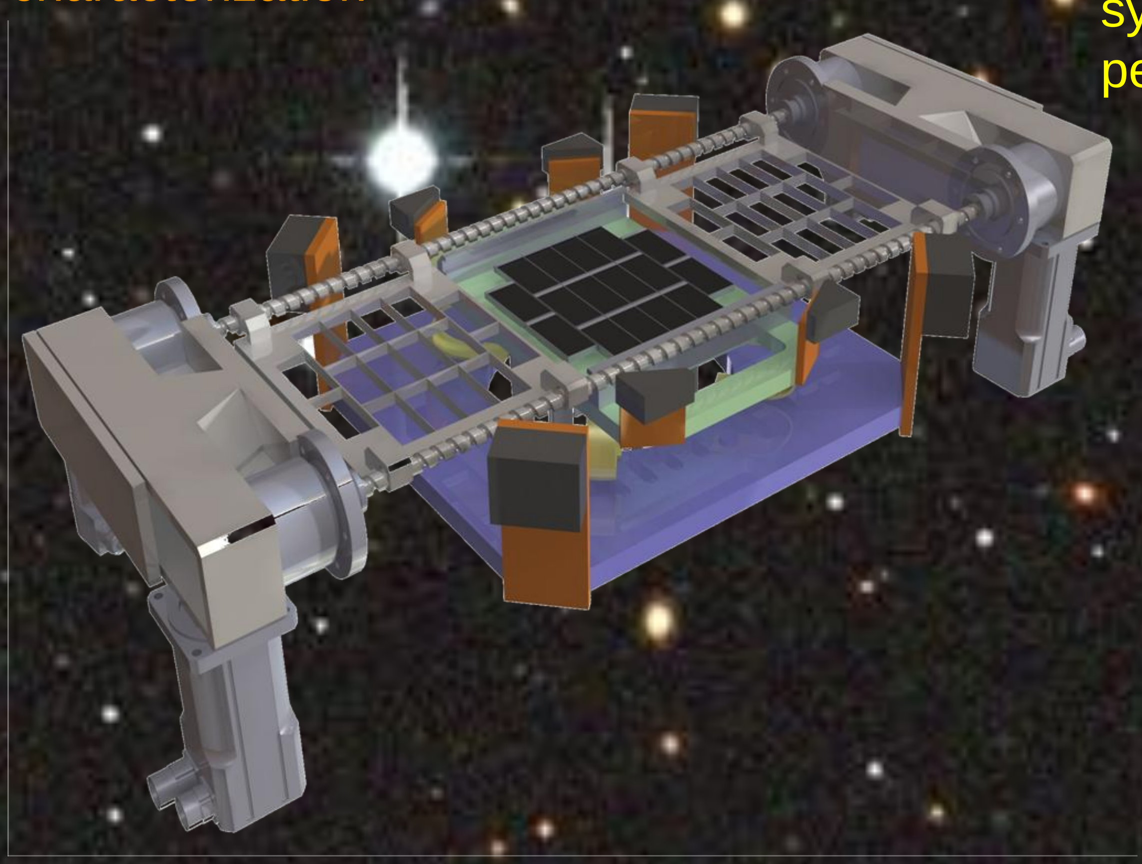
We are currently working on the design of two camera concepts: a first one of intermediate size (PAUCam-1) which should serve as a proof of concept but still designed to deliver scientific valuable data and a second large one (PAUCam-2) to exploit the full capabilities of large field of view focal planes. The main components of the camera are: the camera vessel, the entrance window, a segmented filter tray to support the narrow band filters, a mechanism for filter tray interchange, the CCD plate, the cold plate, the cooling system, the vacuum system, the front end electronics, diagnostic devices and cables, connectors and feedthroughs.

Set-up testing station for CCD characterization

The camera distinctive features are the use of many narrow band filters and a large field of view. Relevant aspects for the camera performance are:

- The filter system interchange: to maximize performance we need to place the filters very close to the detectors. We also need to be able to change them. We have designed a changing mechanism that works in vacuum conditions.
- The CCDs: we need large format detectotrs with high quantum efficiency in a wide wavelength range with sensitivity up to 1μm.
- The read-out electronics: we need to read many detectors simultaneously with low read-out noise. The system is based on the Monsoon architecture developed by NOAO.

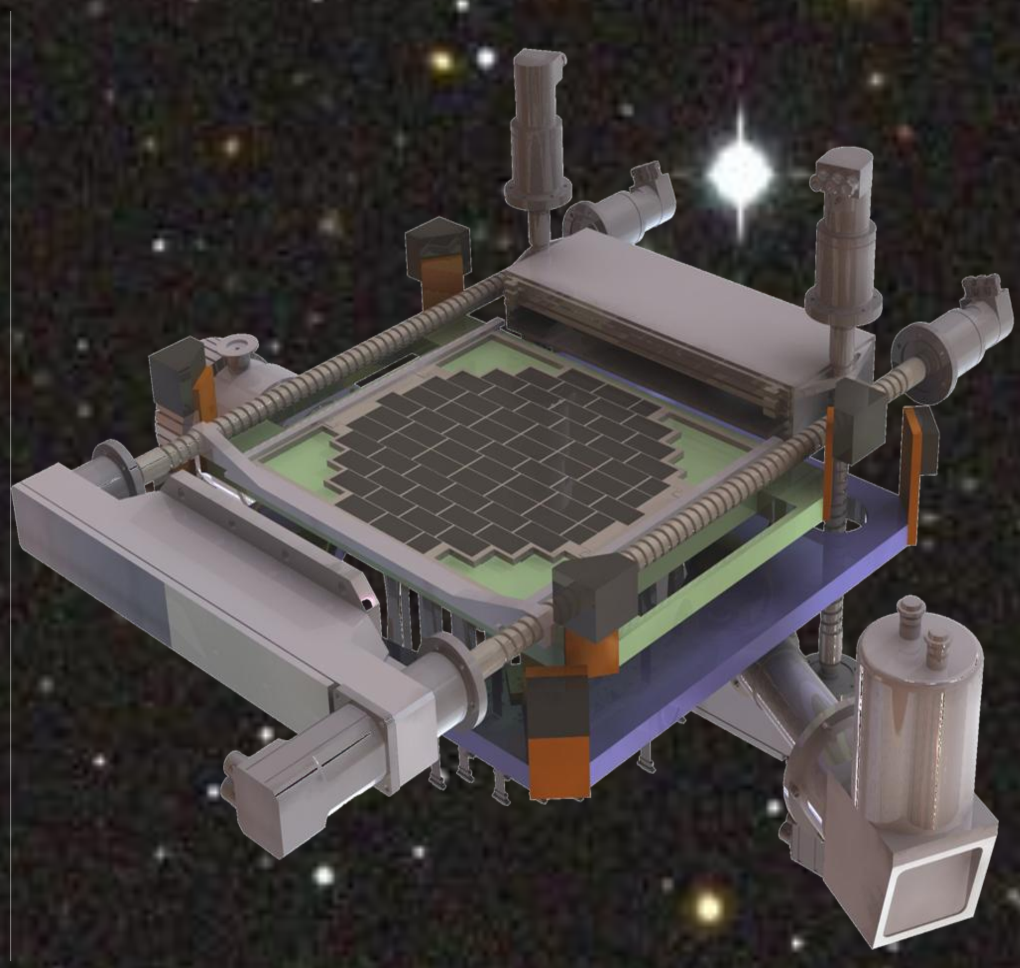
Electronics boards based on the Monsoon read-out system developed by NOAO



Preliminary 3D model of PAUCam-1

Instrument Main Characteristics

	PAUCam-1	PAUCam-2
Field of view	20cm	40cm
Number CCDs	~15	~50
Number filters	~40 narrow + 5 wide	
Wavelength range	4500-8500 narrow 3500-10000 wide	
Pixel size	15μm	
Read-out noise	<5e$^-$	



Preliminary 3D model of PAUCam-2

Detectors for Astronomy, ESO Garching, 12-16 October 2009