FIRST: direct imaging of exoplanets with interferometry

Elbereth conference

28/02/2020

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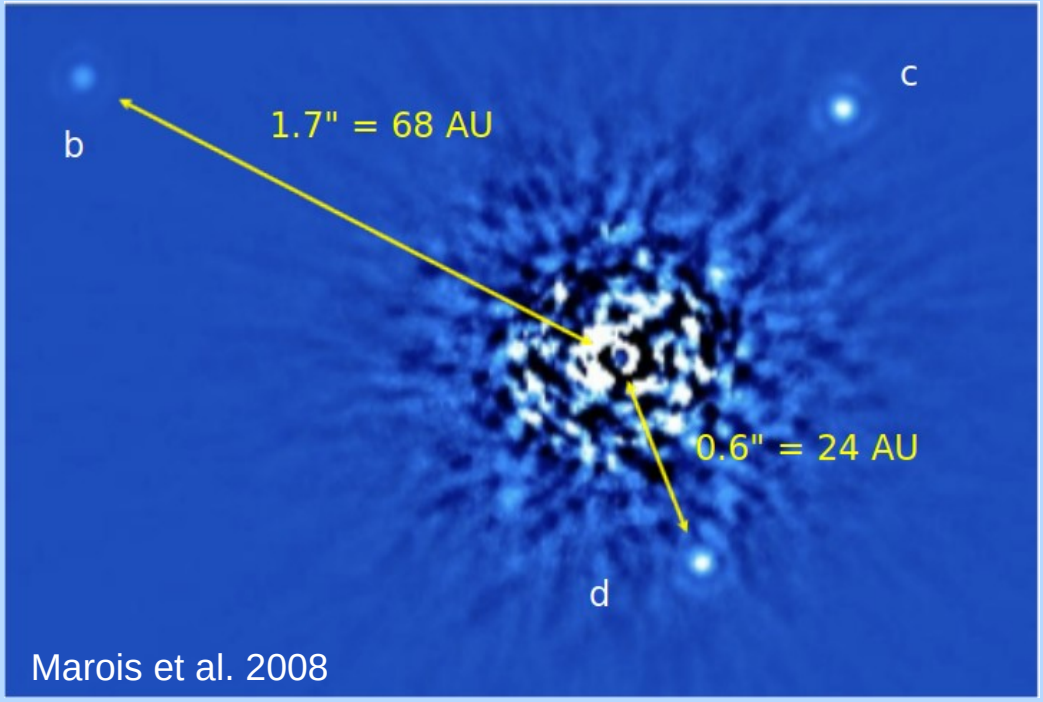
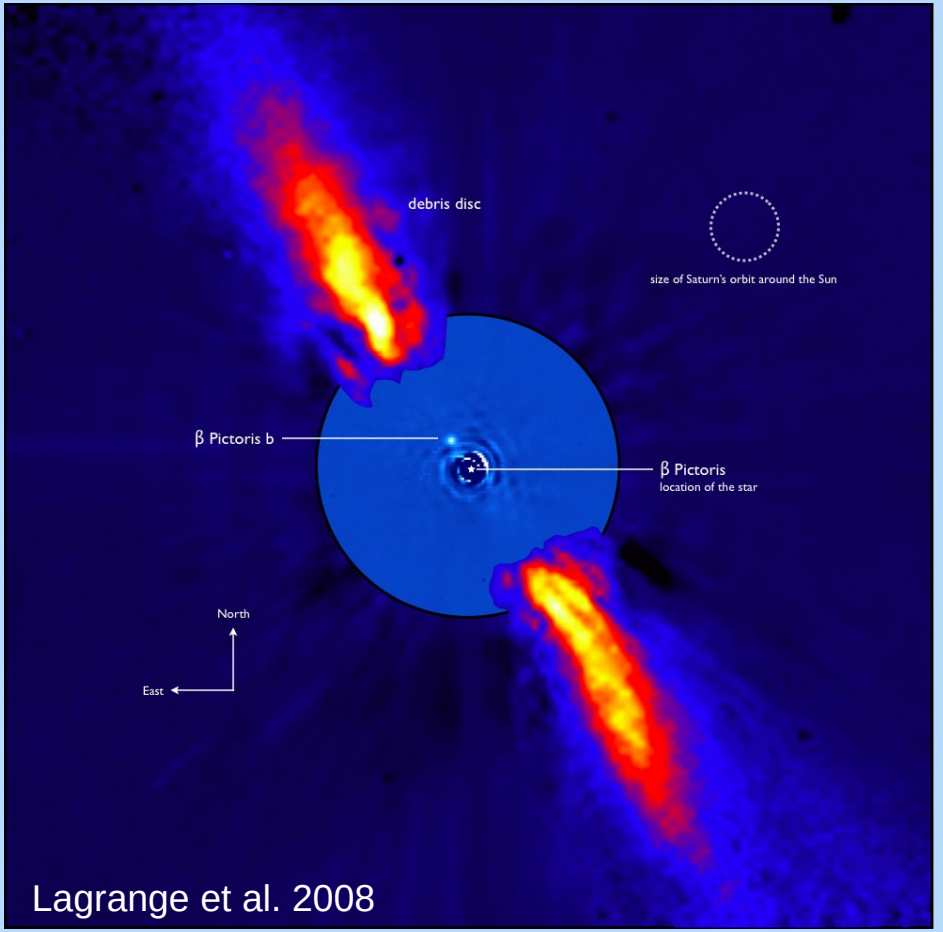
Direct imaging of exoplanets



Marois et al. 2008



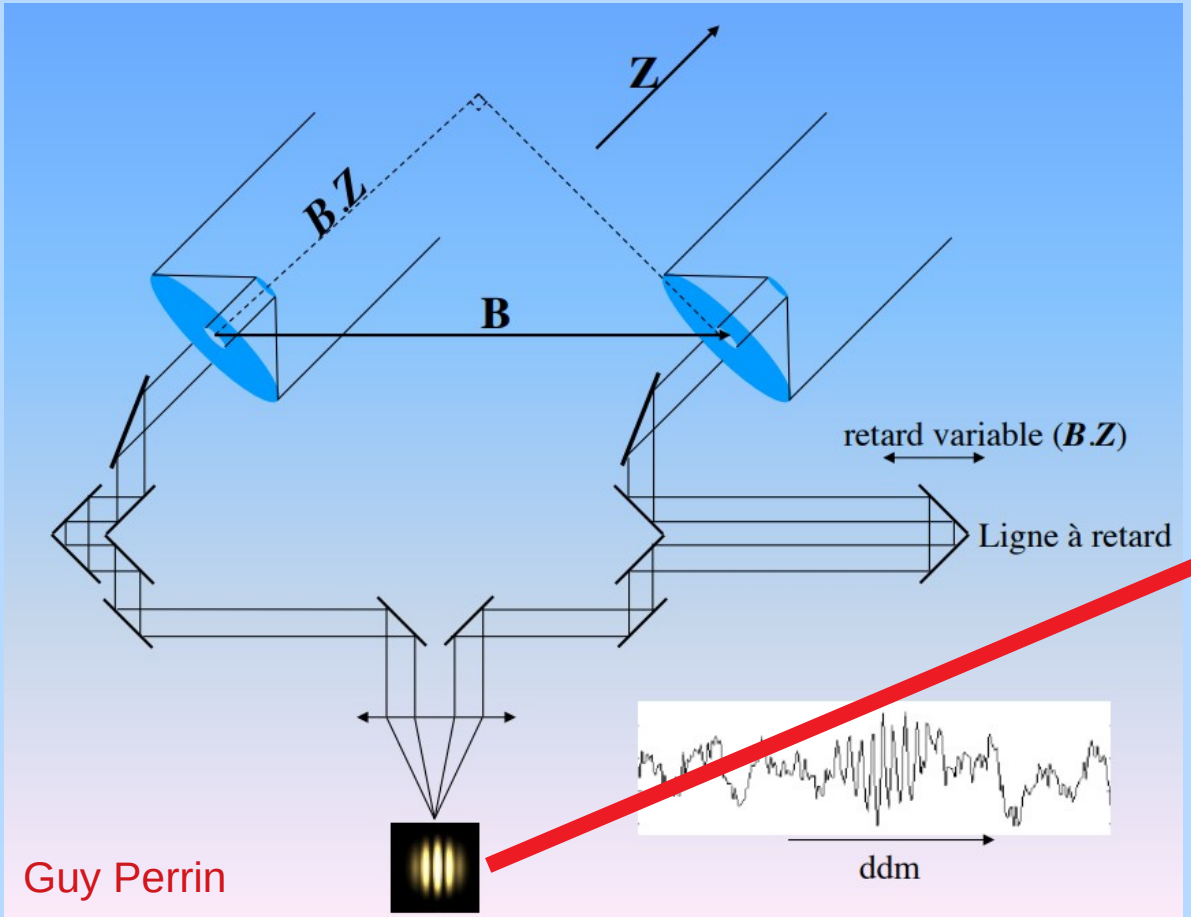
Lagrange et al. 2008

Imaging of a substellar companion :

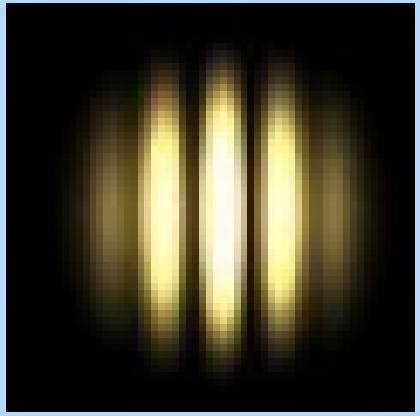
- Close to the star 0.1”
- At a high contrast 10^{-6} 10-9

Long baseline interferometry

Angular resolution: from λ/D (diffraction limit) to λ/B



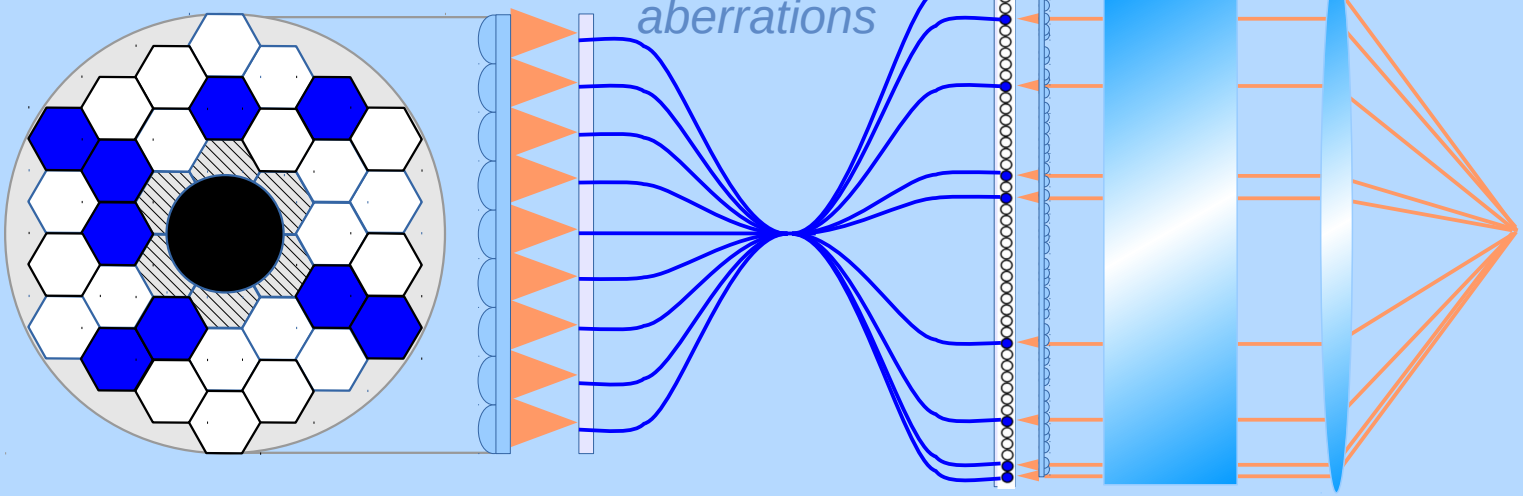
Interference between several telescopes



Information about the scientific target coded in the fringes (contrast and phase)

Fibered Imager foR a Single Telescope

Angular resolution down to λ/2D

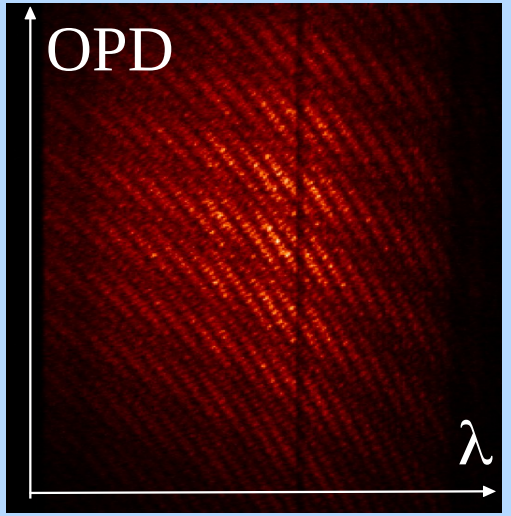


Optical fibers

They filter the wavefront from aberrations

Prism

Cross-dispersion



Interference pattern

as a function of wavelength

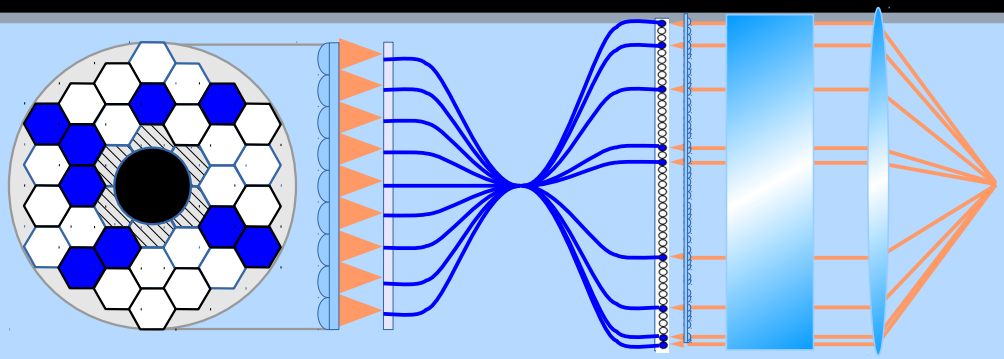
Pupil masking

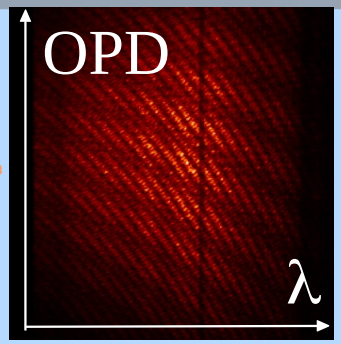
The pupil is divided into sub-pupils

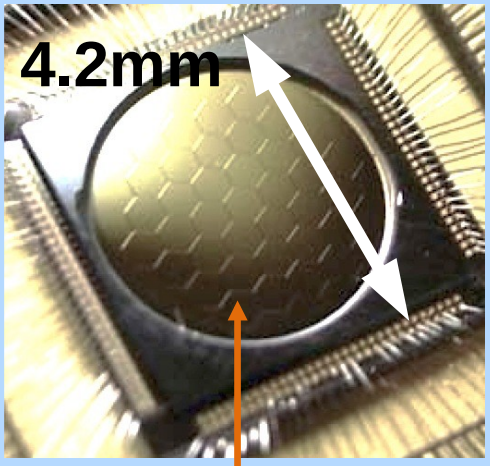
Pupil remapping

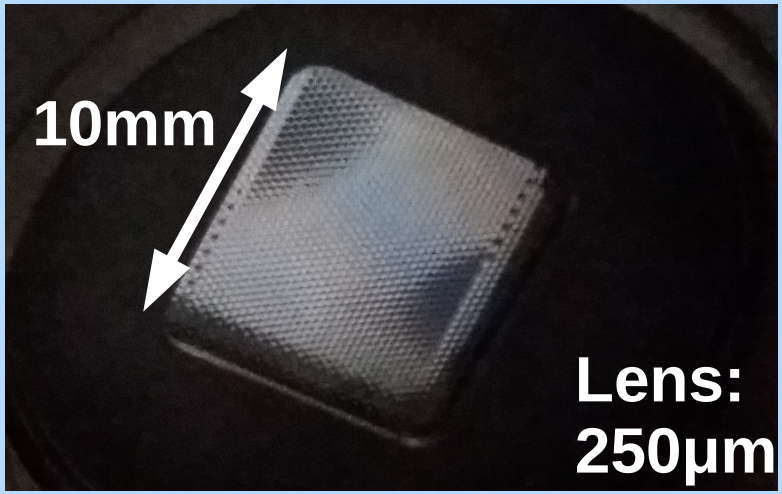
Fiber outputs are rearranged in a linear configuration

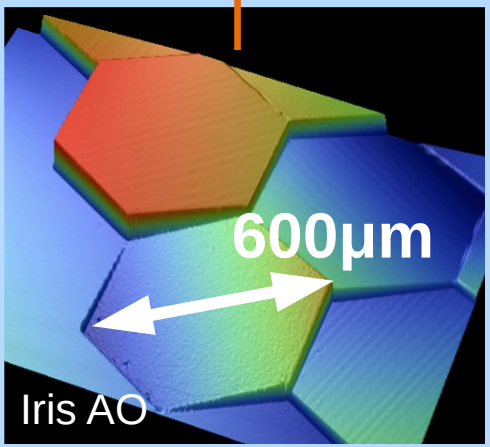
Pupil masking and remapping



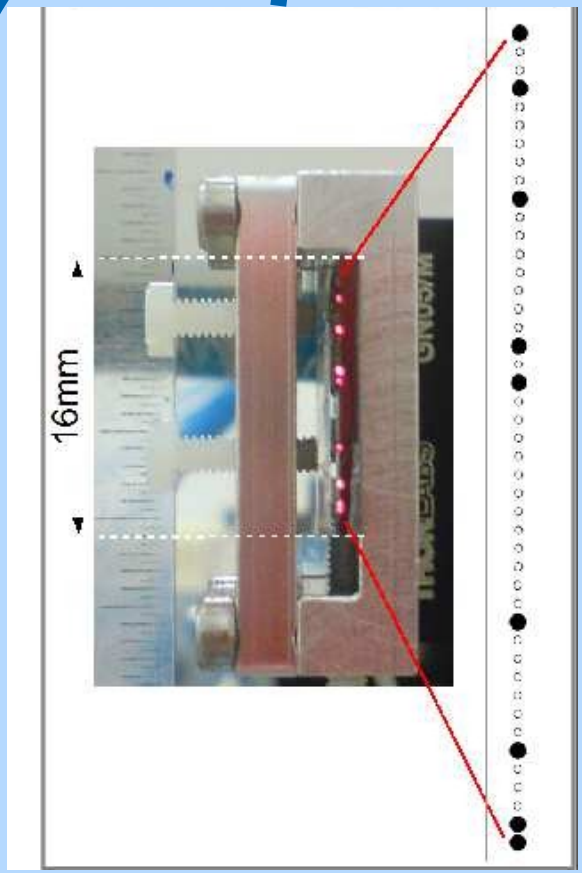




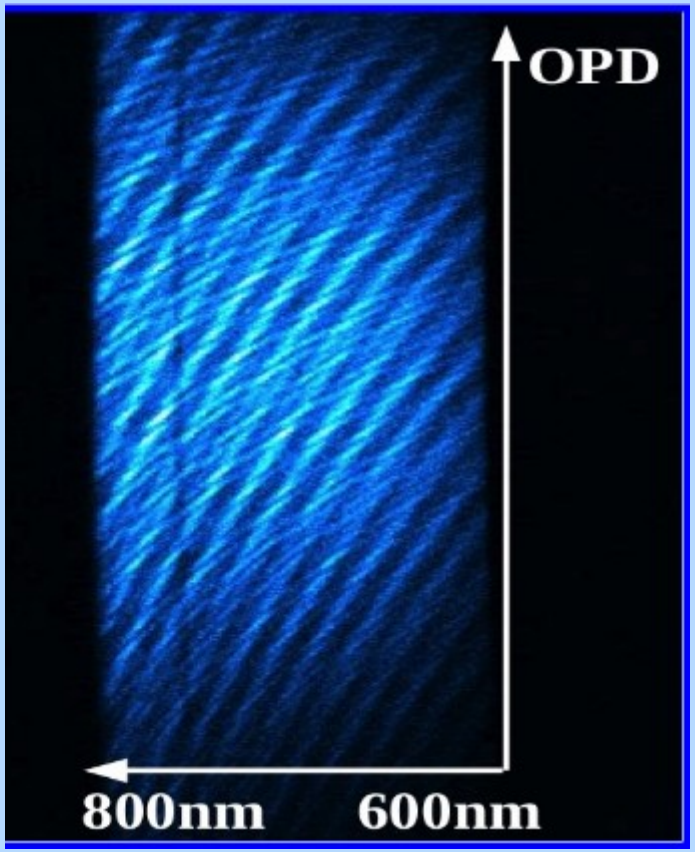




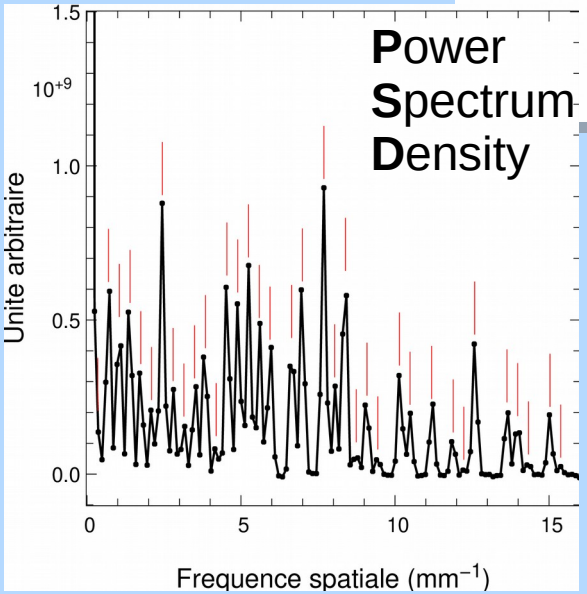
Fibre
5µm



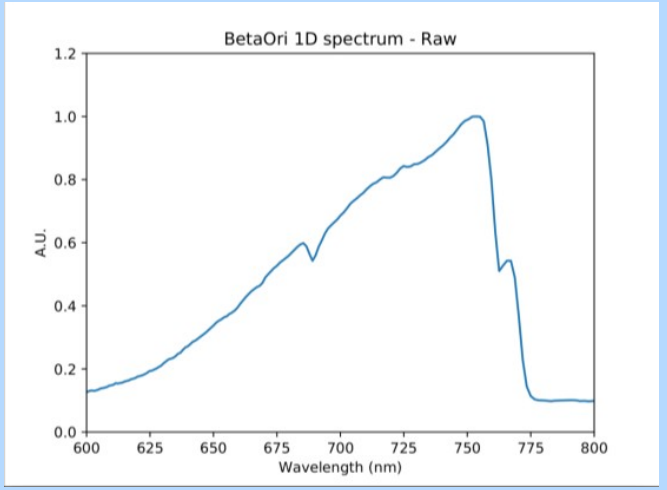
Observations



FT



Integrate

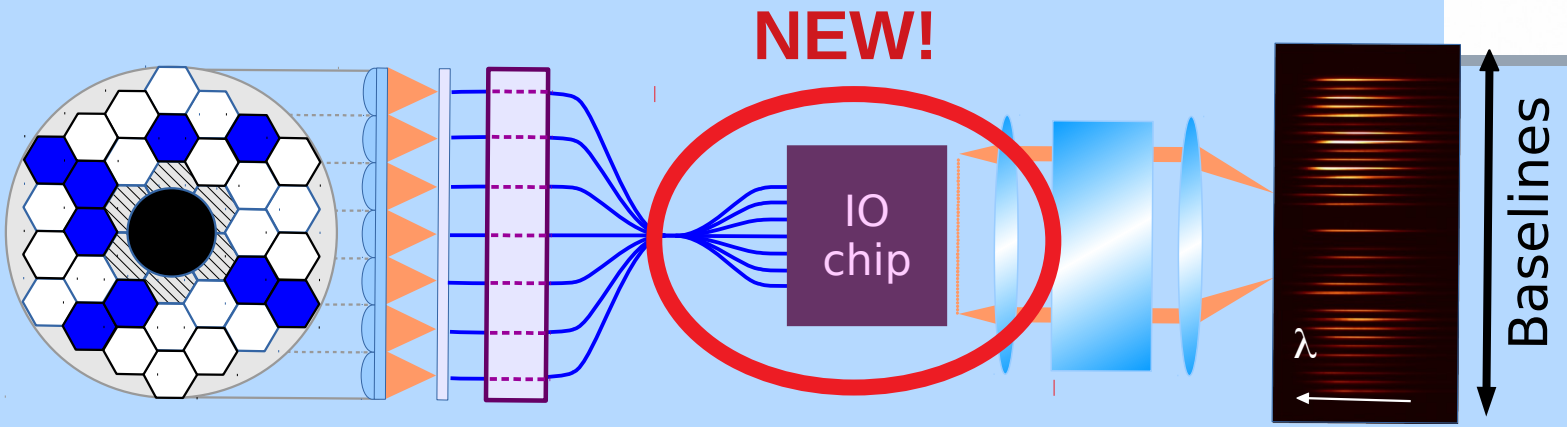


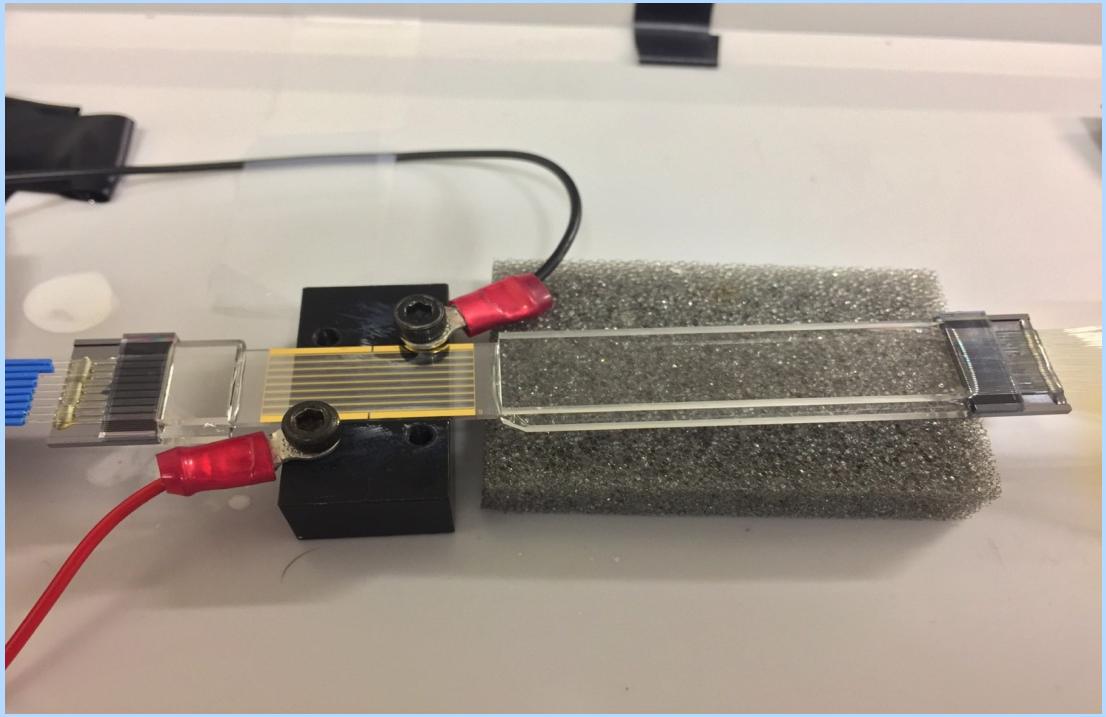
Information estimated from FIRST data:

- Position of the companion (separation)
- Intensity ratio between the components, as a function of wavelength

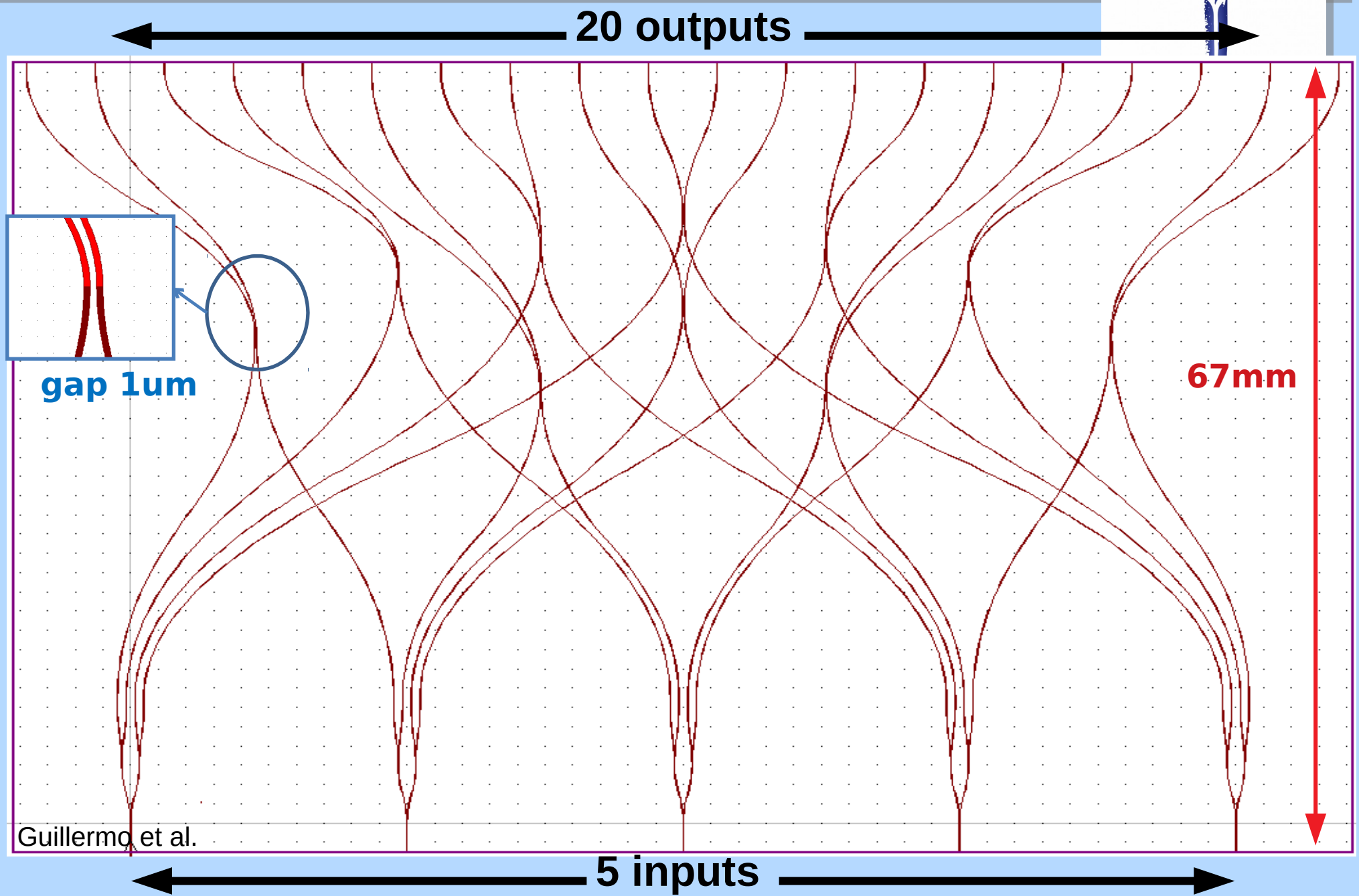
My thesis project: FIRSTv2

Upgrade of the interference setup



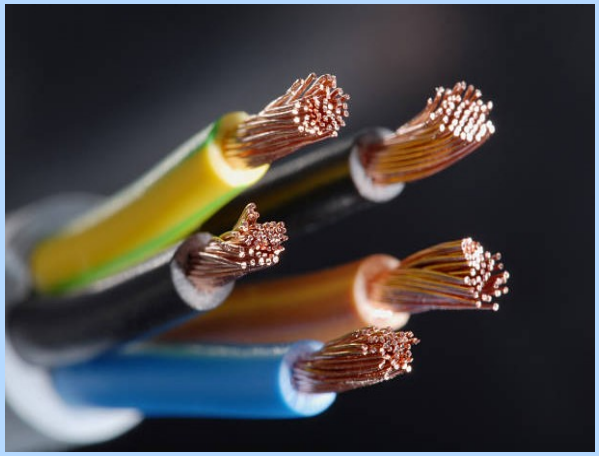


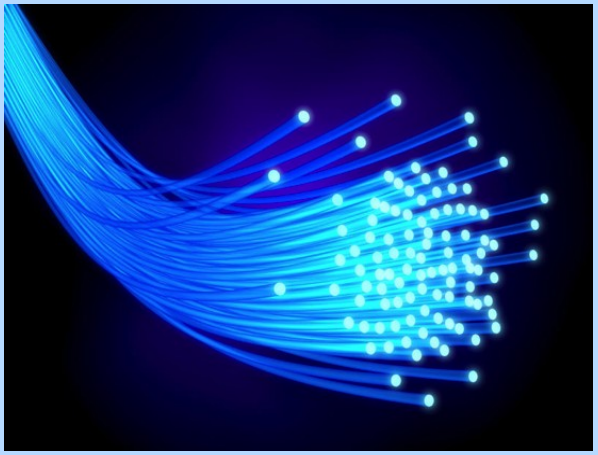
Integrated Optics principle

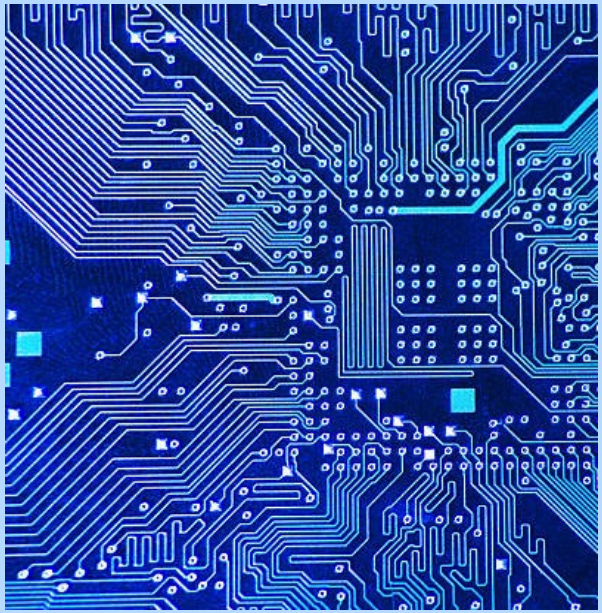


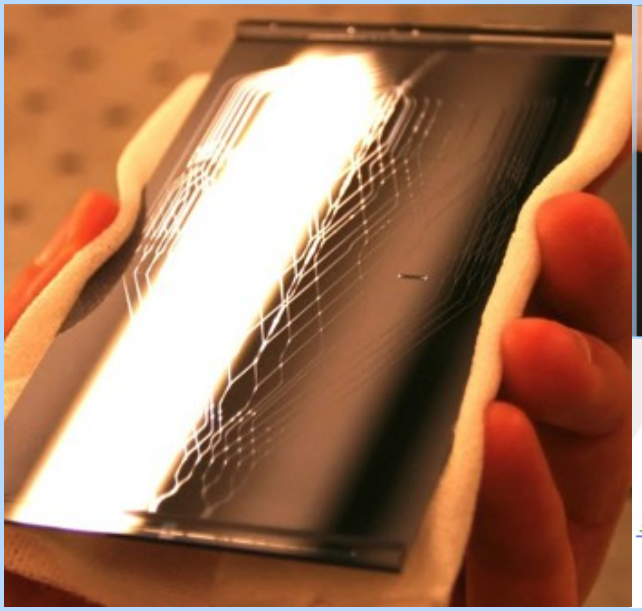
Guillermo et al.

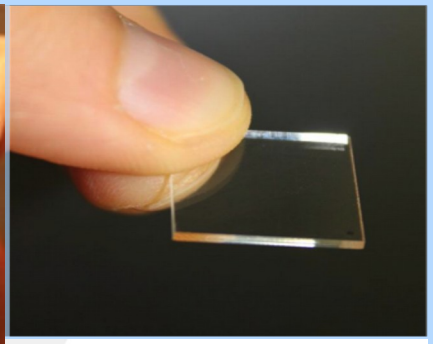
Cool technology

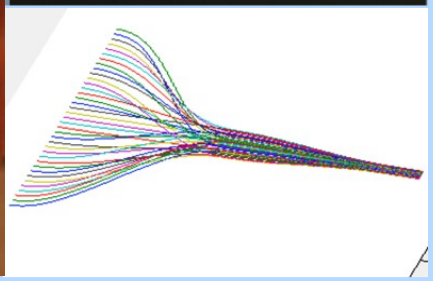




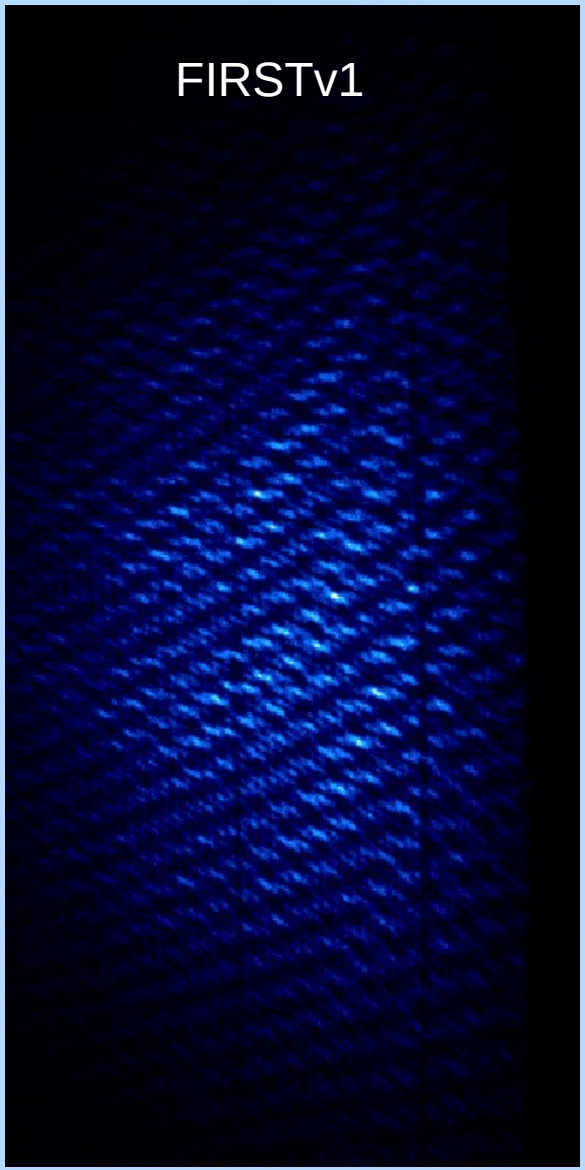


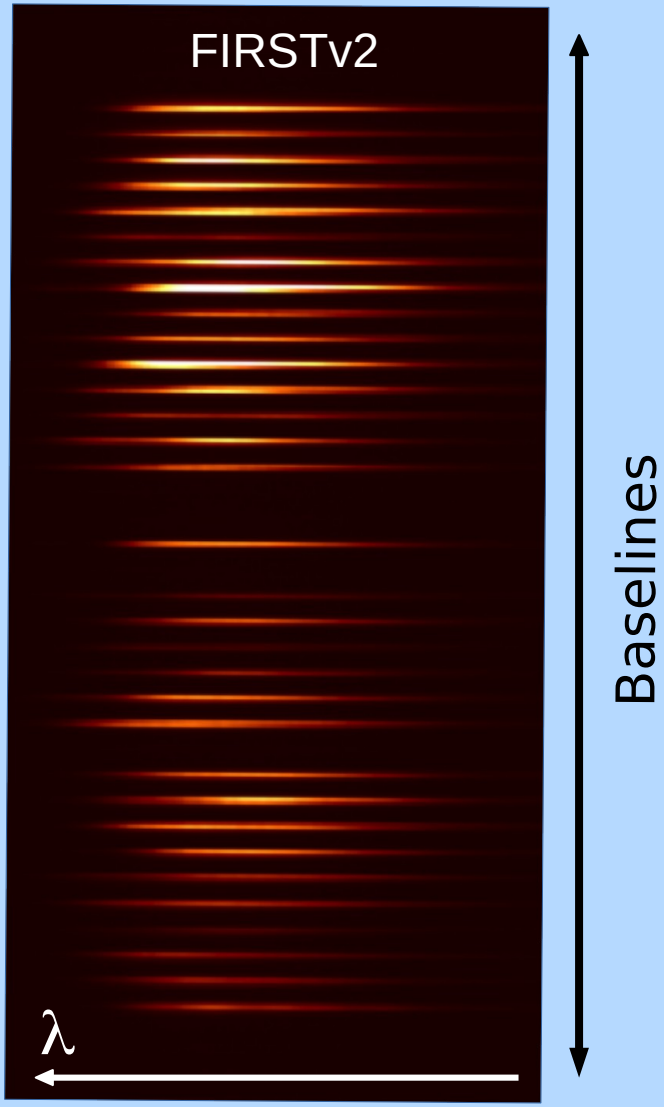






New output data





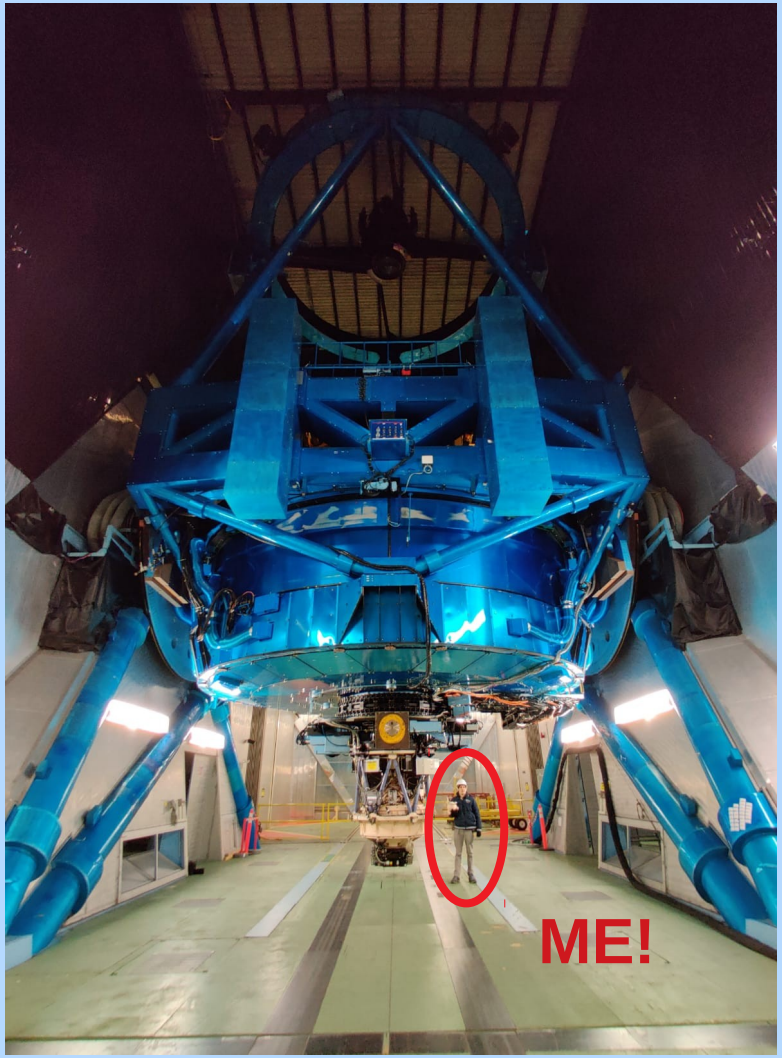
- Baselines are independently recombined

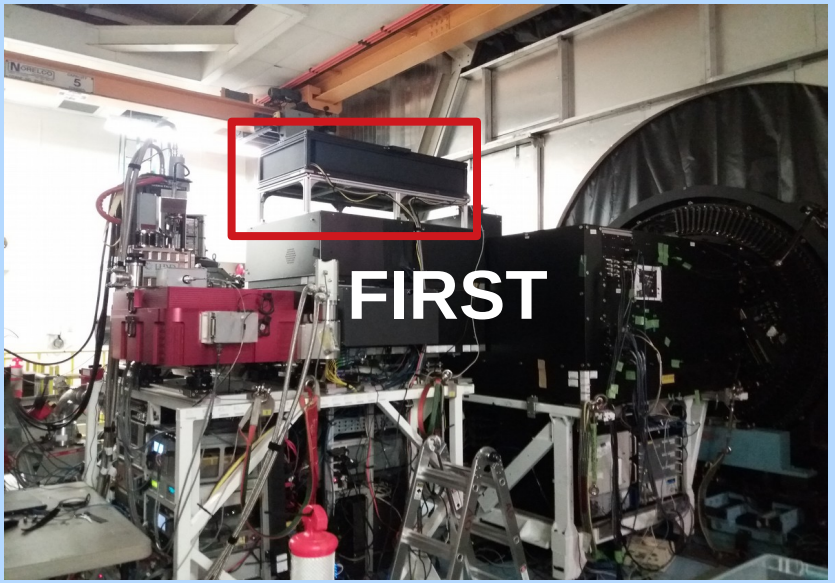
- Fringes are coded on a few pixels (instead of a few hundreds) → increased sensitivity

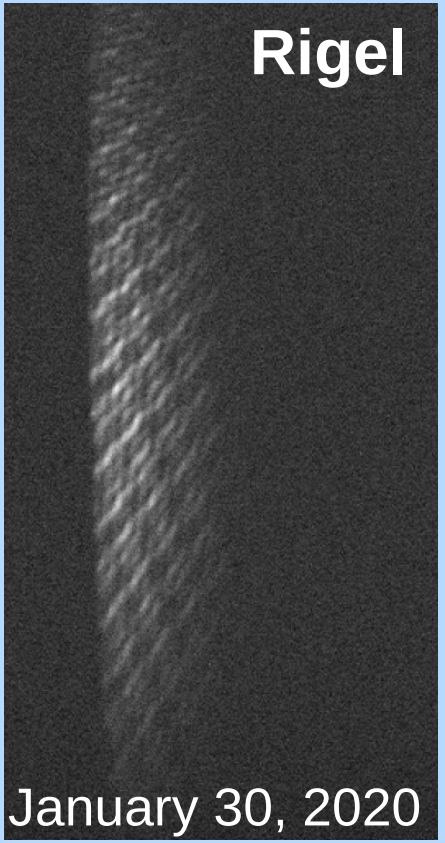
- Fringes are temporally scanned

Integration at the Subaru telescope has started...

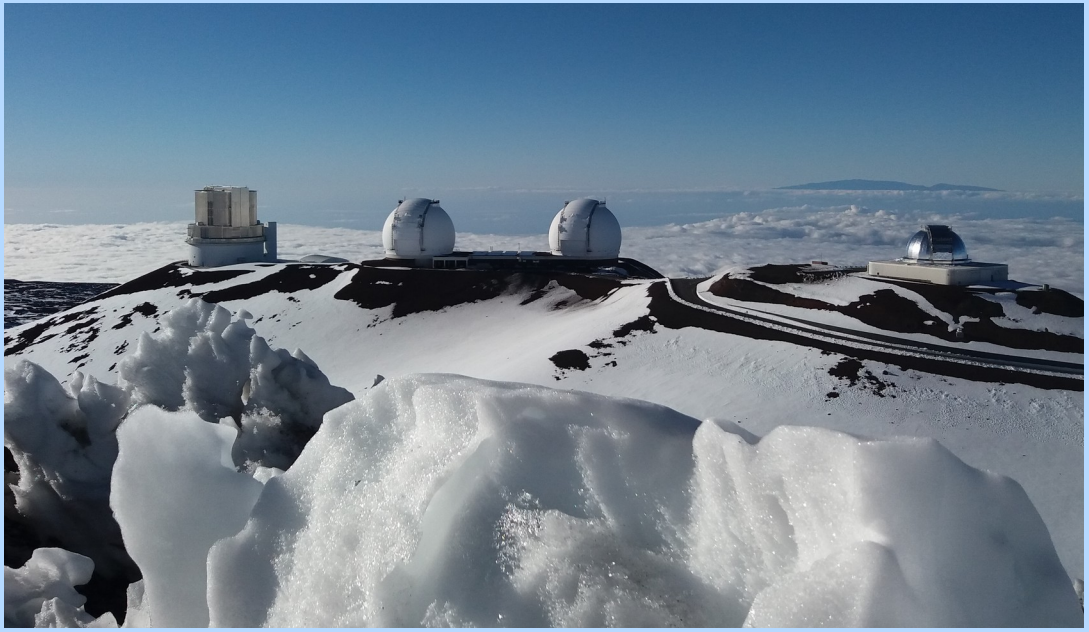
After the characterization of the instrument in the lab, Integration at Subaru in Hawaii!







Thank you!



My PhD project (not displayed)

- Characterization of the integrated optics chip in the lab (Meudon)
- Software development to control the instrument (delay lines, fringe modulation...)
- Integration at the Subaru telescope
- Development of the data reduction pipeline for astrophysic data
- On-sky data
- Data analysis: substellar companion detection?