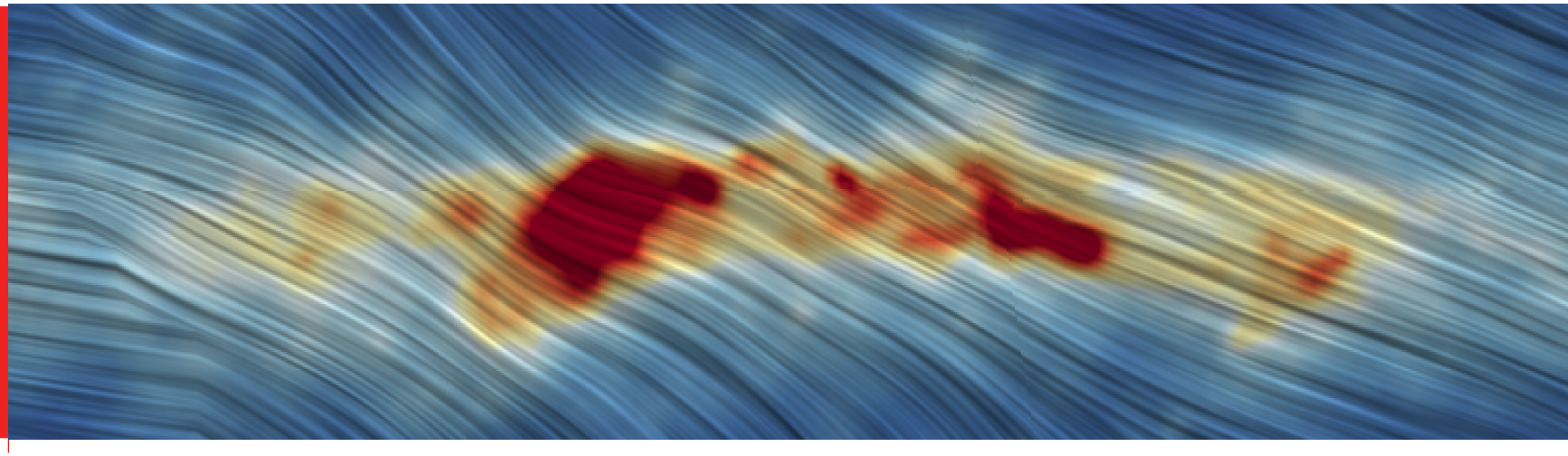
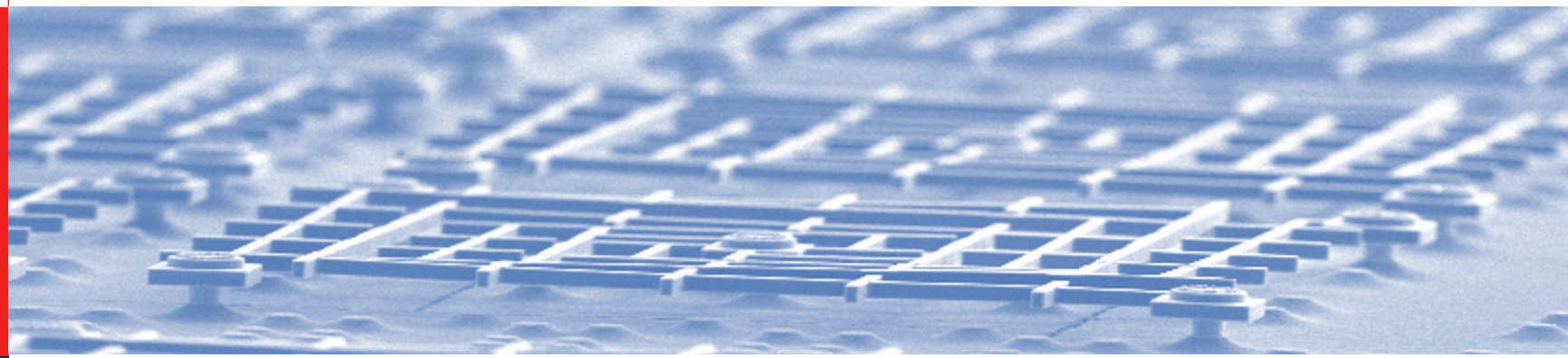


ne journée de l'Axe
Astrophysique

DUATE SCHOOL
sique

The B-BOP detector, a new generation of resistive bolomet for submillimeter astronomy combining imaging, polarime and spectroscopy within the pixels



Timothée Tollet

Rodriguez, V. Revéret,
. Dussopt, A. Aliane

FOCUS
Focal Plane Array for Universe Sensing

université
PARIS-SACLAY

ummary

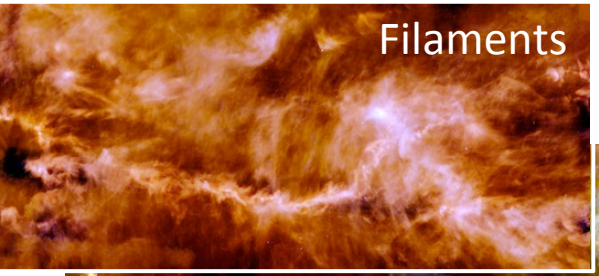
1. The scientific cases in the sub-mm astronomy

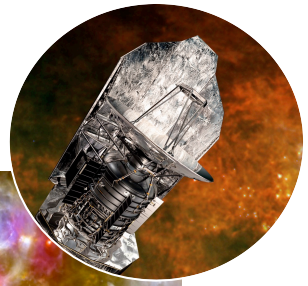
2. B-BOP, presentation and working principles

3. Development of on-chip spectroscopic solution for sub-mm detectors

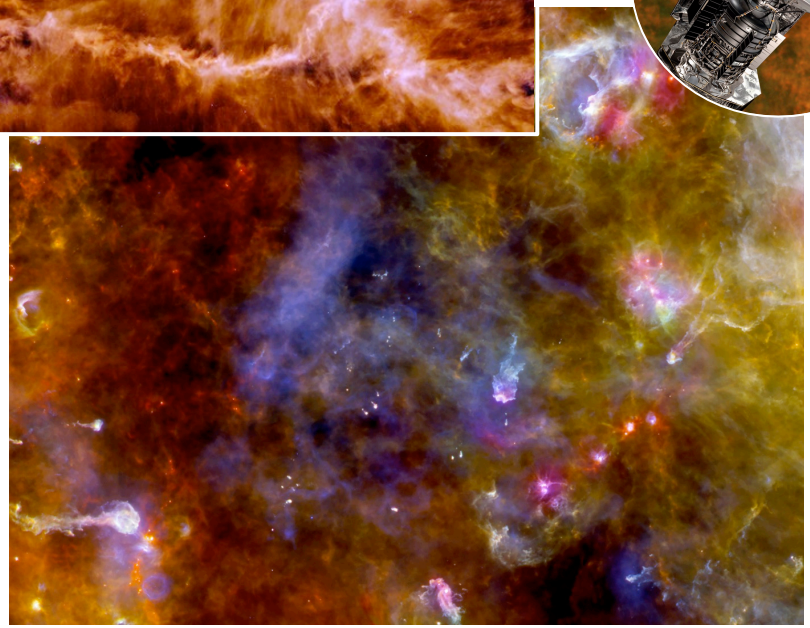
4. Perspective for B-BOP on the sky

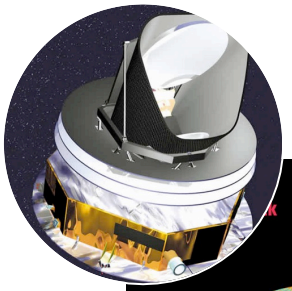
ne submillimeter astronomy : the main study
ses



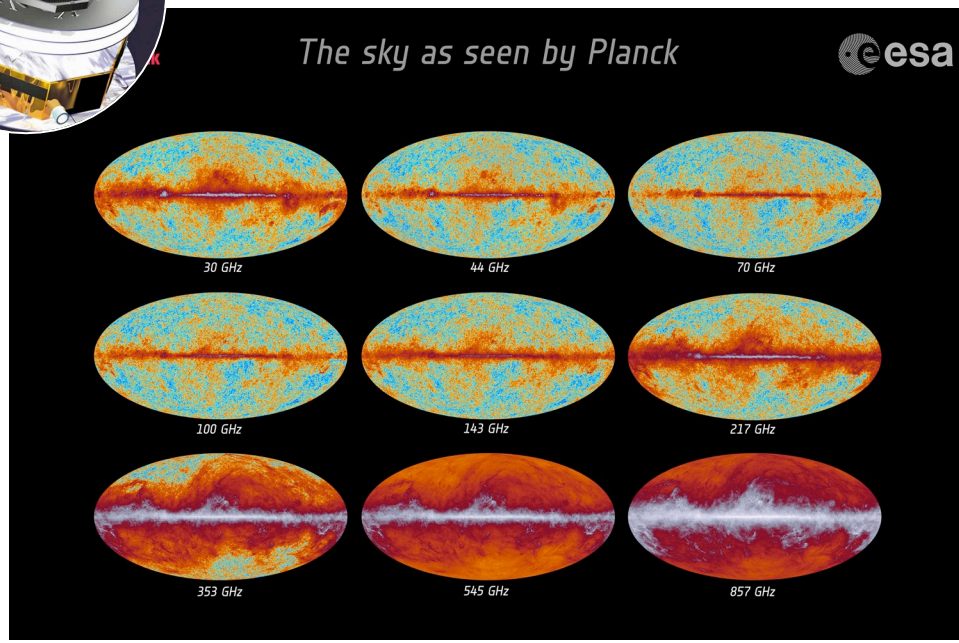


Herschel





Planck

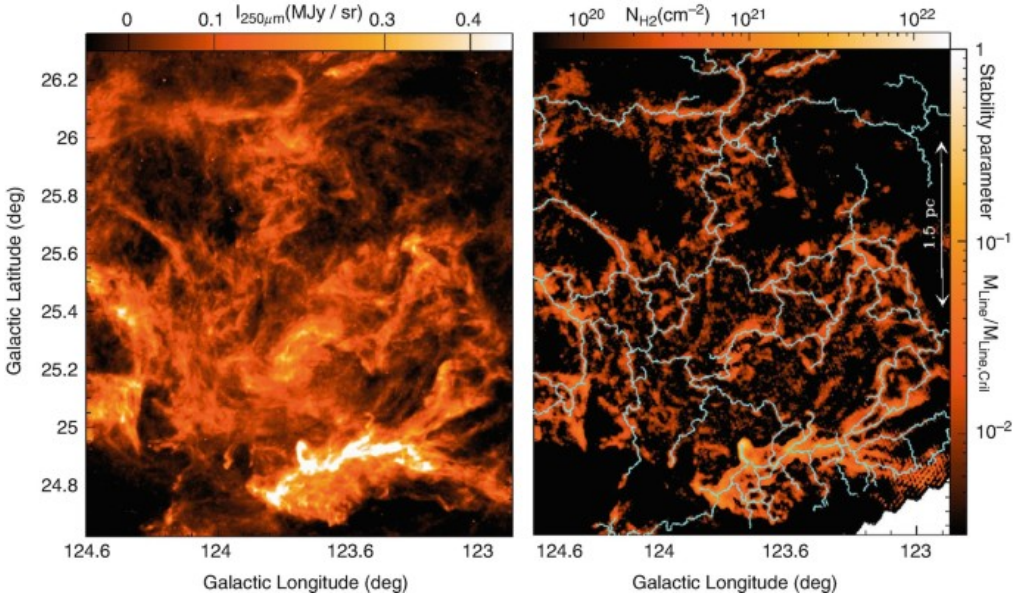


- What's the physics that explains the filaments?
- Role of Magnetic Field in the filament network
- Study of the evolution of the ISM

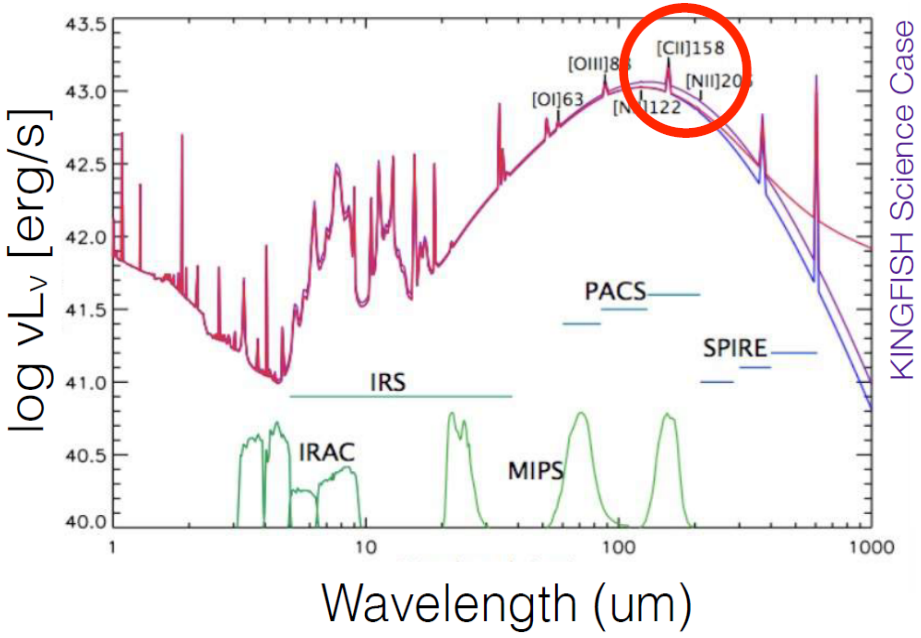
- Detection of B-Modes in the CMB
- Spectral distortions of the CMB

strumental requirements for future sub-mm ssions

Need for High Sensitivity (sub)mm detectors (<10^{-18} W/√Hz) comprising :
polarimetric and spectroscopic capabilities



Polarimetric capability
To map the magnetic field in the interstellar medium

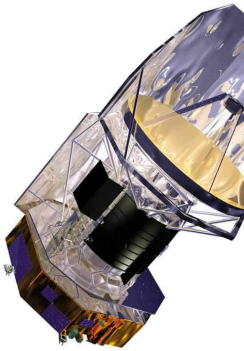


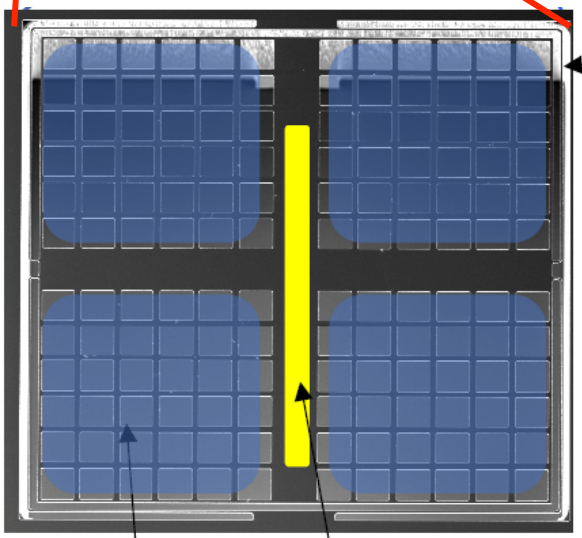
Spectroscopic capability
To detect characteristic spectral lines that are tracers of the ISM

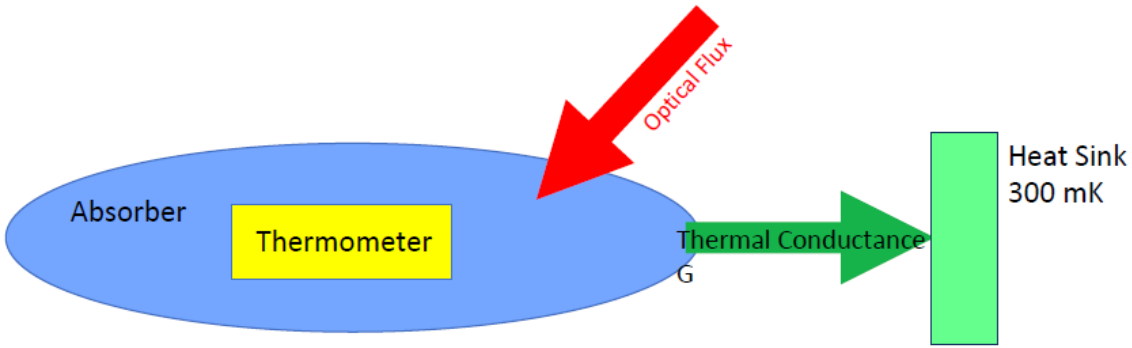
BOP, heritage of the Herschel/PACS olometer

The PACS bolometer :

- Operated at 300mK
- All silicon design at high impedance (~GOhms)
- Sensitivity ~2.10^{-16} W/√Hz







Principle of operation of a bolometer

BOP, a quarter-wave resistive bolometer for the b-mm

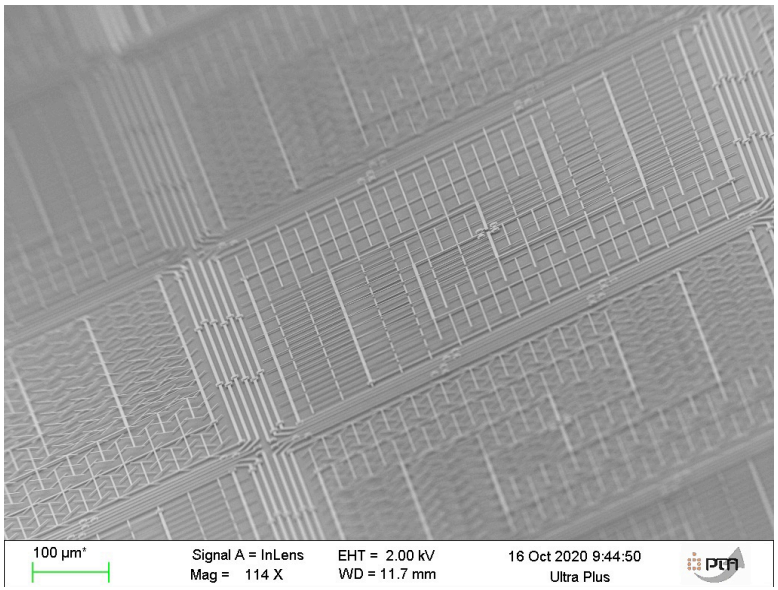
BOP : Imager **AND** polarimeter

nge : 100µm, 350µm, 450µm … until 1 mm?

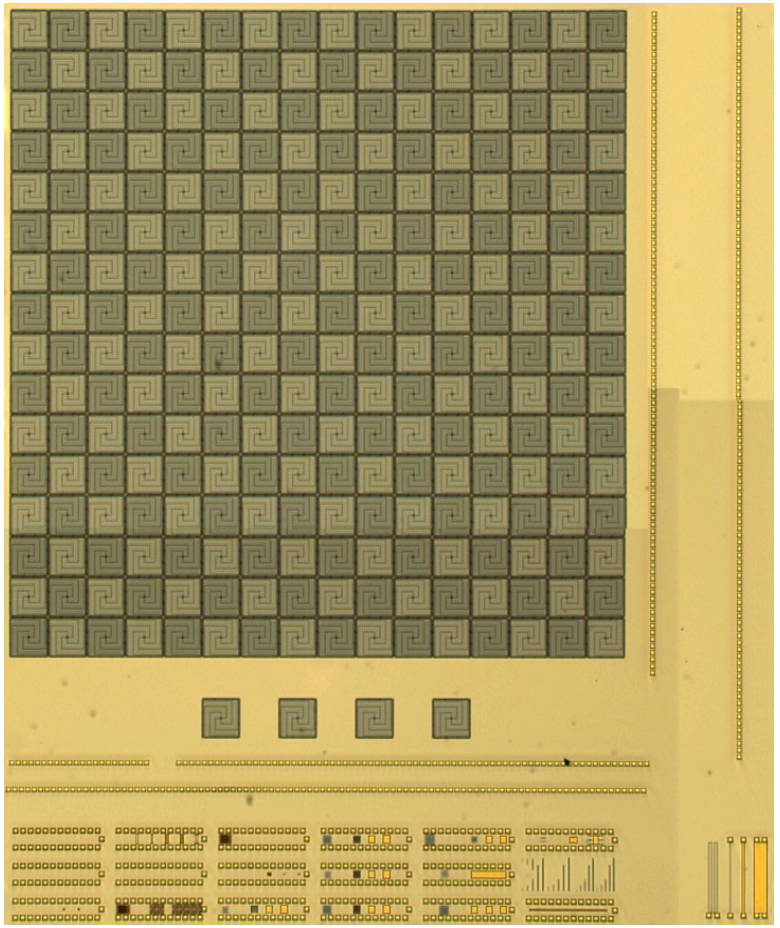
erating temperature : 50mK

gh impedance : ~10GOhms (2-3GOhms under flux)

nsitivity : ~10^{-18} W/√Hz



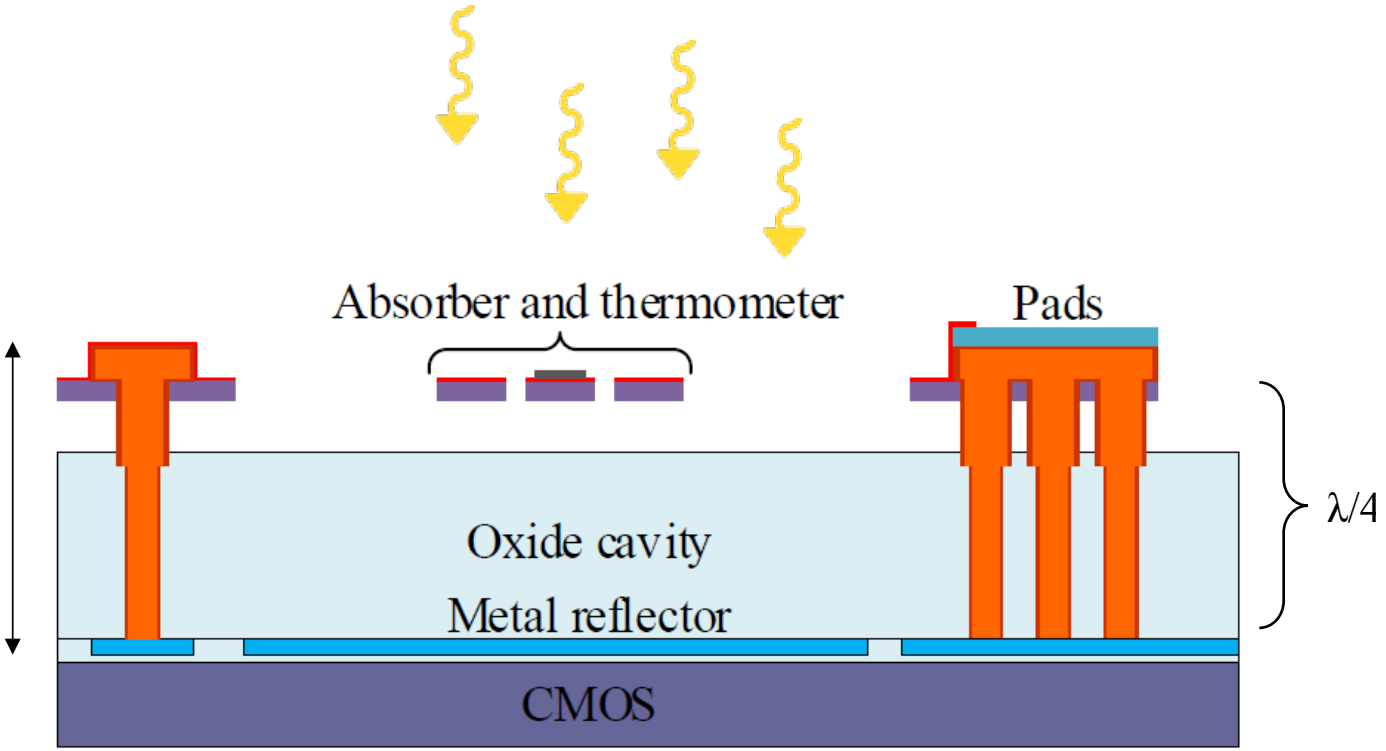
Zoom on the B-BOP pixels



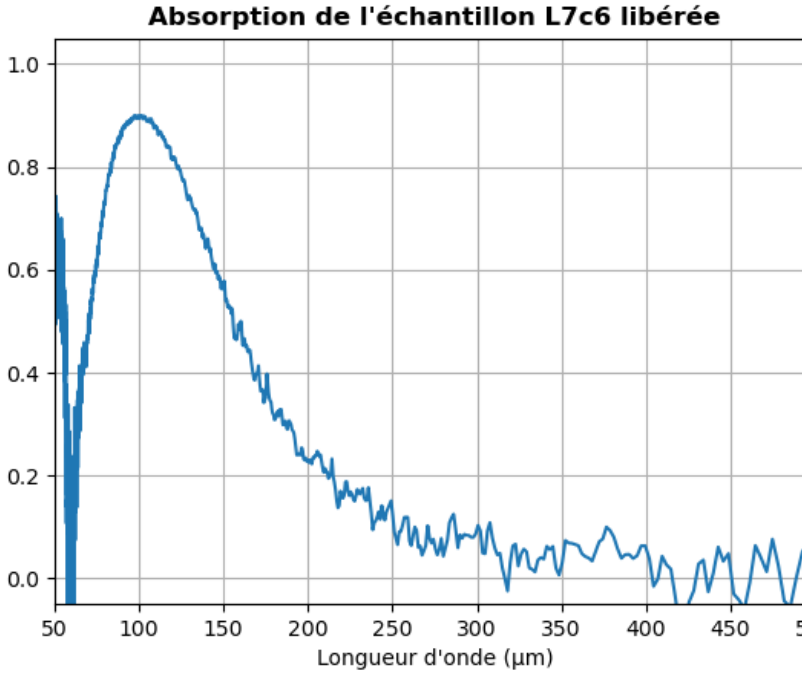
Matrix of a B-BOP prototype

BOP, a quarter-wave resistive bolometer for the b-mm

structure of B-BOP : How is the radiation absorbed?



Schematic cross-section of B-BOP-100

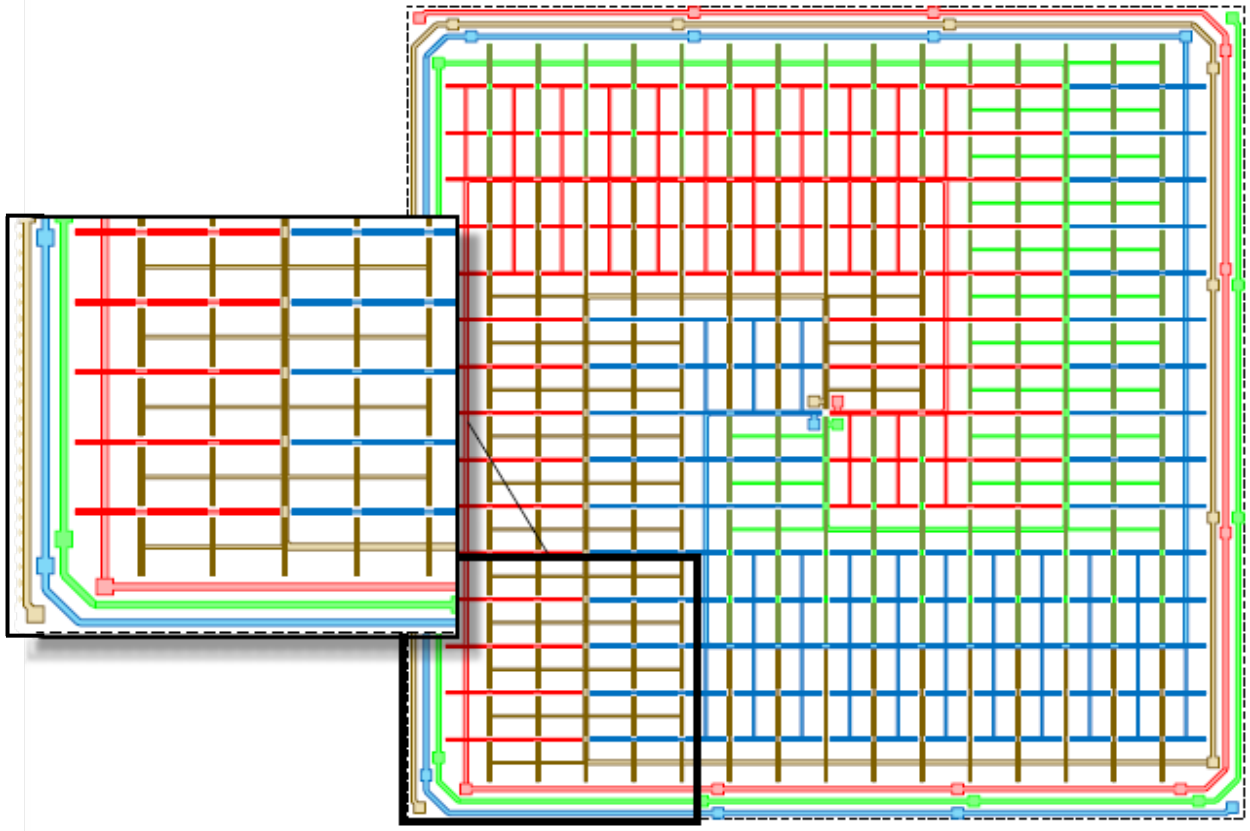


BOP, a quarter-wave resistive bolometer for the b-mm

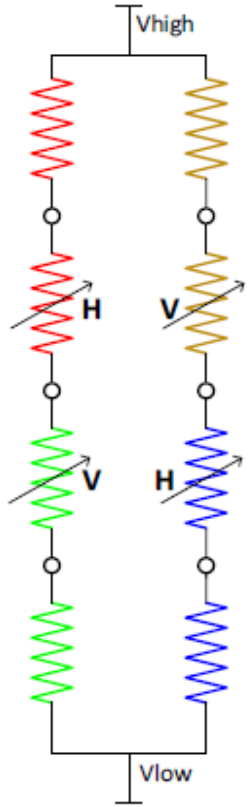
structure of B-BOP : The thermal link, the sensor and the polarisation sensitive elemer

= 1 single element !

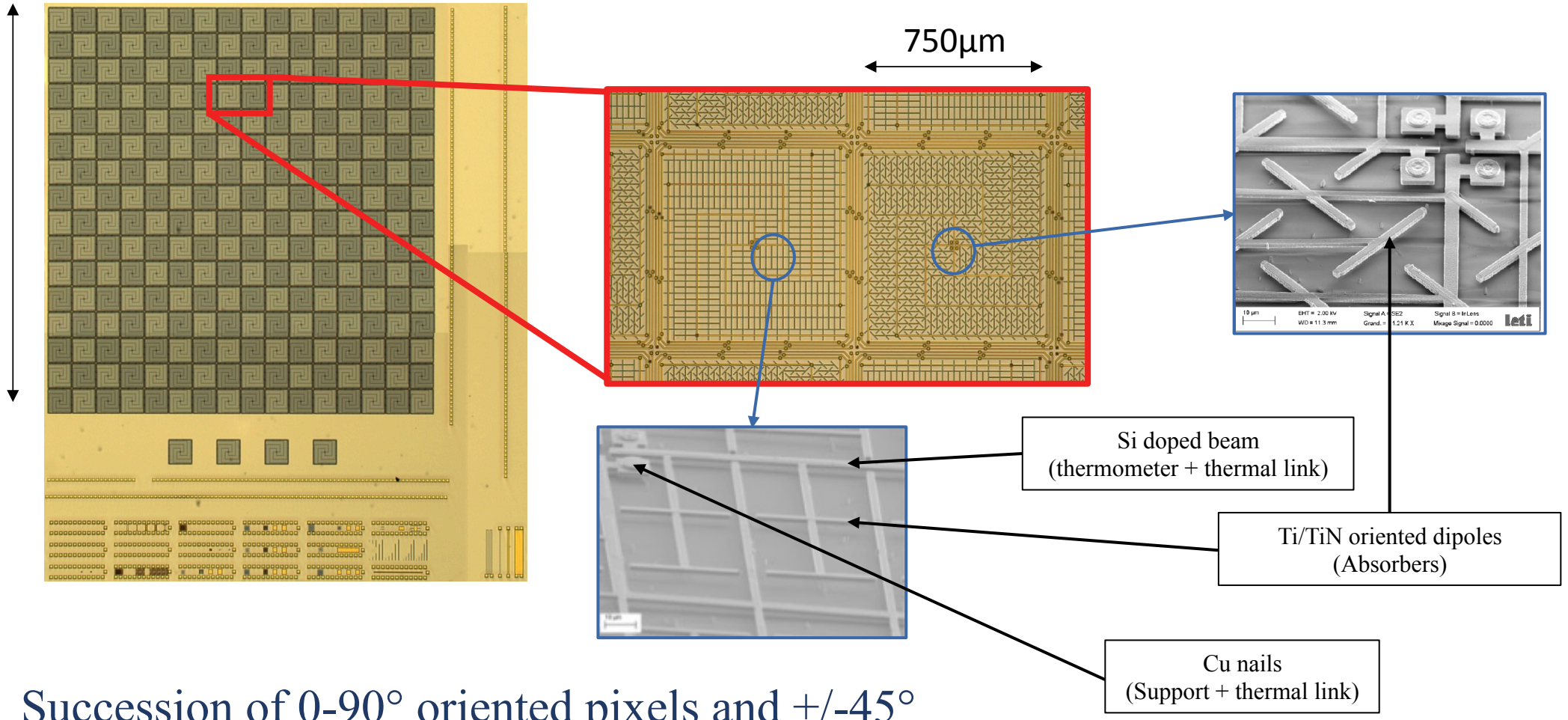
H+V Dipoles



Wheatstone bridge with 6 measurement points



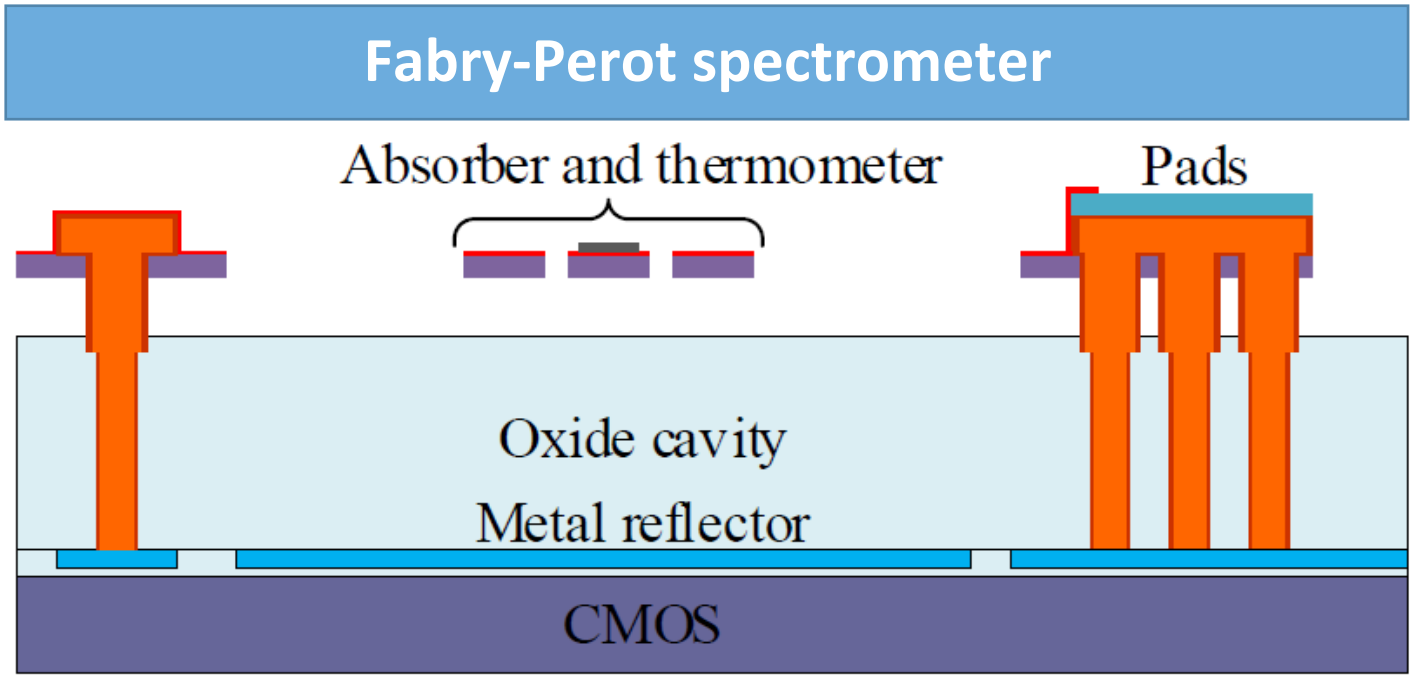
BOP, a quarter-wave resistive bolometer for the b-mm



Succession of 0-90° oriented pixels and +/-45° oriented pixels to determine the Stokes parameters

ldding the spectroscopic capability within the xel

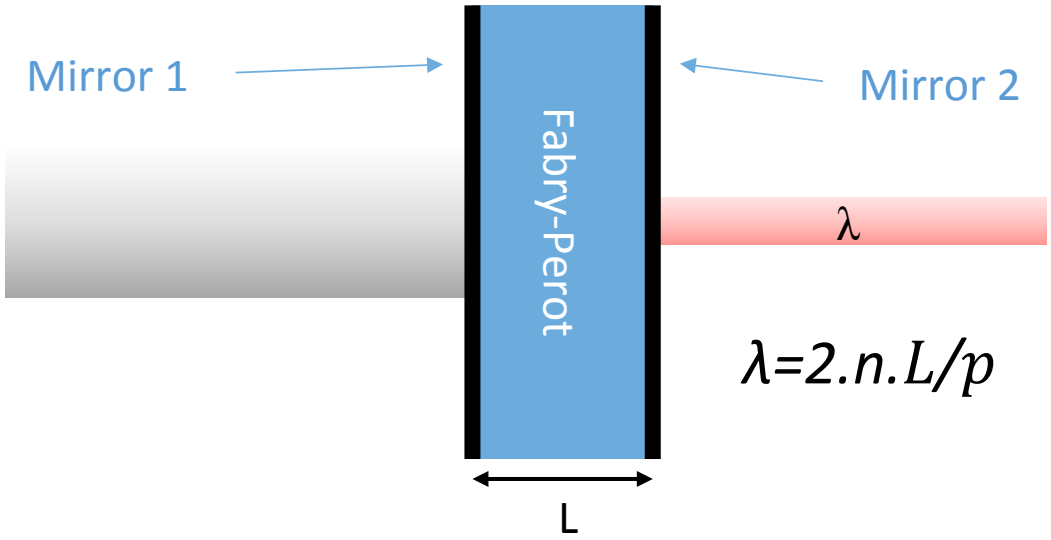
Concept : Add a silicon Fabry-Perot on the B-BOP matrix



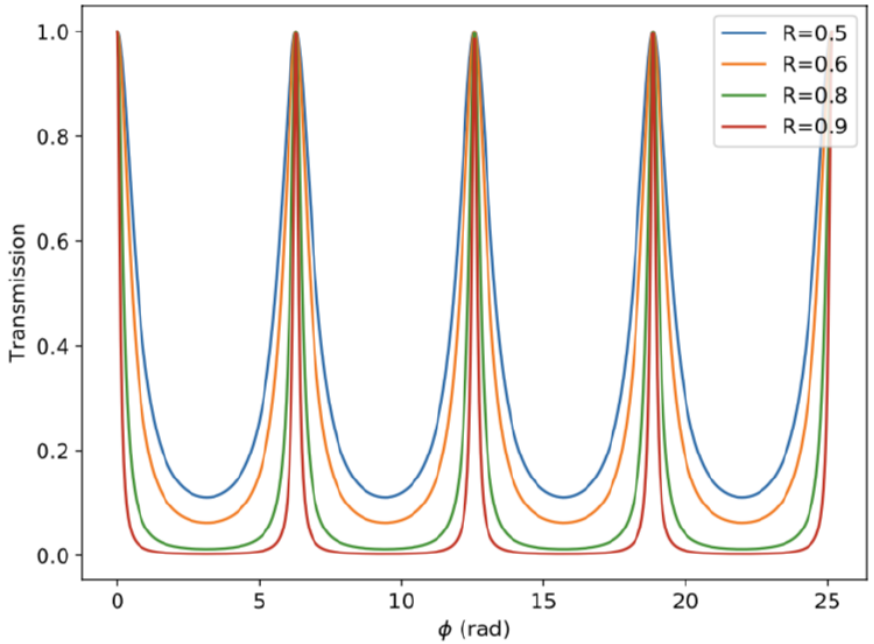
Objective : Get a full-featured detector

lding the spectroscopic capability within the xel

The Fabry-Perot : Interference filter selecting a wavelength "comb"



→ The transmitted wavelengths depend only on the optical size n.L of the cavity!

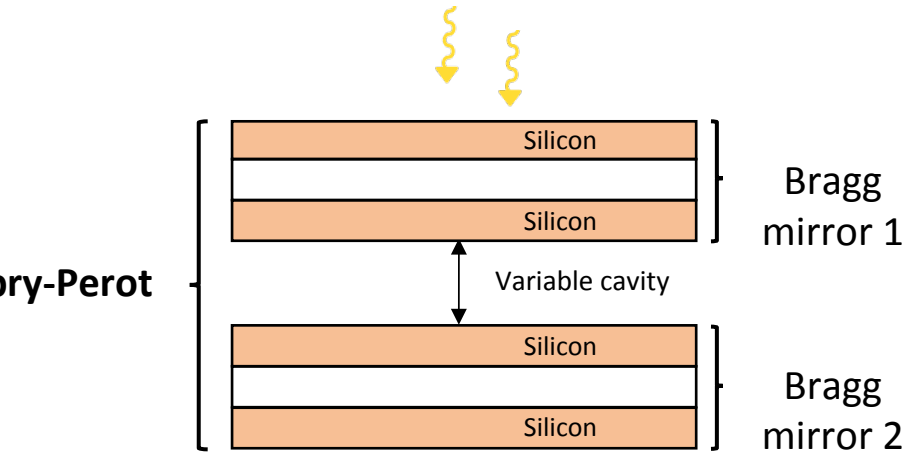


Transmitted wavelengths as a function of the reflexion coefficient

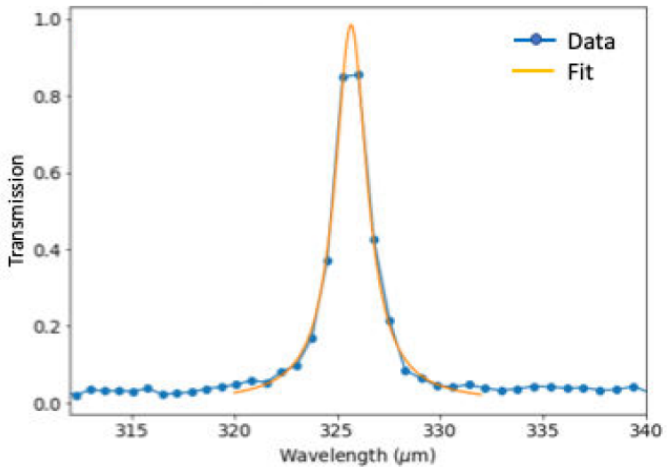
Two multi-band silicon Fabry-Perot technologies being manufactured and tested

lding the spectroscopic capability within the xel

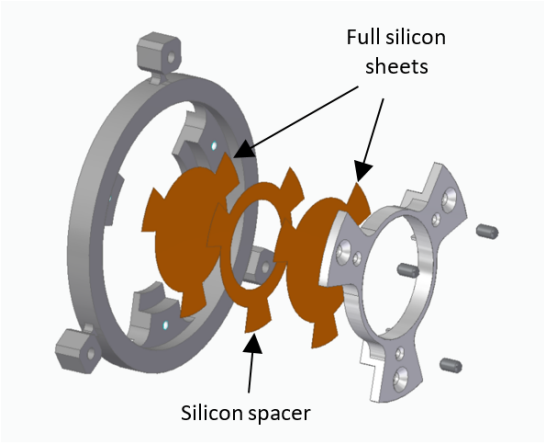
ning Fabry-Perot with Bragg mirrors



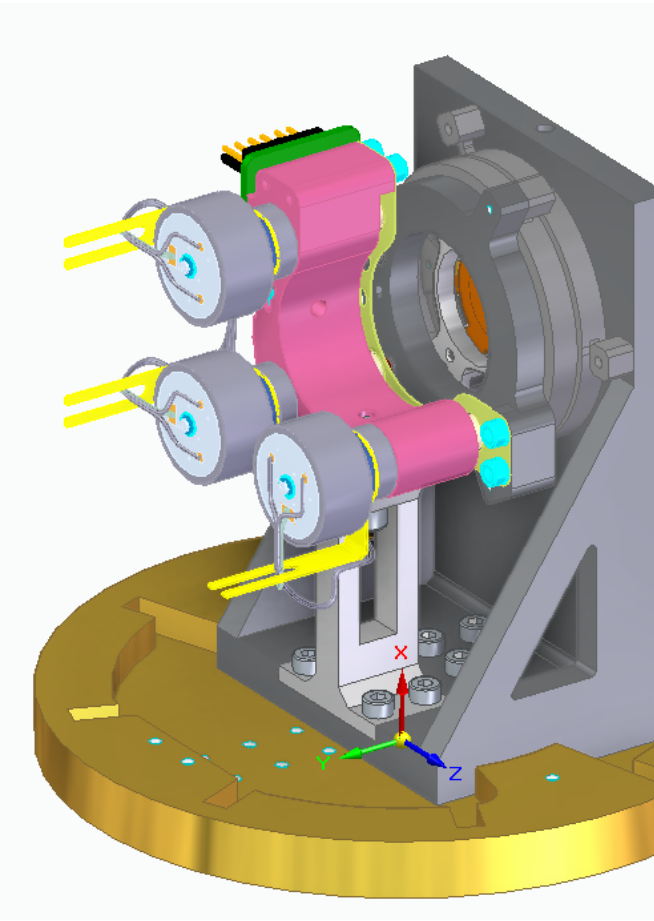
Scheme of the Fabry-Perot



Fixed prototype measurement on a FTS



Assembly and CAO view of a Bragg mirror

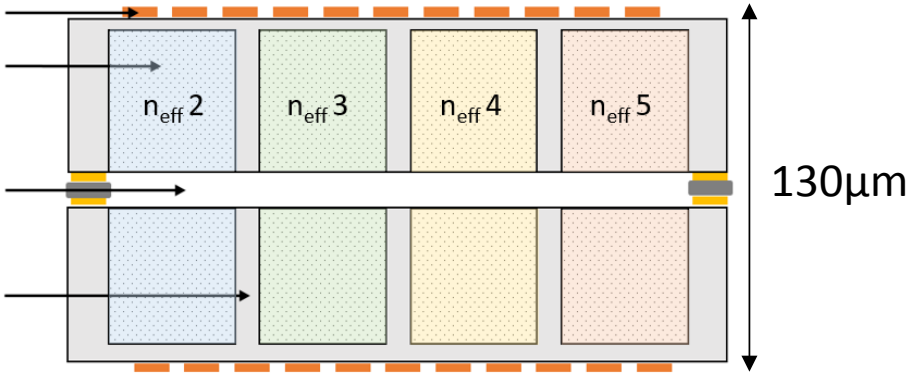


CAO view of the assembly of the sca FP on the cryostat plate

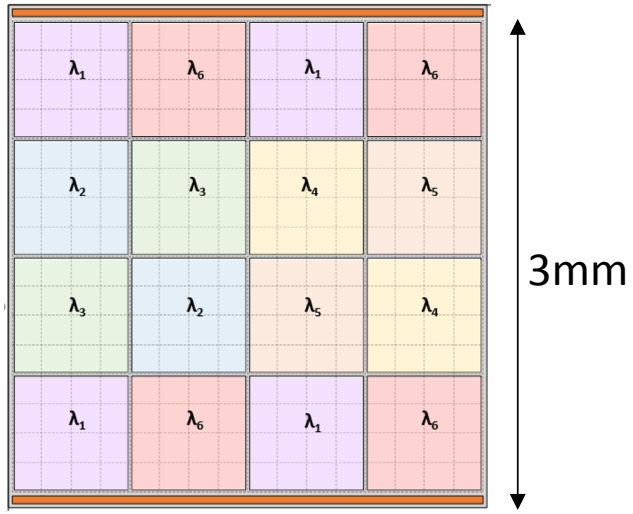
Expected resolution : ~3

lding the spectroscopic capability within the xel

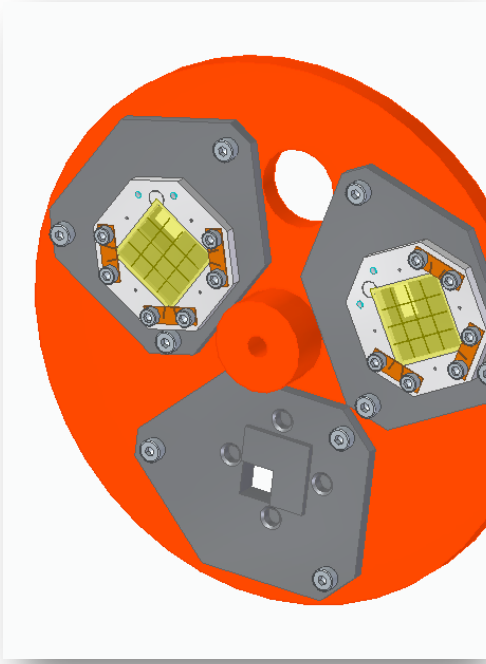
rostructured Fabry-Perot : The FP158



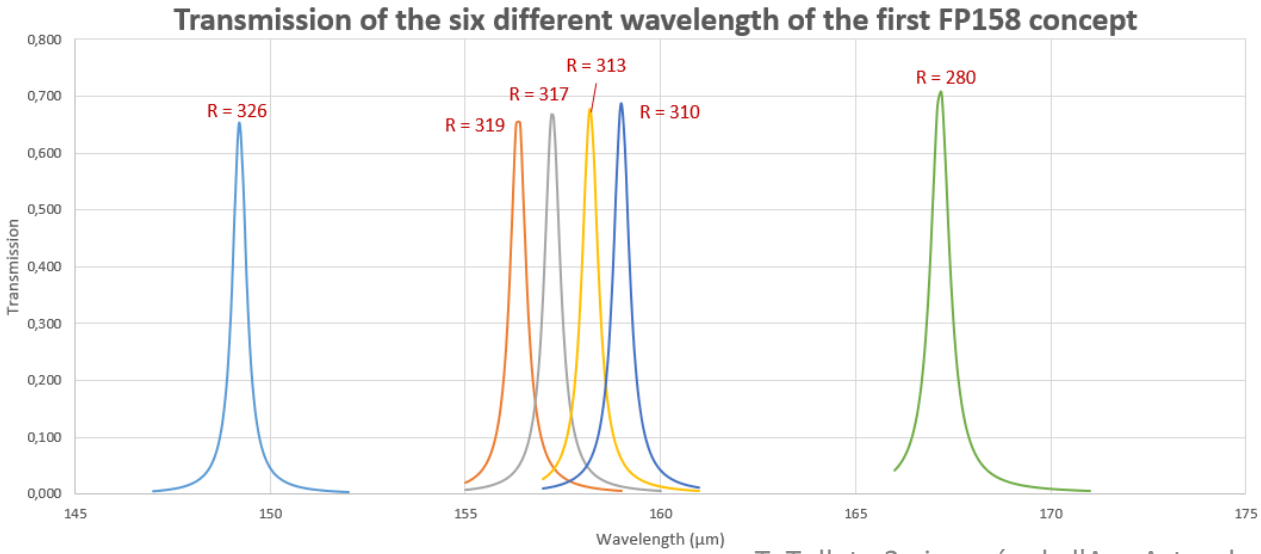
Cut view



Top view



CAO assembly of the FP158 rotating plate of the cryos



Expected resolution : < 300

erspectives for B-BOP

The Artemis instrument on APEX in Chile

The APEX telescope

The Co-PILOT balloon mission

2nd flight of PILOT