«ALOHA at CHARA – L-band Prospects»

François Reynaud

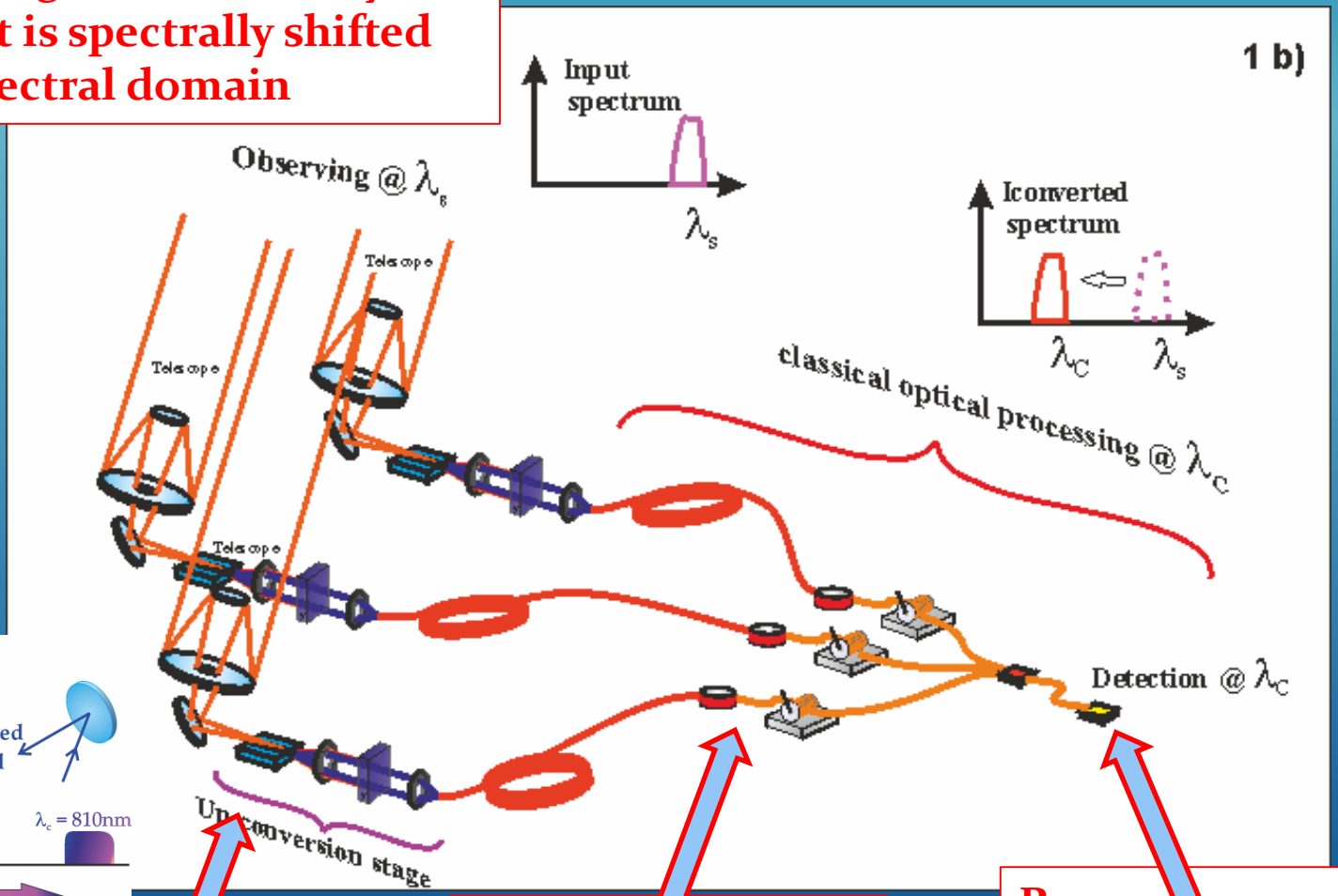
XLIM / Dépt. Photonique IRO Limoges

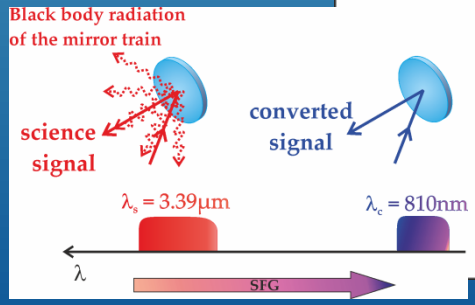
L. Szemendera,L. L. Lehmann, L. Delage, L. Grossard,

Collaboration with the CHARA team : T. Brummelaar J. Strumann. N. Scott ….

New way :

* All the experimental chain is designed at a given wavelength to improve the global efficiency
* The astro light is spectrally shifted to reach this spectral domain





no more black body Radiation downstream to the up conversion stage

High throughput Coherent propagation With guided optics

Room temperature Photon counting detector

The spectral issues : photon counting detectors and nonlinear crystal

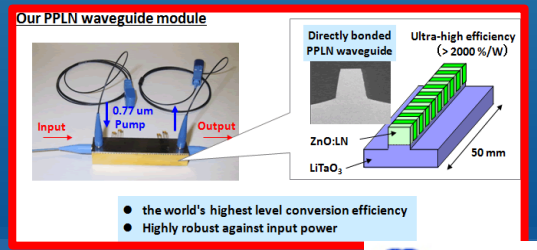
pump laser (µm)			1,064		1,3		1,5		2	
Astro band (µm)										
H	1,50	1,80	0,62	0,67	0,70	0,75	0,75	0,82	0,86	0,95
K	2,00	2,50	0,69	0,75	0,79	0,86	0,86	0,94	1,00	1,11
L	3,20	3,90	0,80	0,84	0,92	0,98	1,02	1,08	1,23	1,32
M	4,50	5,00	0,86	0,88	1,01	1,03	1,13	1,15	1,38	1,43
N	8,00	13,00	0,94	0,98	1,12	1,18	1,26	1,34	1,60	1,73
Q	17,00	25,00	1,00	1,02	1,21	1,24	1,38	1,42	1,79	1,85

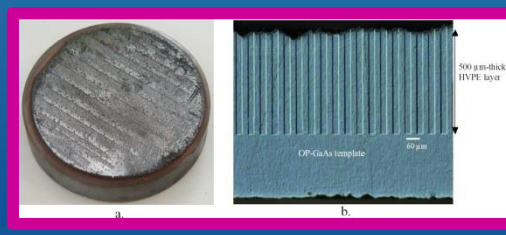
Ambient temperature photon counting detectors

PPLN	0.5-4.5 µm
OP GaAs	1-18 µm

Si APD

In GaAs APD





Strategy of the ALOA project

Pump laser

Crystal

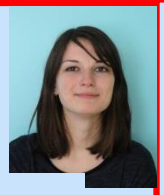
Detector

ALOHA

Selection of:
- Available and reliable pump source
- Available and reliable crystal
- Commercial ambient detector

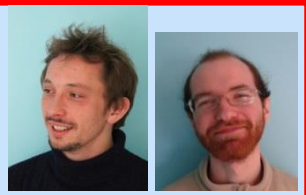
pump laser (µm)			1,064		1,3	
Astro band (µm)						
H	1,50	1,80	0,62	0,67	0,70	0,75
K	2,00	2,50	0,69	0,75	0,79	0,86
L	3,20	3,90	0,80	0,84	0,92	0,98
M	4,50	5,00	0,86	0,88	1,01	1,03
N	8,00	13,00	0,94	0,98	1,12	1,18
Q	17,0	25,00	1,00	1,02	1,21	1,24

Current test



Pascaline

H band >> 630 nm
Si APD detectors
PPLN
1.06 µm laser diode as pump



Ludovic and Lucien

L band >> 810 nm
Si APD detectors
PPLN
1.06 µm laser diode as pump

ALOHA strategy

	ALOHA @1.5 µm	ALOHA @3.4 µm	ALOHA @ 10 µm
Inlab tests	*General principle *Noise investigation *Acquisition with a blackbody source *New crystals	*General principle *Noise investigation *Acquisition with a blackbody source *New crystals	*Starting activity
On sky test	*Sensitivity 2014 *Fringes 2015	*Sensitivity *Fringes….	
	Spectral mode Photometry		

ALOHA CHARA @1.55 µm on sky missions

On sky demonstration

Photometry Mission 2014

First fringes Mission 2015

Photometric tests 2014

↓

In lab development

↓

Interferometric tests 2015

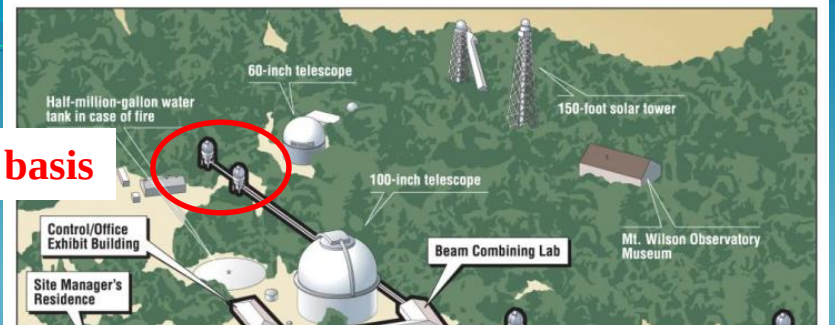
↓

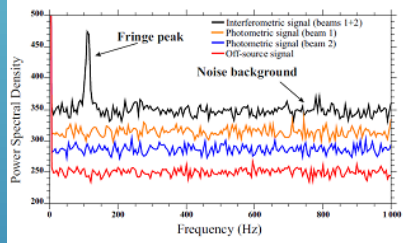
In lab development

↓

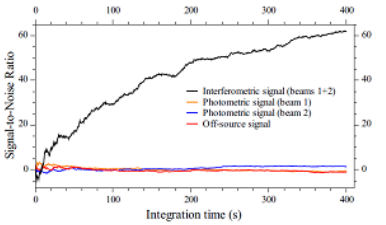
C calib and spectro 2017

S1 S2 basis



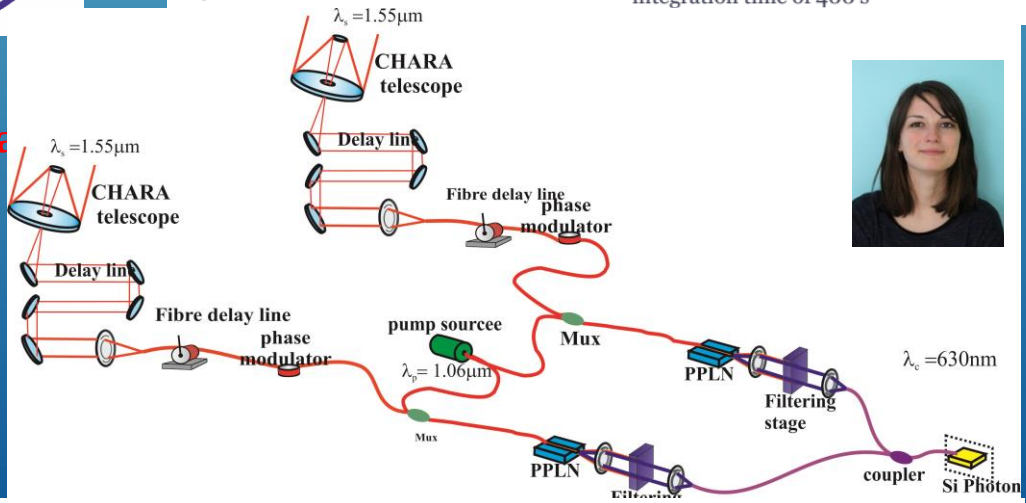


Frequency modulation of the fringes at 110 Hz



Detection with a SNR equal to 62 for an integration time of 400 s

S1 S2 ba

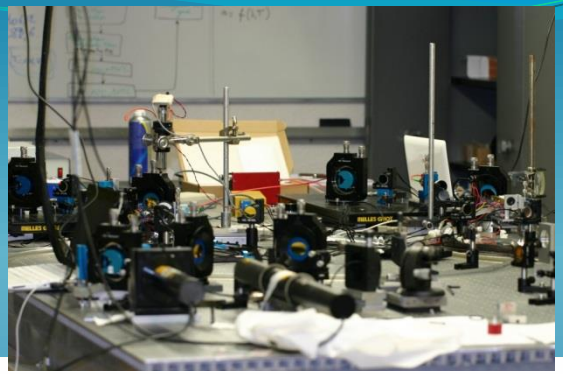


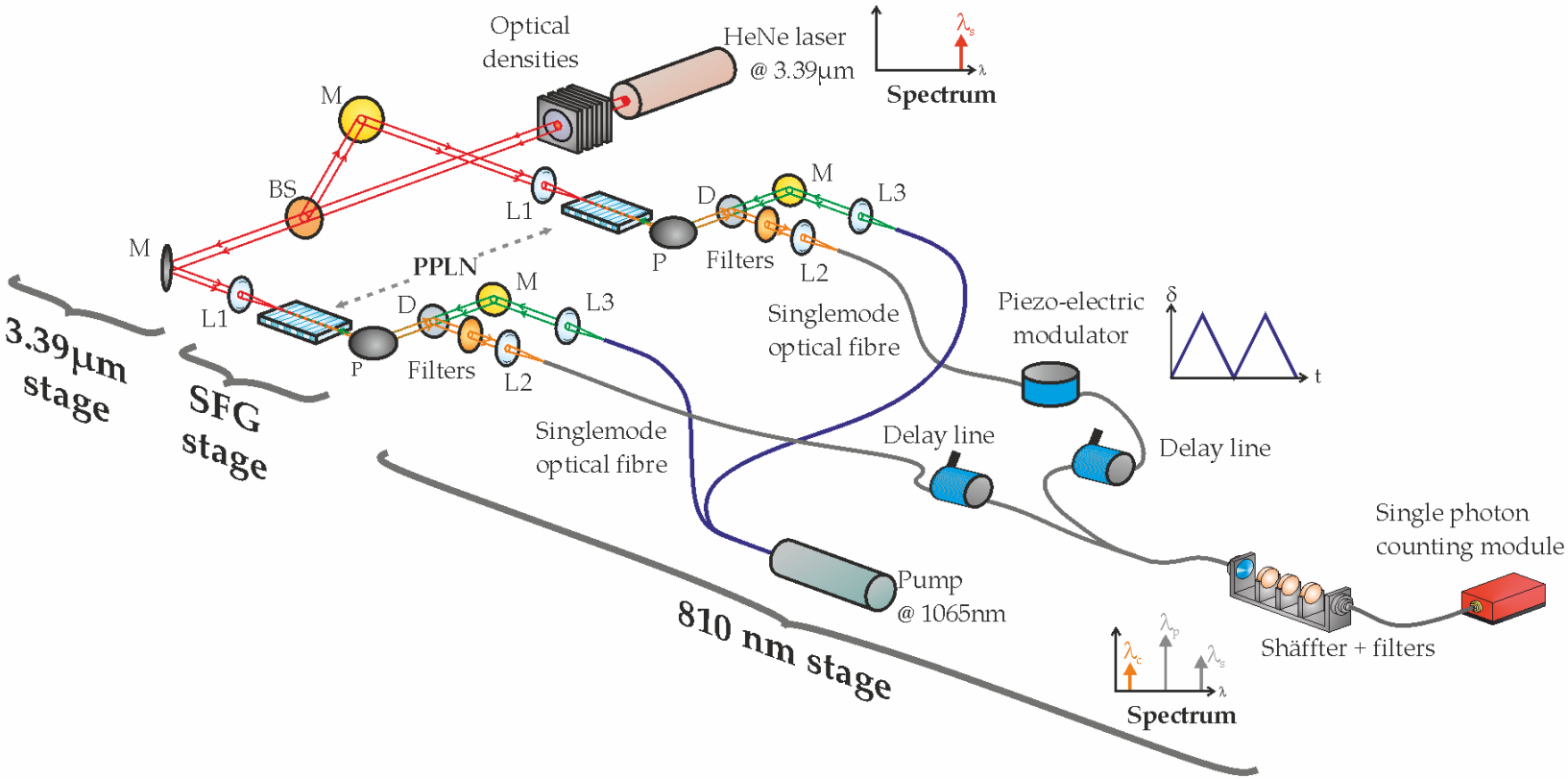
« On-sky fringes with an up-conversion interferometer tested on a telescope array »
P. DARRÉ, R. BAUDOIN, J. -T. GOMES, N. J. SCOTT, L. DELAGE, L. GROSSARD, J. STURMANN, C. FARRINGTON, F. REYNAUD and T. A. BRUMMELAAR , Phys. Rev. Lett. (IF : 7.9, 2016

ALOHA @3.39 µm

In laboratory experiment :

* Demonstration of the principle
* Spectral behavior
* Noise investigation
* Photon counting regime
* Blackbody source

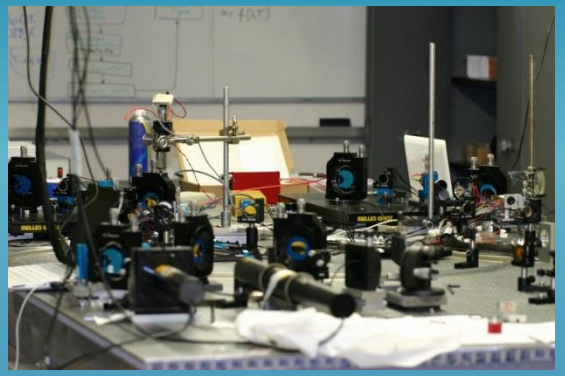


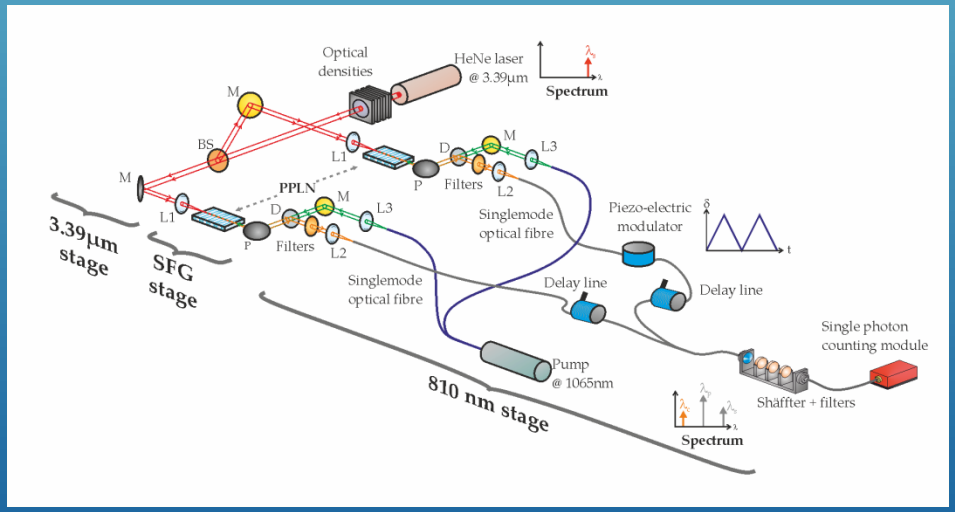


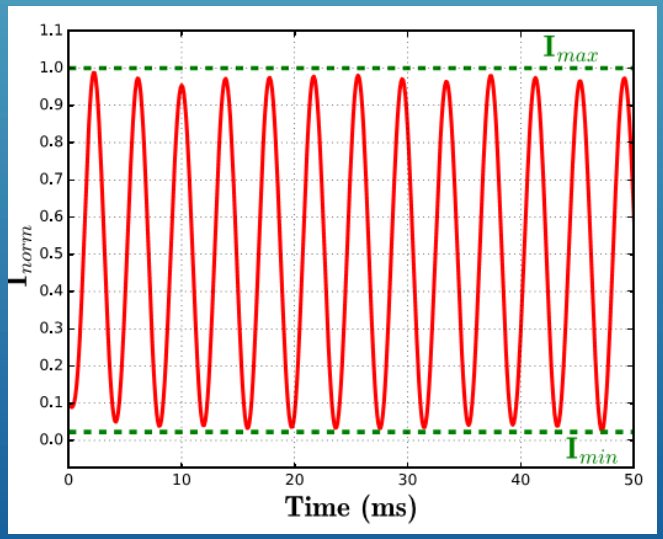
ALOHA @3.39 µm

In laboratory experiment :
high flux results

* Source HeNe 3.39 µm
* mW range
* 98% contrast
*reliable





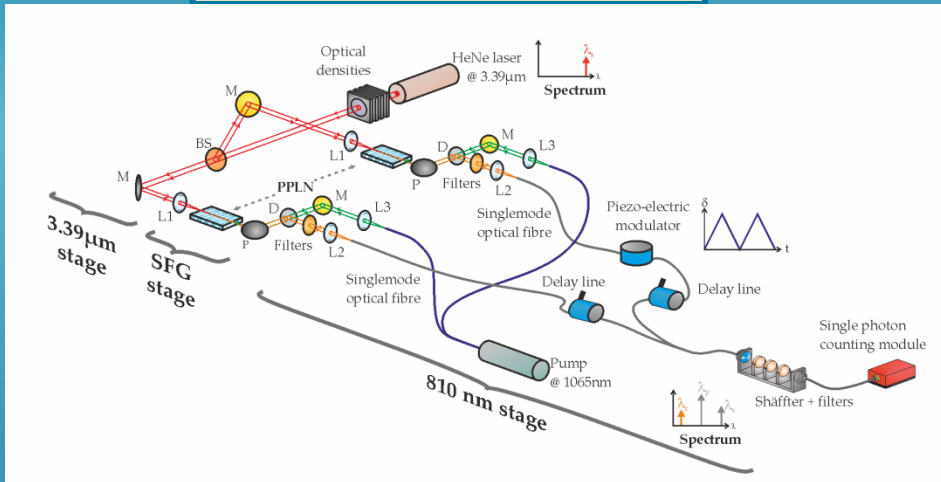


« In-lab ALOHA mid-infrared up-conversion interferometer with high fringe contrast @λ = 3.39 µm » L. SZEMENDERA, P. DARRÉ, R. BAUDOIN, L. GROSSARD, L. DELAGE, H. HERRMANN, C. SILBORHORN and F. REYNAUD
Monthly Notices of the Royal Astronomical Society, vol. 457, no. 3, pp. 3115–3118, Apr. 2016

ALOHA @3.39 µm

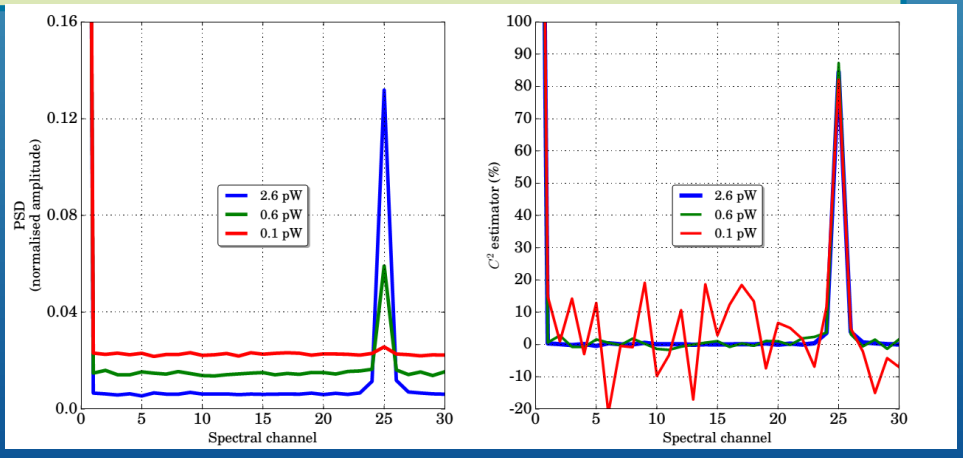
In laboratory experiment :
photon counting regime

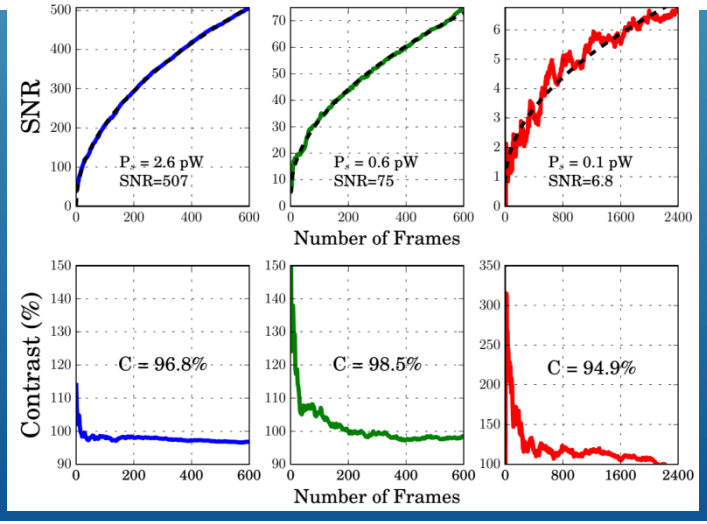
Source HeNe 3.39 µm
+ attenuation 80-90 dB



Current performances:

* Fringes acquisition and contrast estimation
* Very poor conversion efficiency 10^{-5} (old technology)
* Estimated sensitivity 1m² tel >> Lmag = 0
*New components >> conversion eff x 100

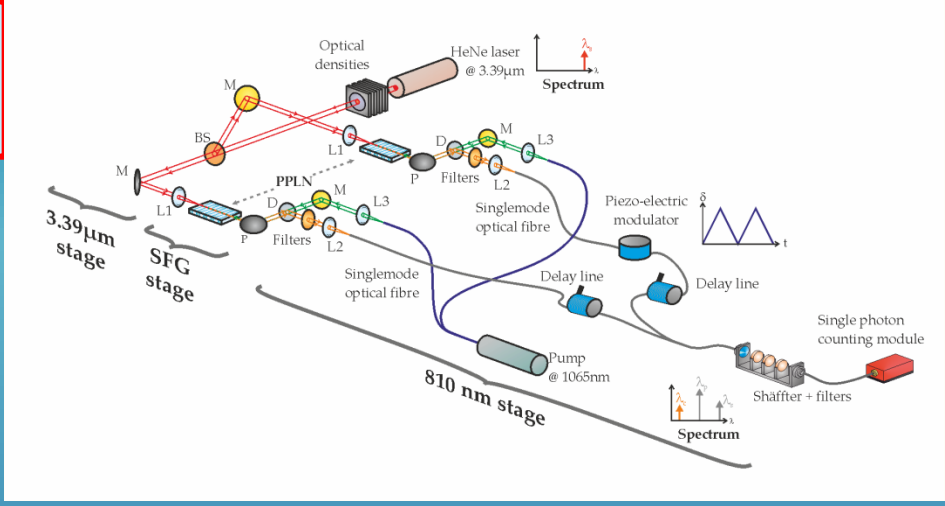




"In-lab ALOHA mid infrared up-conversion interferometer in the photon counting regime @ λ=3.39µm", L. Szemendera, L. Grossard, L. Delage and F. Reynaud Submitted to MNRAS

ALOHA @3.39 µm

In laboratory experiment :
photon counting regime + black body



Current performances:

*** First fringes acquisition and 40% contrast estimation but**

-dissymmetry of the PPLN

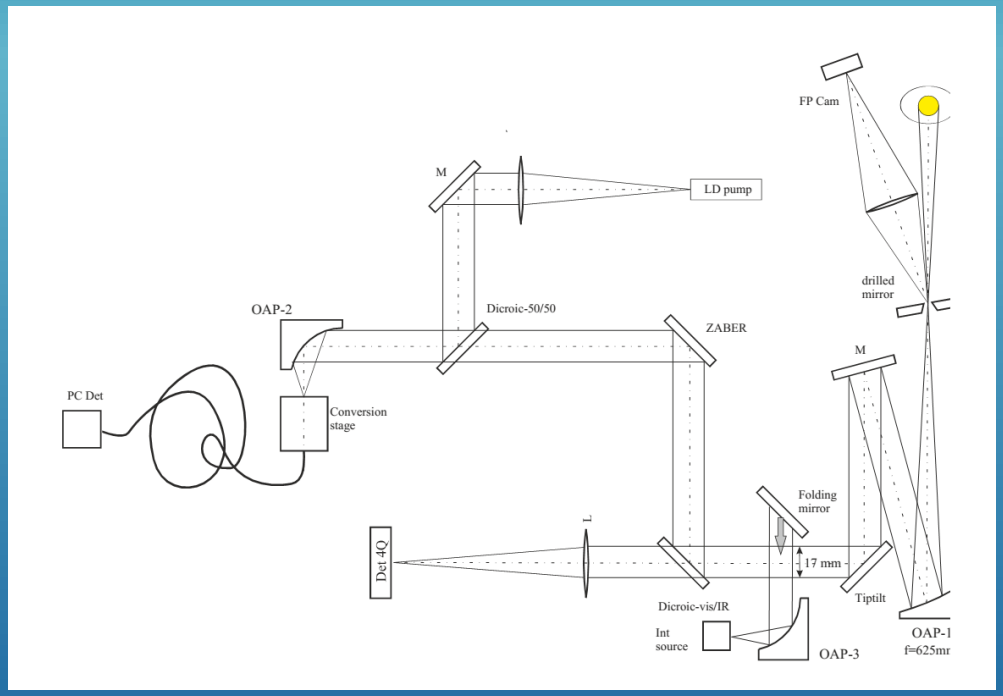
-Very poor conversion efficiency 10^{-5} (old technology)

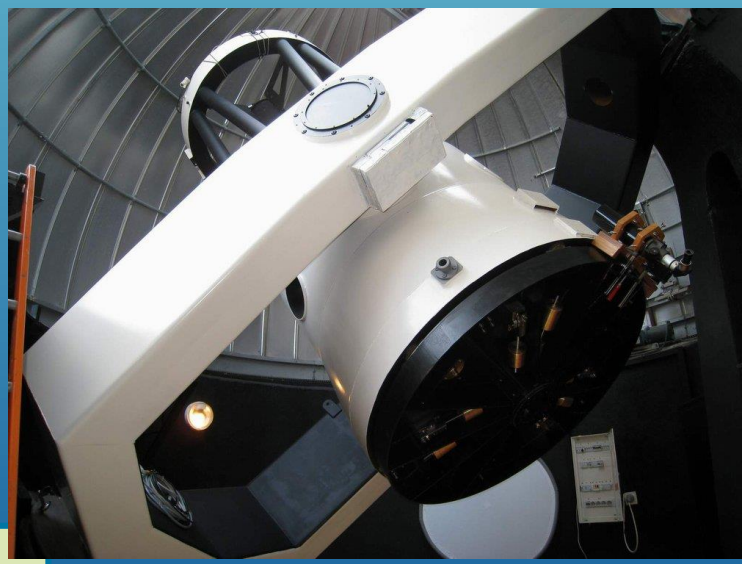
***New components under preliminary test >> conversion eff x 100**

In progress

ALOHA @3.39 µm C2PU

Sensitivity tests on C2PU OCA/Calern



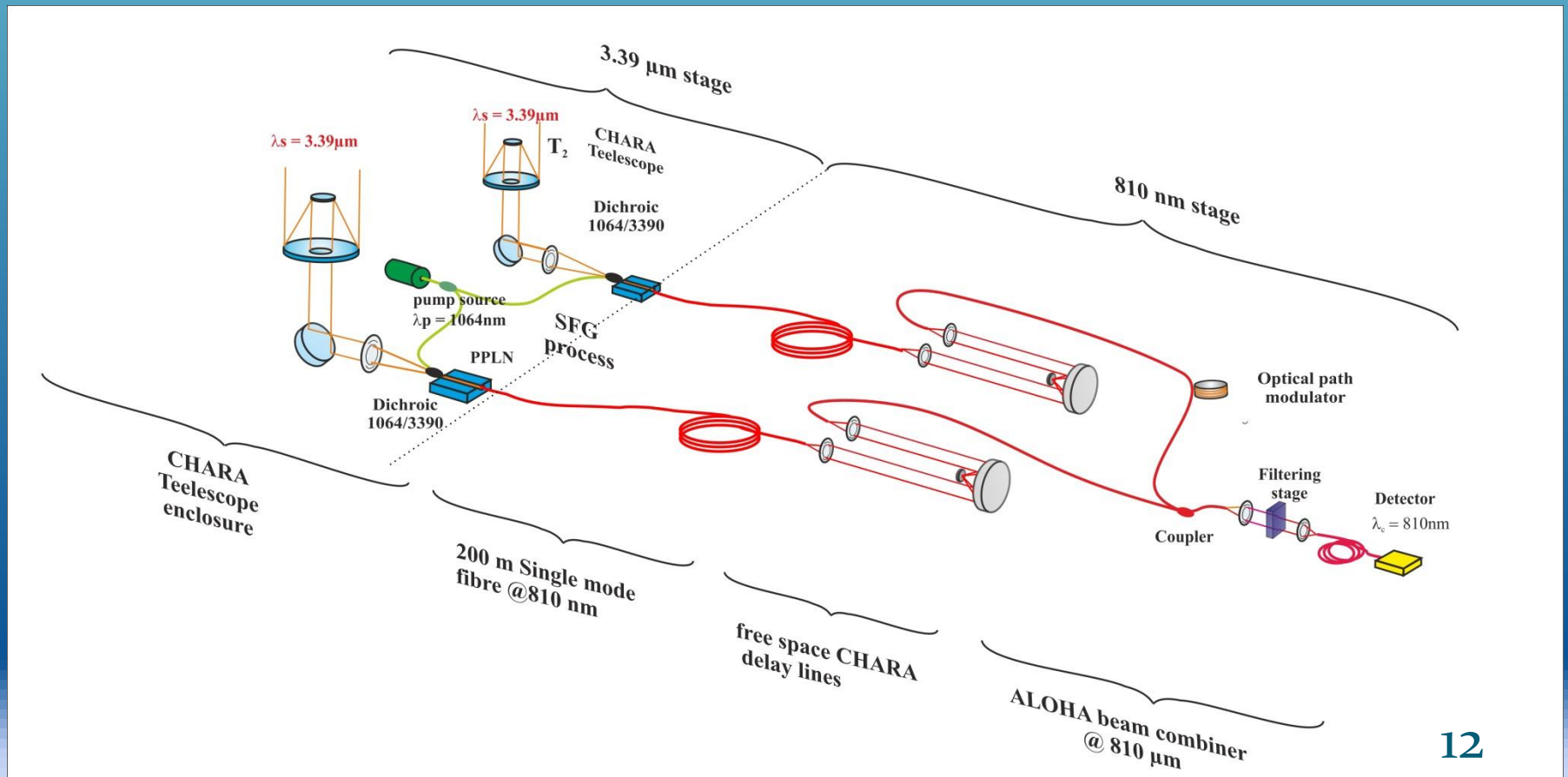


*the 1m telescope C2PU east
*Tip tilt
*Goal : scale the photometry between the lab and the sky
*Mission planed in May
*Collaboration JP Rivet F. Morand

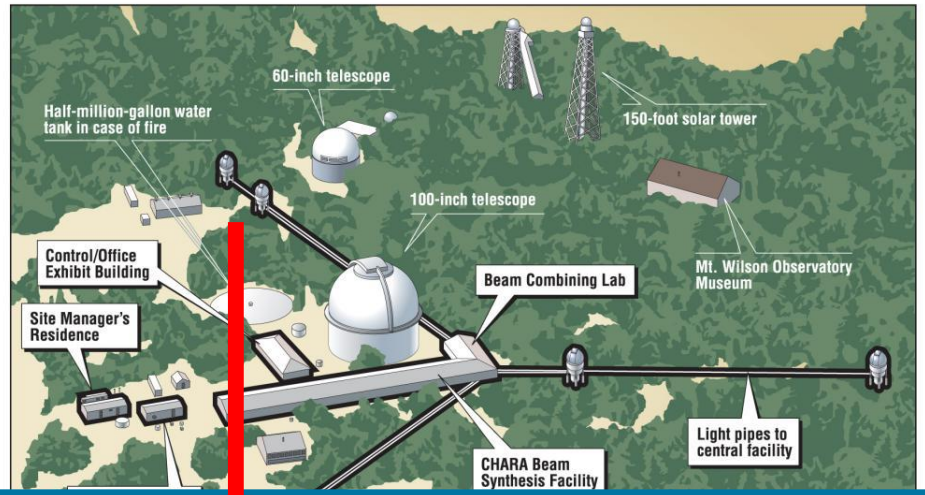
ALOHA CHARA @3.39 µm project

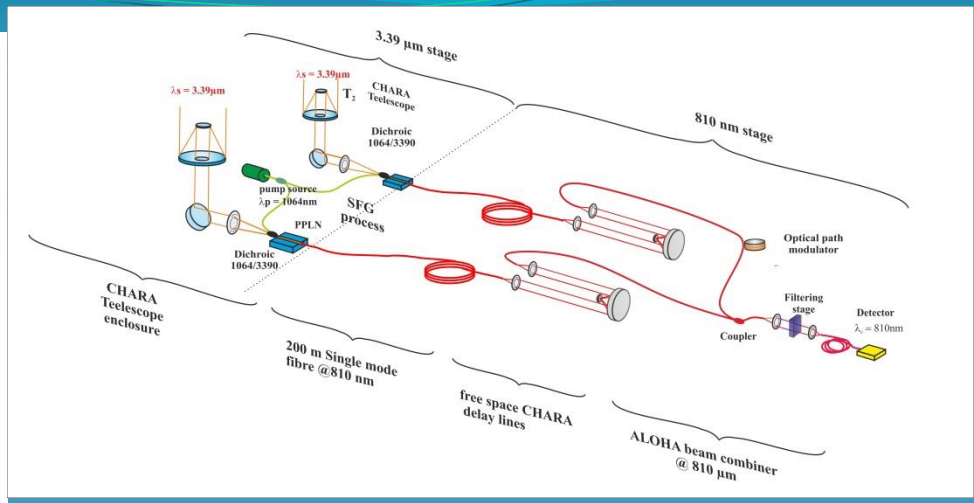
General scheme

Telescope	Propagation	Delay Line	Beam combination
Dichroic Injection, raster	250 m PM 810 nm OPD stabilization	CHARA >>Fibre DL?	JOUFLU >>Specific table?



ALOHA CHARA @3.39 µm project

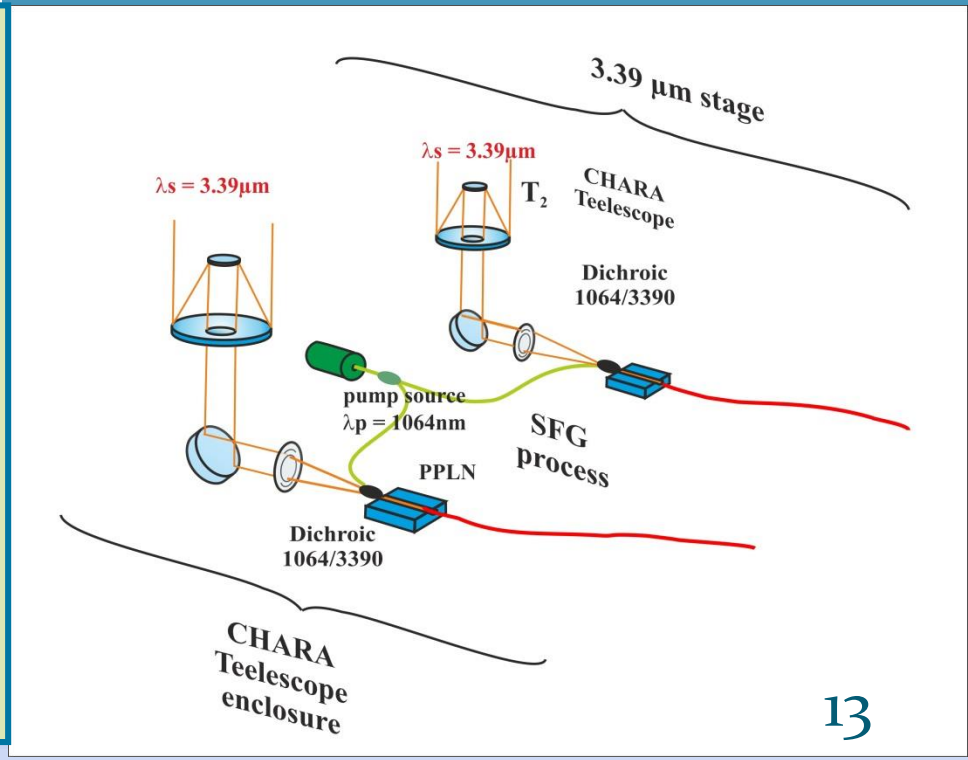




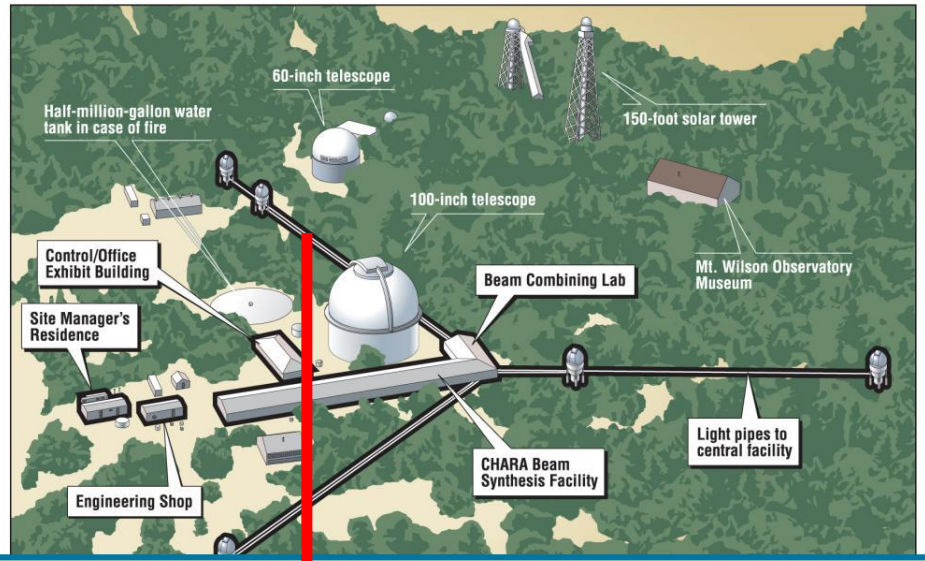
Telescope stage

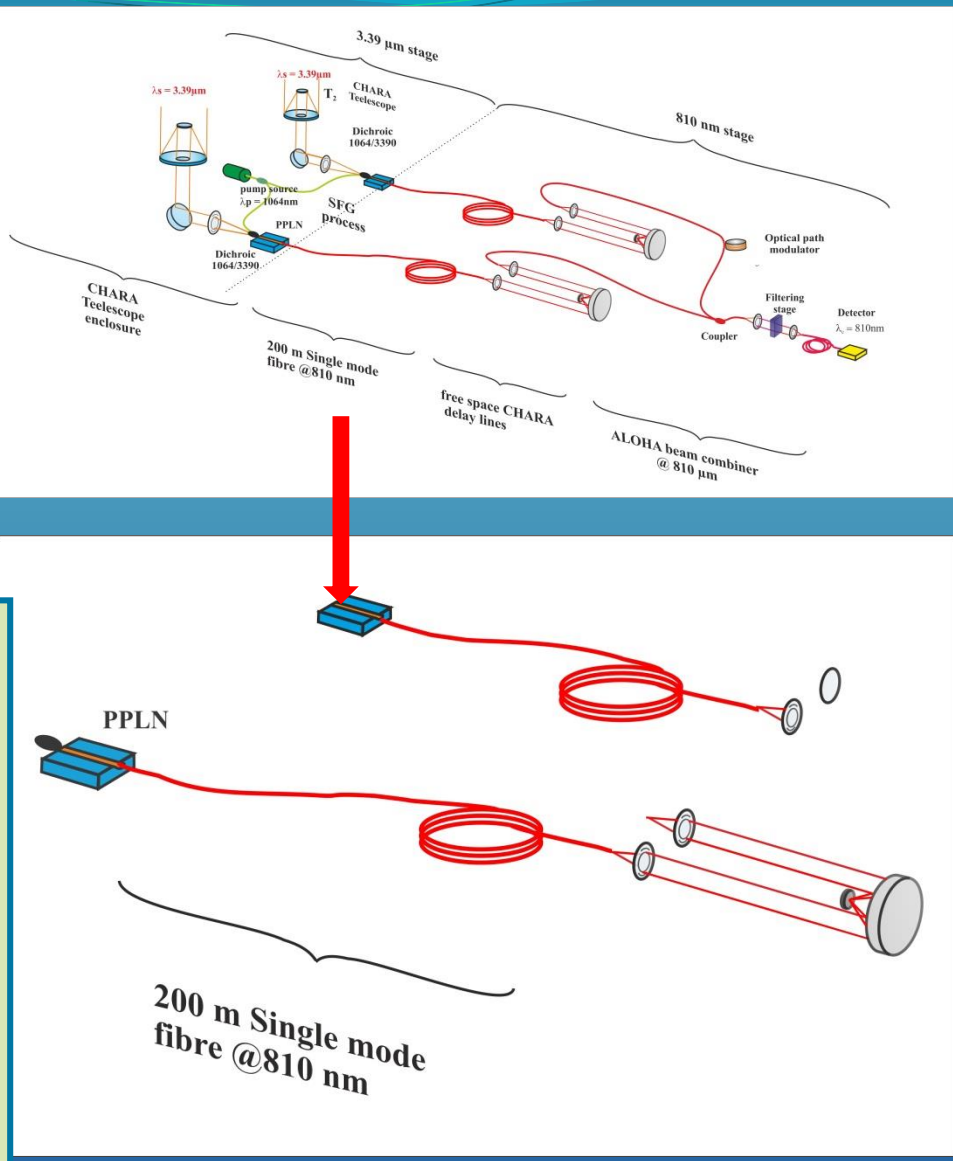
*S1 S2 for the first tests
*Tip tilt + AO + raster >> CHARA
*Dichroic plate in the convergent beam of the AO
* Injection stage
* Reference source existing source but vis + NIR MIR ?

To be investigated with Laszlo and Theo



ALOHA CHARA @3.39 µm project

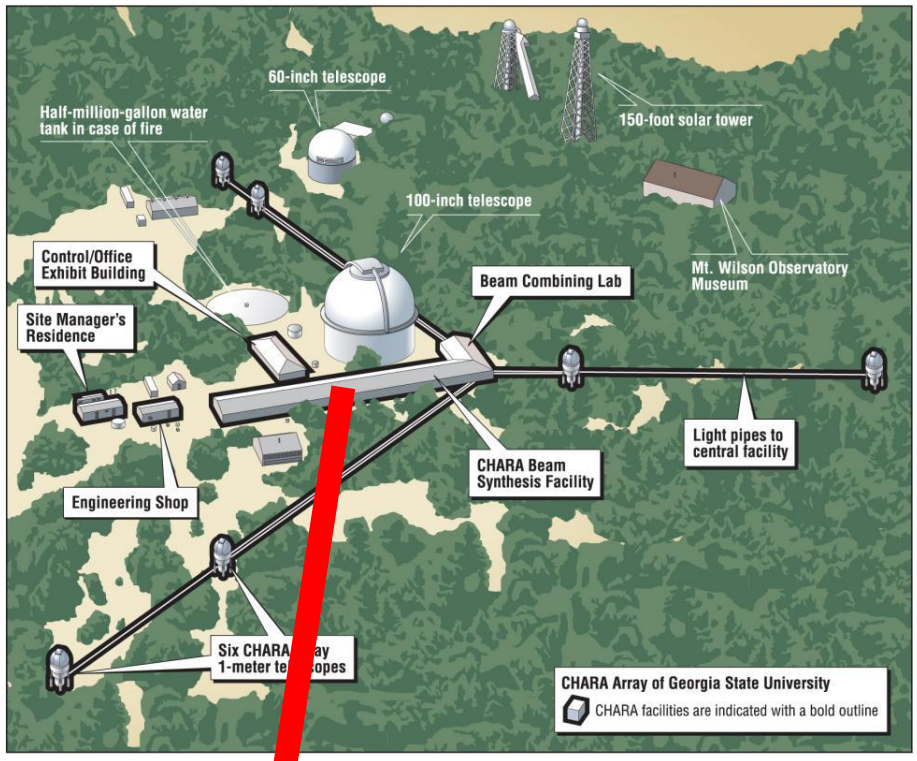


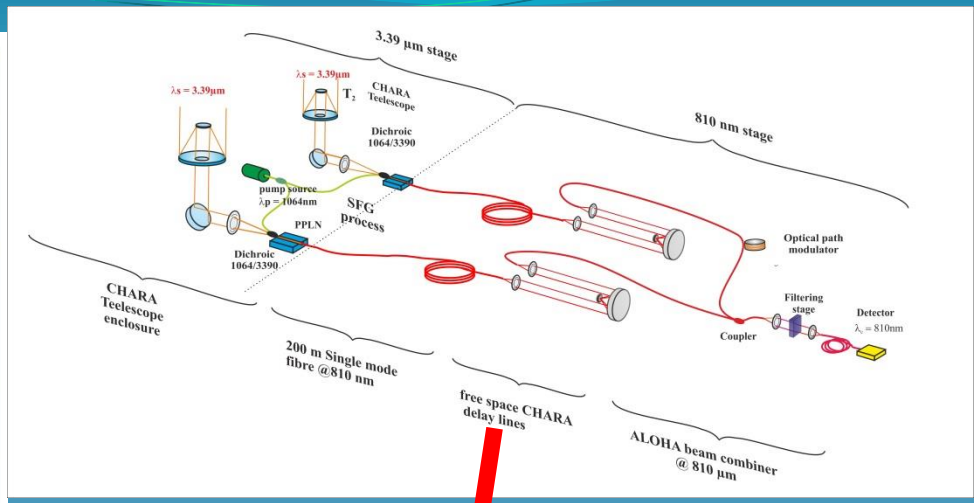


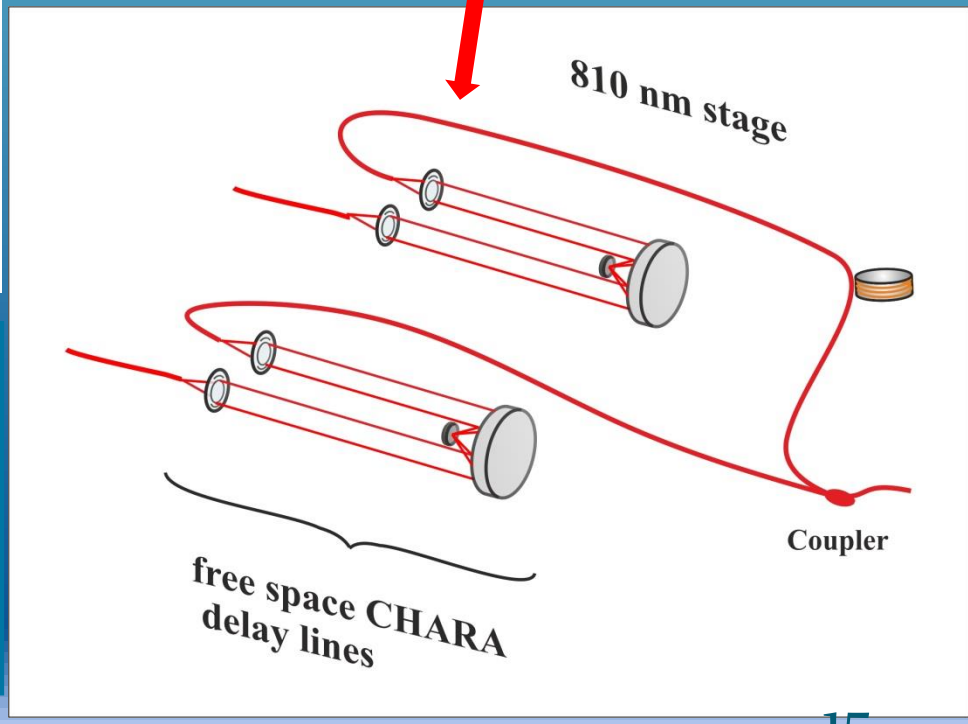
Fiber link

- Between S1 S2 and the lab
- First test with the OHANA fibers coming back from Mauna kea.
- inter config >>> opd fluctuation tests (in coupler + beam combiner
- = Mach Zehnder)
- Optical path stabilization ?
- Cable wrap influence
- How to lay the fibers?

ALOHA CHARA @3.39 µm project







Delay lines

***use of the CHARA delay lines**

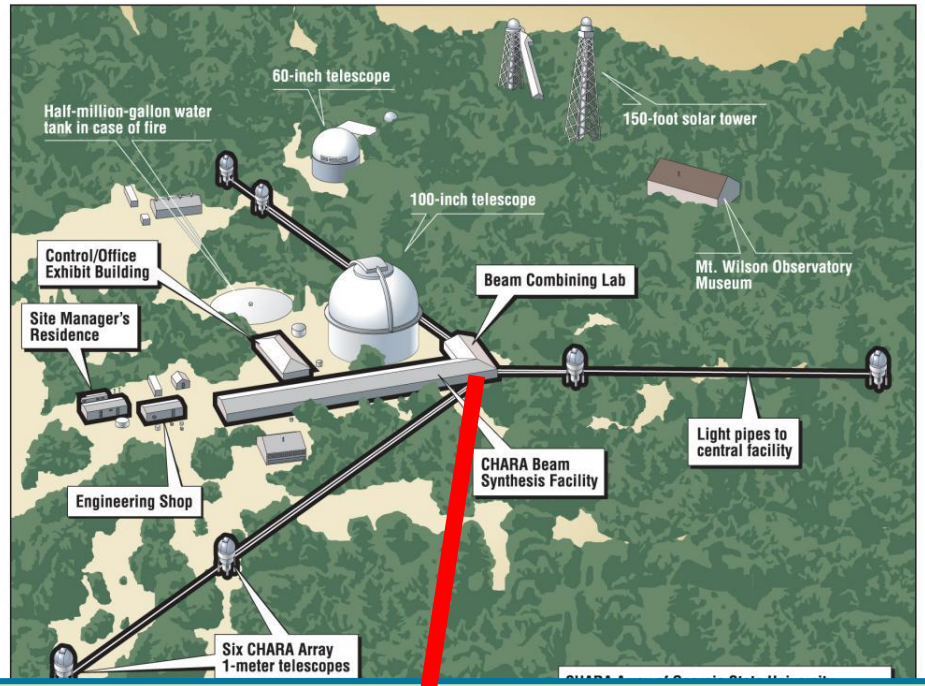
***Collimation and injection stage**

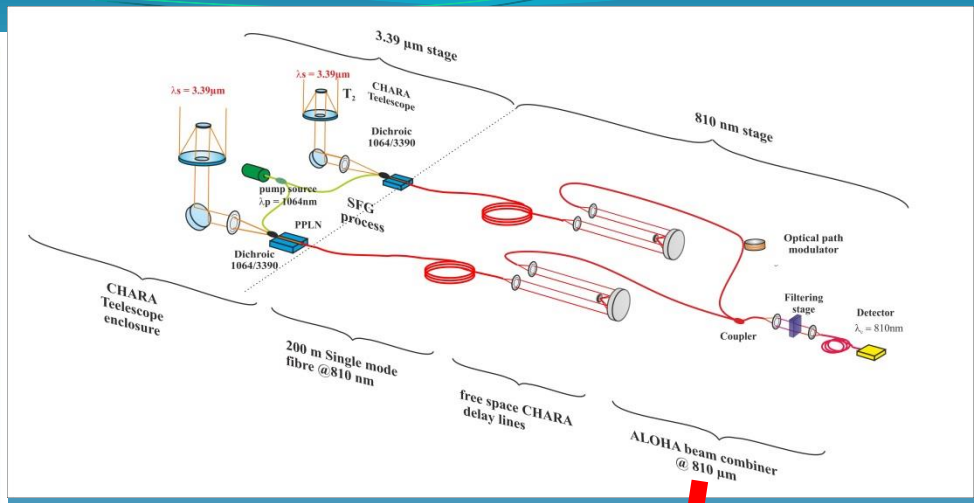
*** Mechanical mounting on the DL rail**

*** Beam diameter ? 'smaller than 5"**

rq: diam =1" >> Lf >> 100m !!!

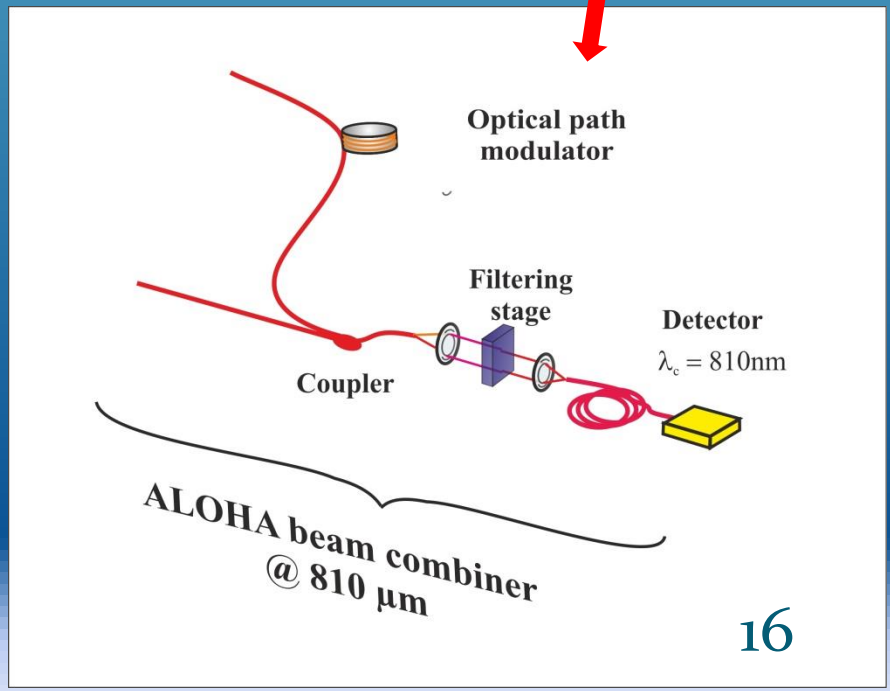
ALOHA CHARA @3.39 µm project





Beam Combiner

* In the lab close to the DL
*Fully experimented in lab
*All guided with fibers and coupler
*OPD modulation by PZT
* Si APD detector + data processing



Next mission
2017 Oct?

*** Test of ALOHACHARA@1.55µm spectro config/ photometry….**

***Fiber link test with the ALOHA 300 m fibers (internal source)**

*** Analysis and design of the MIR conversion stage on S1 and S2**

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