"ALOHA CHARA @L band ; Progress in 2018 and perspectives"

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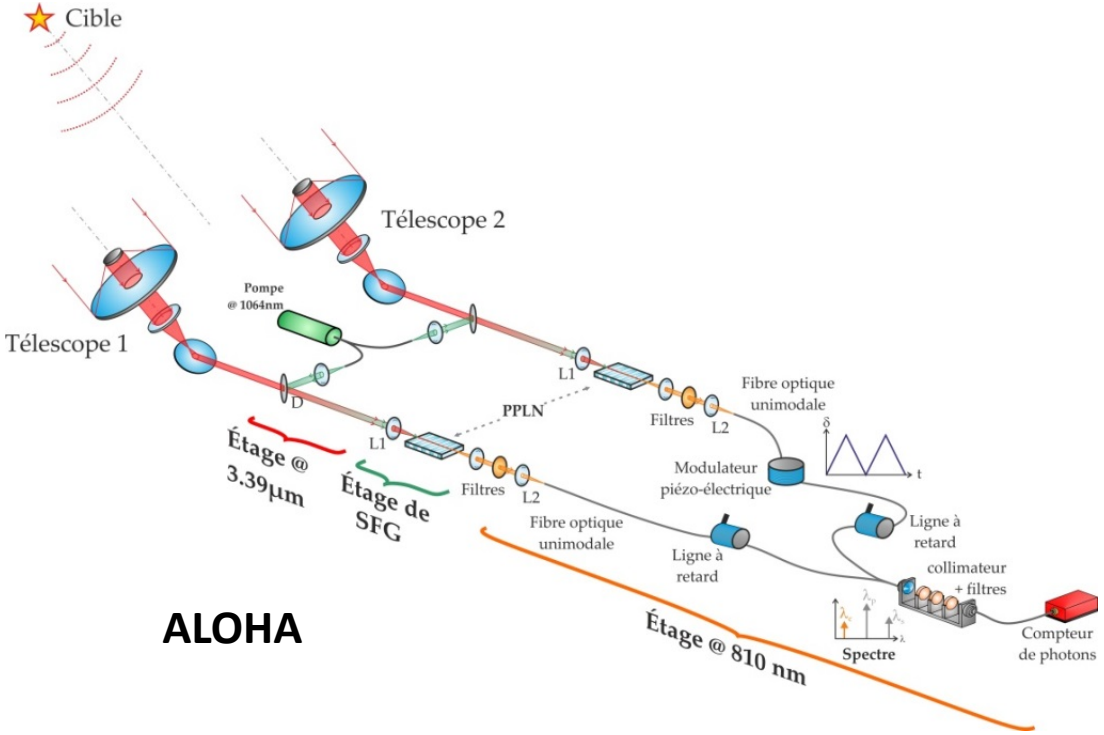
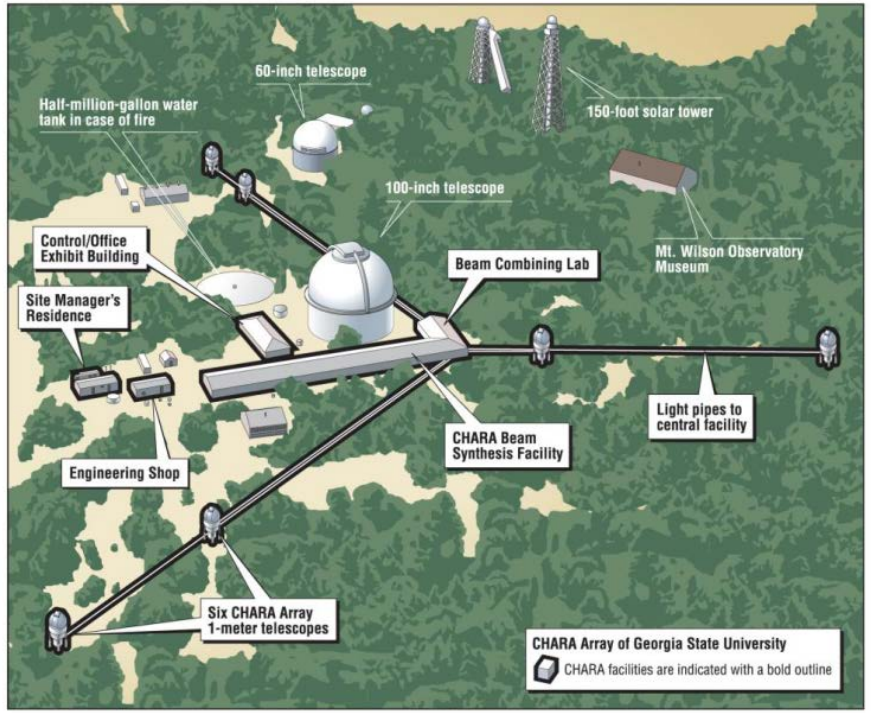
Evolution of the project



ALOHA



CHARA

@ 1.55 µm / H band : ALOHA development in lab >>> On the sky test @ CHARA

First fringes ; new functionalities ; launching interface = JOUFLU

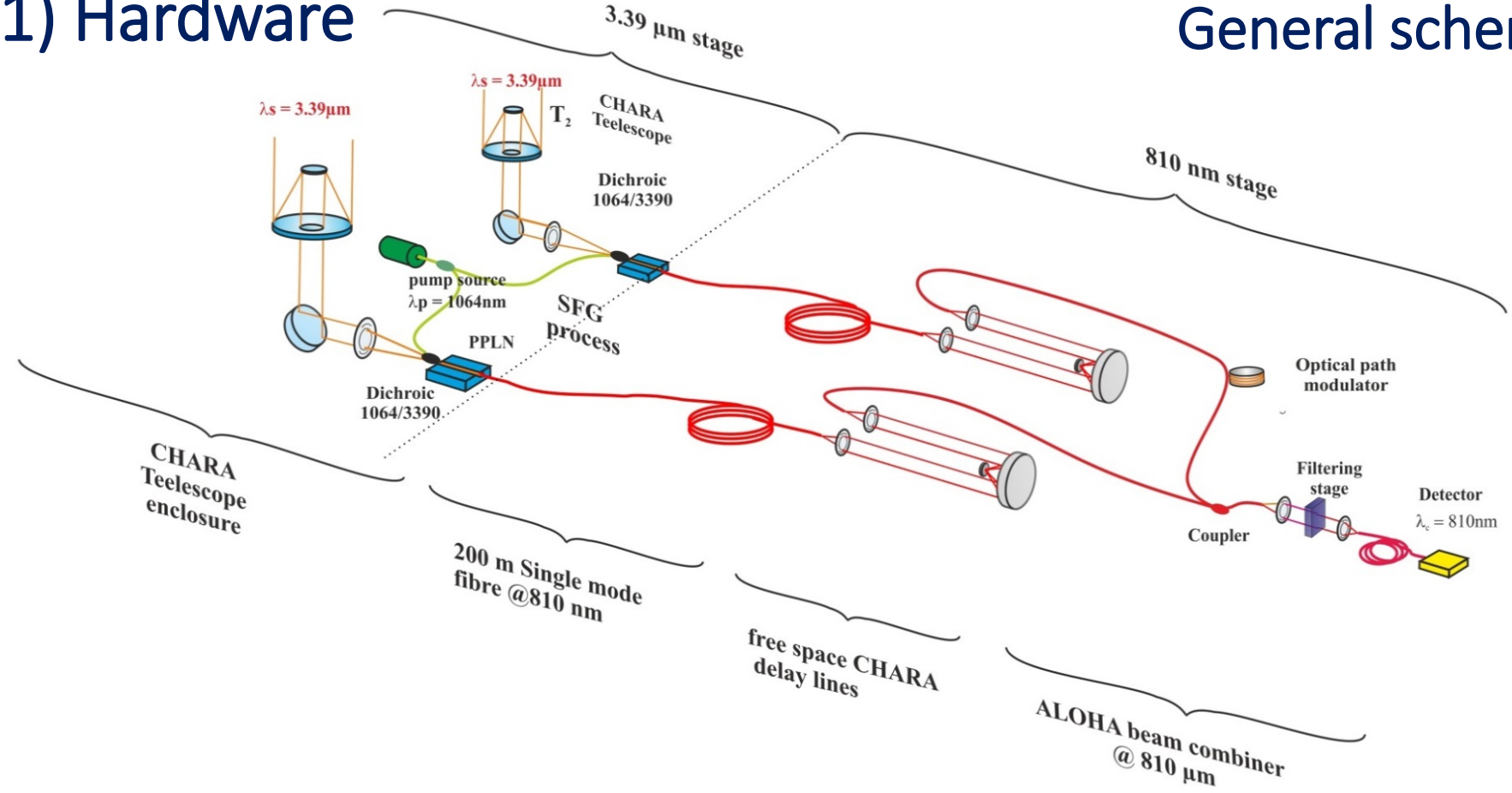
@ 3.5 µm / L band : ALOHA development in lab >>> On the sky test @ CHARA

ALOHA strategy

	ALOHA @1.5 µm **1.5µm + 1.06 µm > 630 nm**	ALOHA @3.5 µm 3.5µm + 1.06 µm > 817 nm	ALOHA @ 10 µm 10µm + 1.5 µm > 1.3 µm
Inlab tests	* Noise investigation * **Multi channel spectral mode**	* Noise investigation * New crystals * **Fringes with a blackbody source**	*Starting activity
On sky test	* Sensitivity 2014 * Fringes 2015	*Sensitivity 2018 June Preliminary result Lmag = 2.8 *Fringes….	

1) Hardware

General scheme



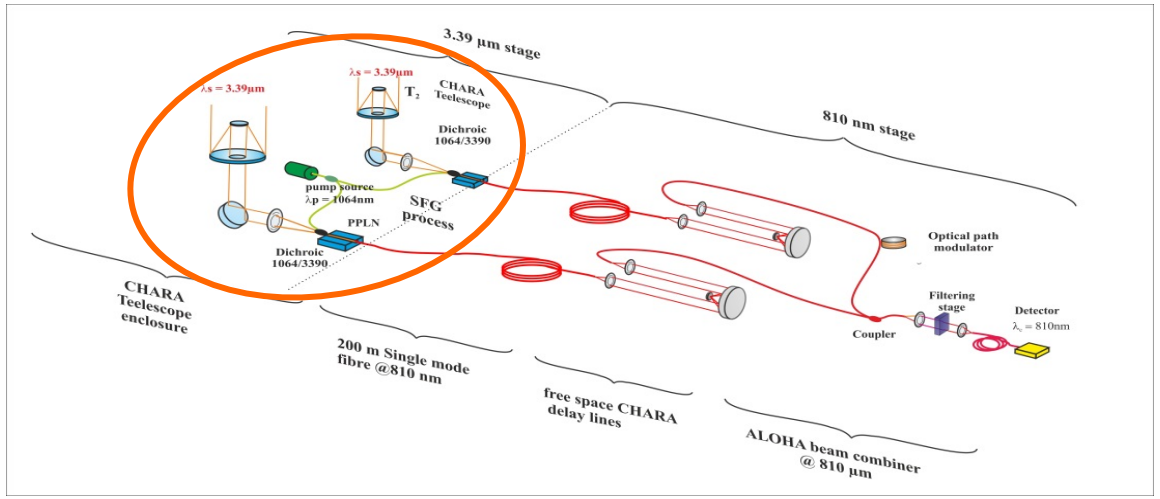
Telescope	Propagation	Delay Lines	Beam combiner
Dichroic Injection Raster scan	250 m PM 810nm fibers OPD stabilization	CHARA DL Interfaces	Specific

Telescope stage

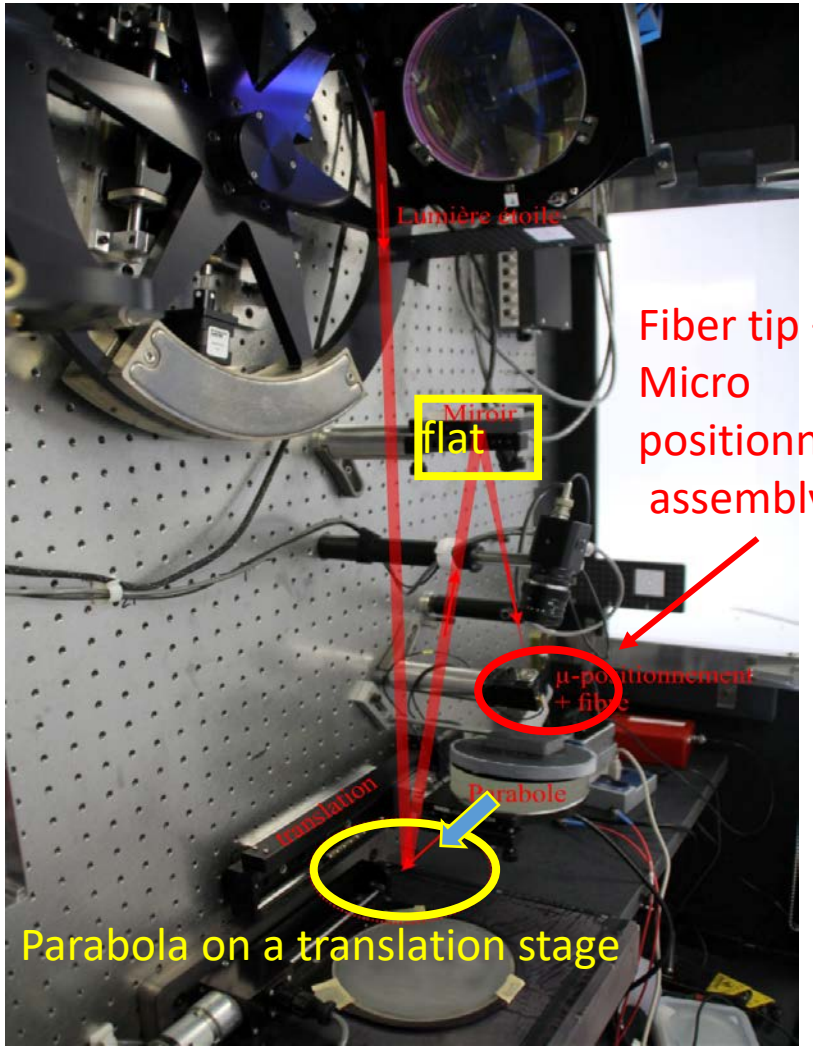
Status :

*Tip tilt + AO + raster >> existing on CHARA
* Injection / conversion stage under development @XLIM
* In 2017 : test of the thermal disturbance of the PPLN
thermal regulation > OK
- In 2018 : test of the launching assembly @ 1.5 µm H band
On the sky (see below).

Beam picked before M5



M4

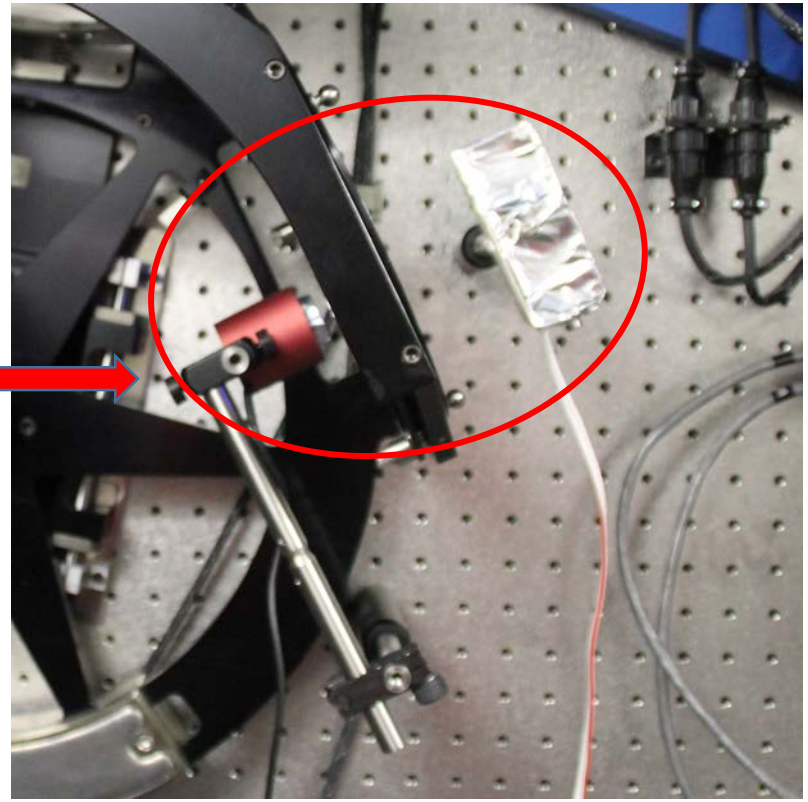


M5

Telescope stage

Status :

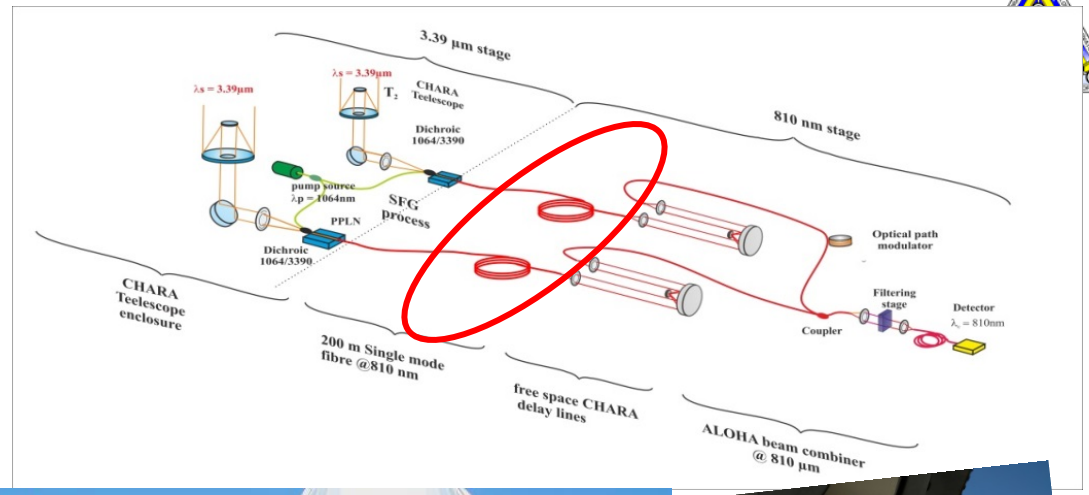
* Test of the dichroic without coating on the CHARA carousel
30% transmission in L band (@ 3.5 µm)
… no so bad … no so good but sufficient for first tests



To be achieved :

* Finalization of the conversion stage (dichroic and pump injection ; optimization of the NA …)
* Compatibility with a vertical table
* Fibers routes through the telescope mount **!**

Fiber link

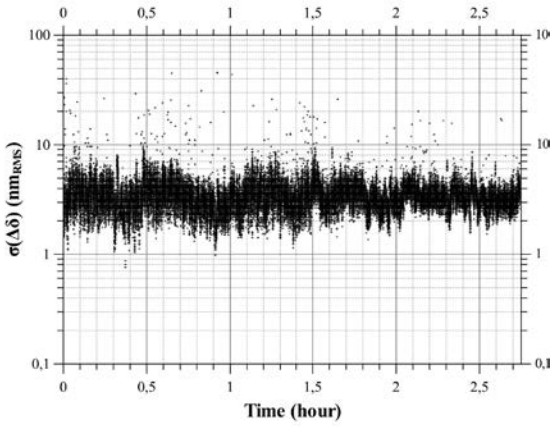


Status :

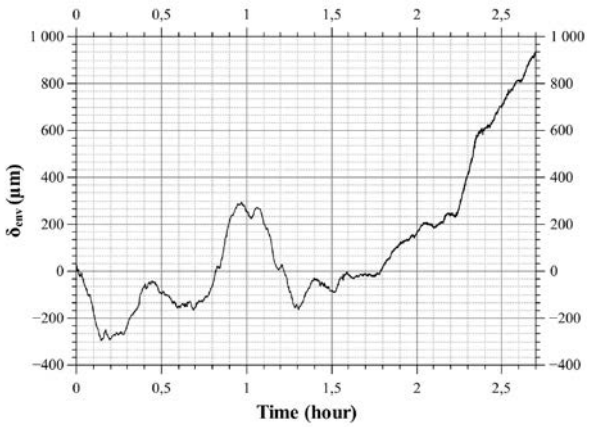
In 2017

First test and stabilization with the OHANA fibers @ 1.55 µm achieved last year is now accepted for publication in

Experimental Astronomy



OPD stability



OPD correction

« Environmental characterisation and stabilisation of a 2×200-meter outdoor fibre interferometer at the CHARA Array » ; **Lucien Lehmann · Laurent Delage ·Ludovic Grossard · Francois Reynaud · Steve Golden · Craig Woods · Larry Webster · Judit Sturmann · Theo ten Brummelaar·**

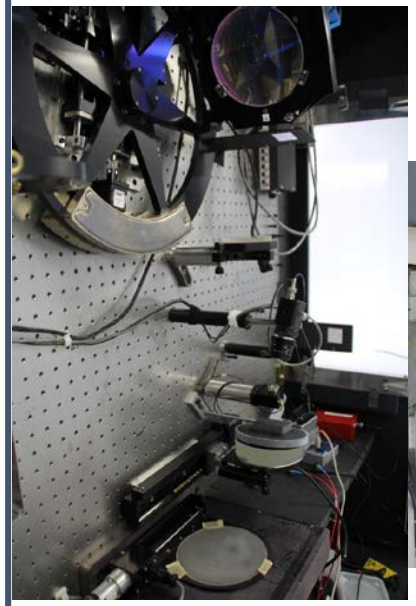
Fiber link

Status :

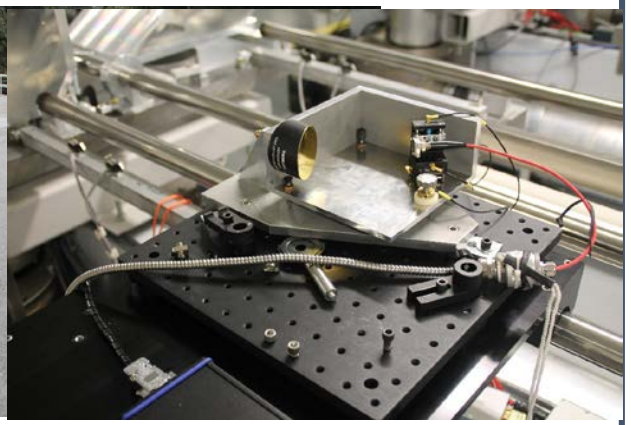
In 2018

First propagation of star light from S1 to the lab with the OHANA fibers @ 1.55 µm

See global tests below



S1 >> dome >> tunnel >> lab building >> delay line rails

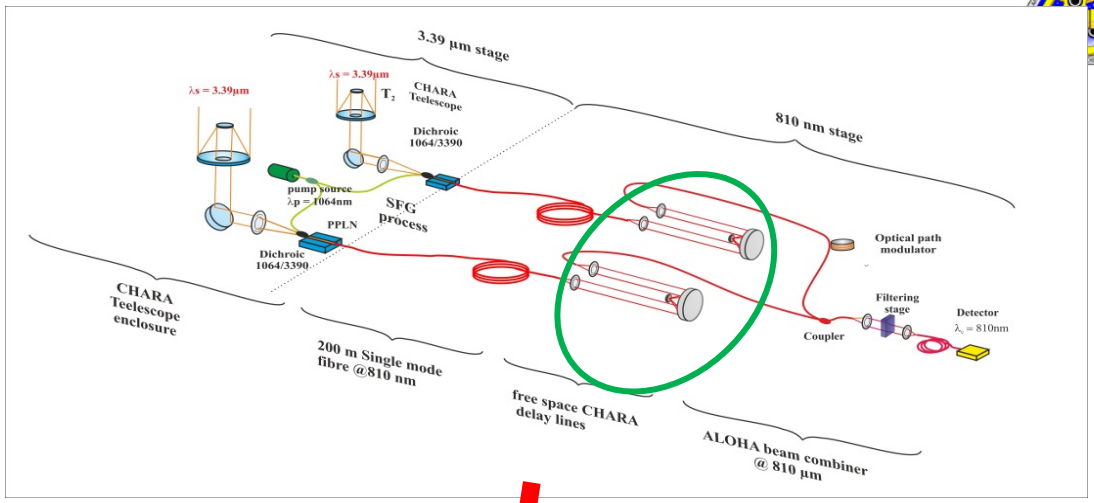


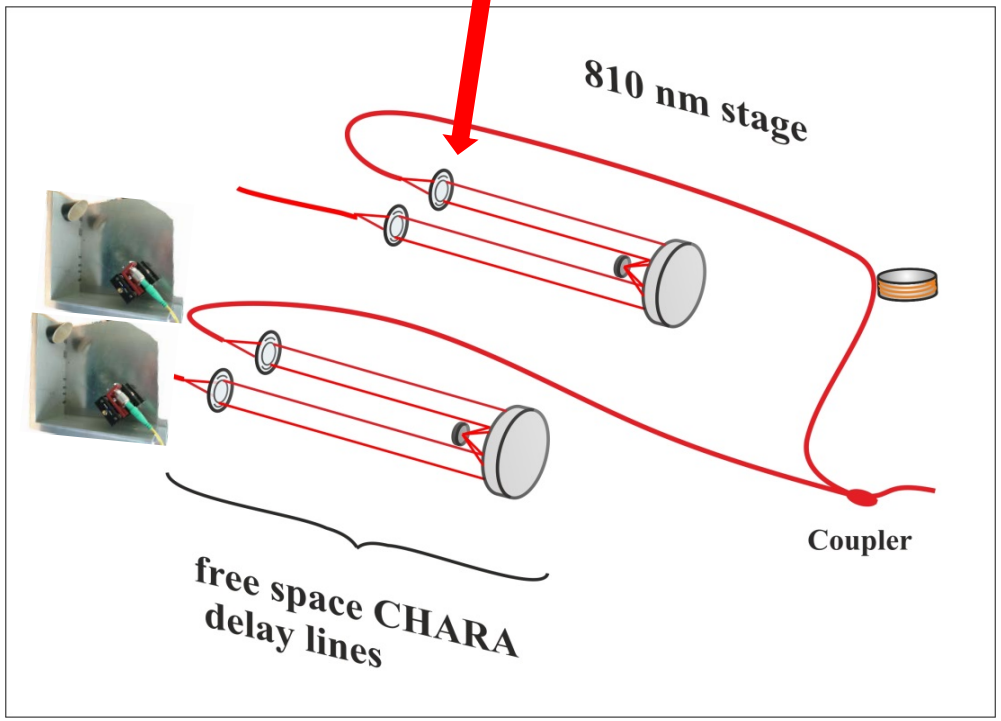
Fiber link

Current steps and to be achieved :

* S1 S2 selected (telescope access ; baseline >> delay line)
* The convenient route is identified (! Telescope mount route!!!)
* Permanent implementation of the fiber routes. To be discussed and done with the CHARA team
* Packaging of the 250 m @ 810 nm (lab to S2_S1) long fibers (XLIM lab and outside the lab…)
* Use the duct to lay the 810 nm (ALOHA) and 1.5 µm (OHANA) fibers ?
* Fibers for pump sharing between S1 and S2

Delay lines





Status :

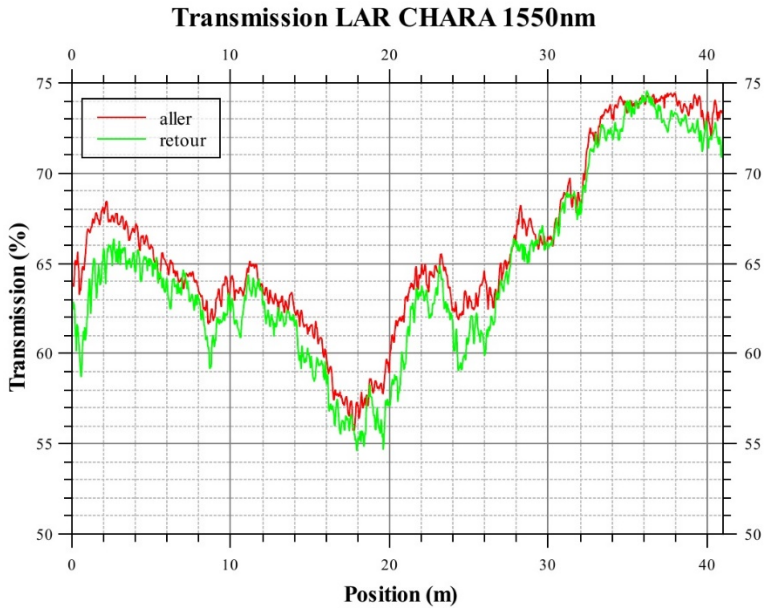
* Use of the CHARA delay lines
* Collimation and injection prototype tested in 2018
* Beam diameter 1-2 ” (Lf >> 100m !!!)
* Collimator and injection stage final version
* Mechanical mounting on the Delay Line at CHARA
* Test at CHARA (Stability of the coupling with an internal source and on the sky)

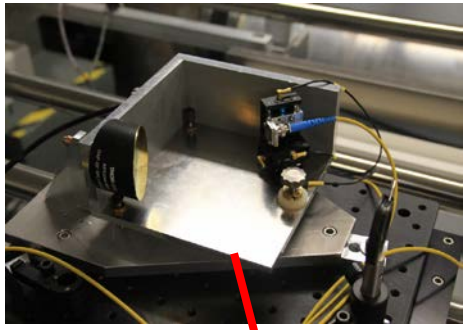
To be achieved :

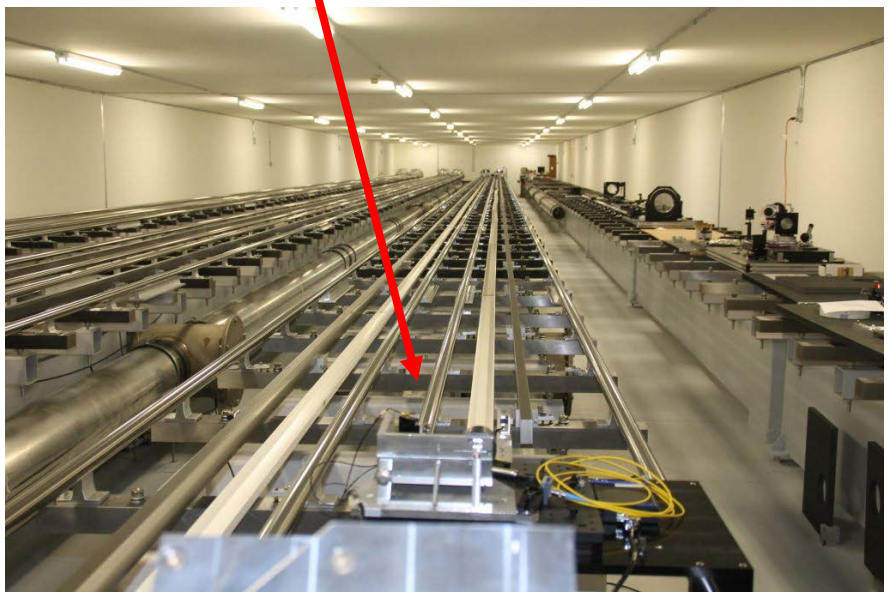
* Duplication in progress
* Integration of the OPD servo loop using the pump light

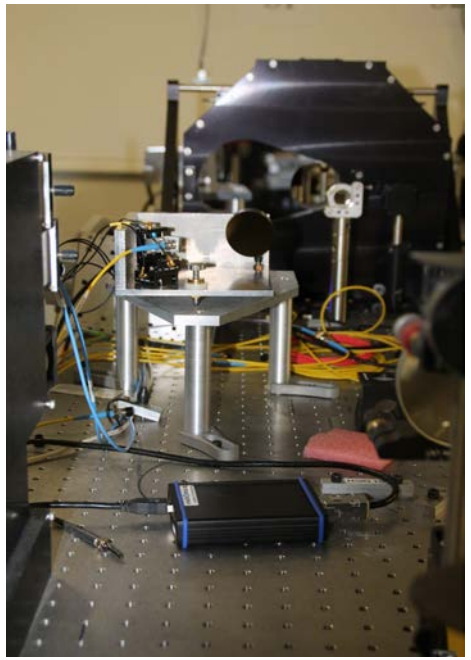
Delay lines

*Tests on the transmission in H band all along the stroke 55% ≤T≤ 75%
Internal source









Beam selection table

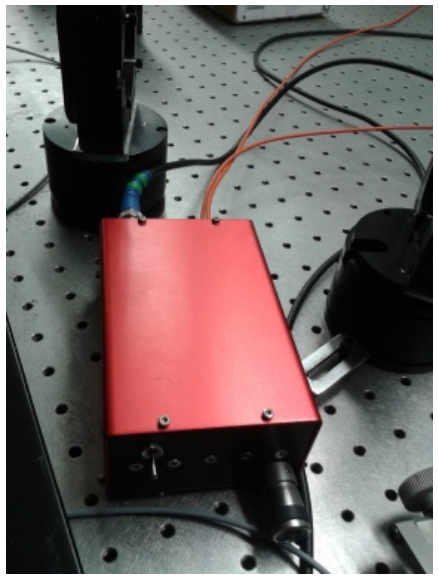
Beam Combiner

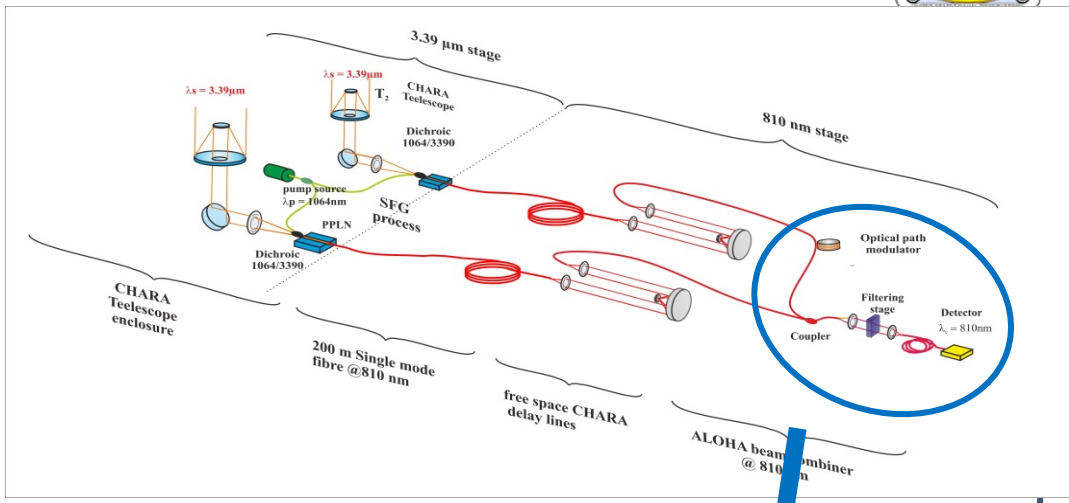
Status

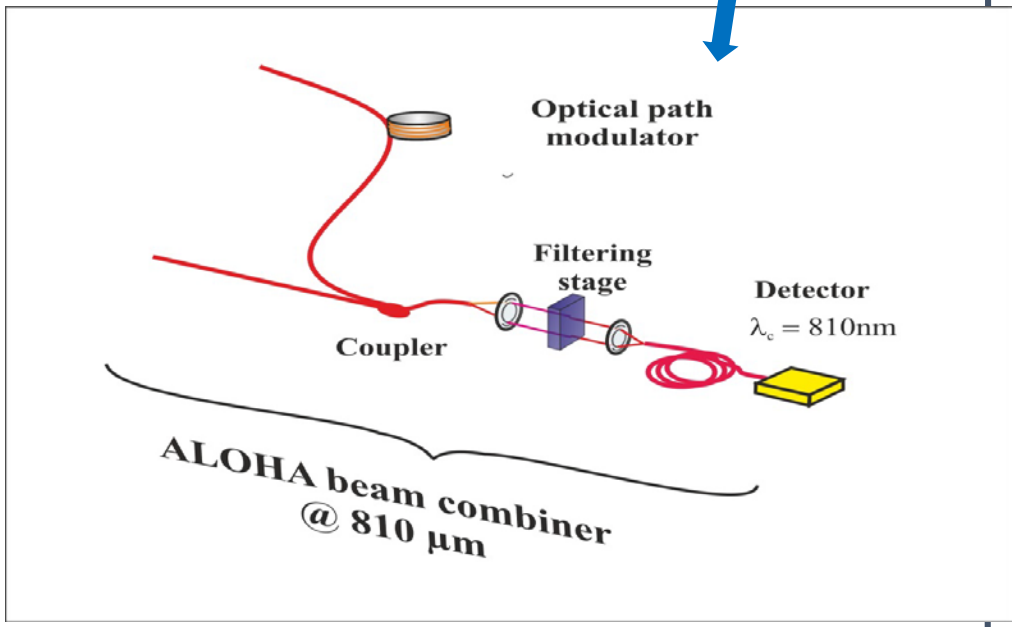
* All guided combiner with fibers waveguides and coupler
* OPD modulation by PZT stroke = 750 µm
* Fiber delay line stroke = 5 mm
* Filtering stage
* Si Photon counting detector + data processing

To be achieved

* Optical tests and calibration





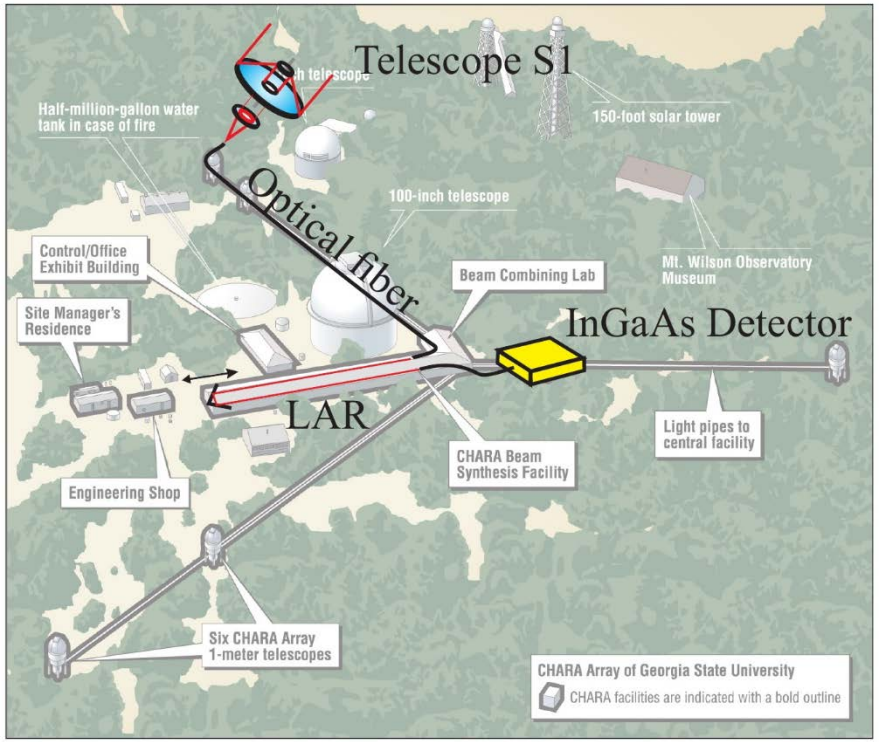


2) On the sky tests

At CHARA (H band)

*Use of the OHANA H fibers to link S1 to the lab
*Implementation of a full ALOHA arm excepted the conversion
i.e. injection stage > 250 m H fiber > CHARA delay line > H fiber
* Simple uncooled InGaAs photodiode
* No modulation ; integration time in the range 15 to 200 s
* Global throughput 50% (with an internal laser)
* On sky tests with a r_0 = 2 cm!!

Star	H_{mag}	Integration time (s)		Tension (mV)	Power (fW)	SNR
		Star	Dark			
HD217906	−1.98	185	36	2064.90	4129	42.7
HD200905	0.13	15.1	2.5	200.11	400	20.0
HD205435	2.06	27.9	5.1	37.96	75.9	27.3
HD190603	4.41	29.2	32.3	6.71	13.4	26.1
HD191610	5.08	44.1	25.9	2.62	5.25	16.0
HD189687	5.54	59.5	28.2	2.48	4.96	16.4
HD208682	6.05	113.5	74.3	1.86	3.72	19.9



Test on C2PU epsilon telescope in june 2018 in L band

* Throughput telescope to ALOHA around 1 %
* Tiptilt from OCA
* Fluoride optical fiber >> possible calibration of the conversion stage
* Modulation by a chopper
* Data processing
* Sky and chopper back ground correction

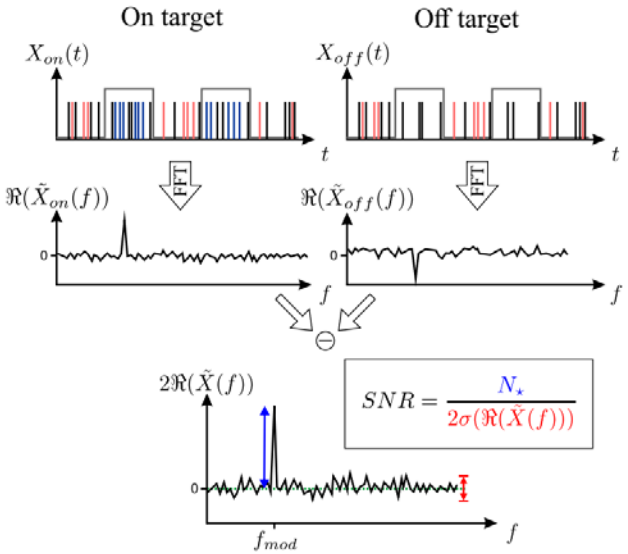
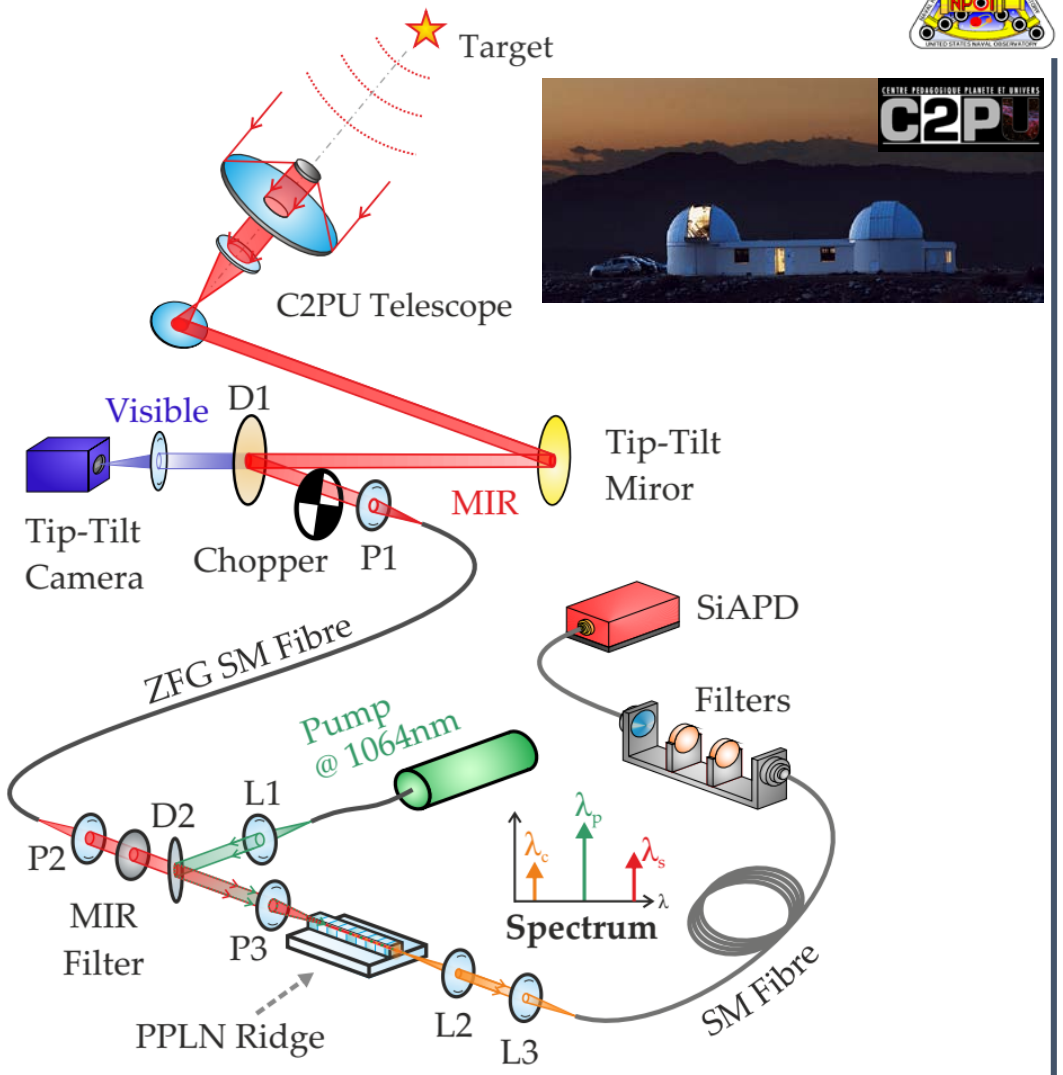


Figure 3. Data Processing.



Source	Observation hour	L mag	Flux[b] (fW · nm^{-1})	Flux[b] (Jy)	Integration time (s) on target	Integration time (s) off target	$N_\star$ (ph/s)	SNR (σ)
Alf Bou	22:51	−3.12	5100	955	60	0	4762	232
Gam Dra	23:37	−1.44	1080	204	120	0	787	61.2
Alf Lyr	03:25	0	288	54	180	180	250	15.4
Eta Cyg	04:00	1.53	70.4	13.4	720	900	46	5.99
Dlt Cyg	04:39	2.77	22.5	4.2	720	1080	20	2.73
Sky BG	05:07	—	—	—	0	180	-96 [a]	8.31
Internal	05:41	—	18.2	—	180	0	1114	97.9

[a] Typical value for $N_{BG} + N_{tel} - N_{chp}$

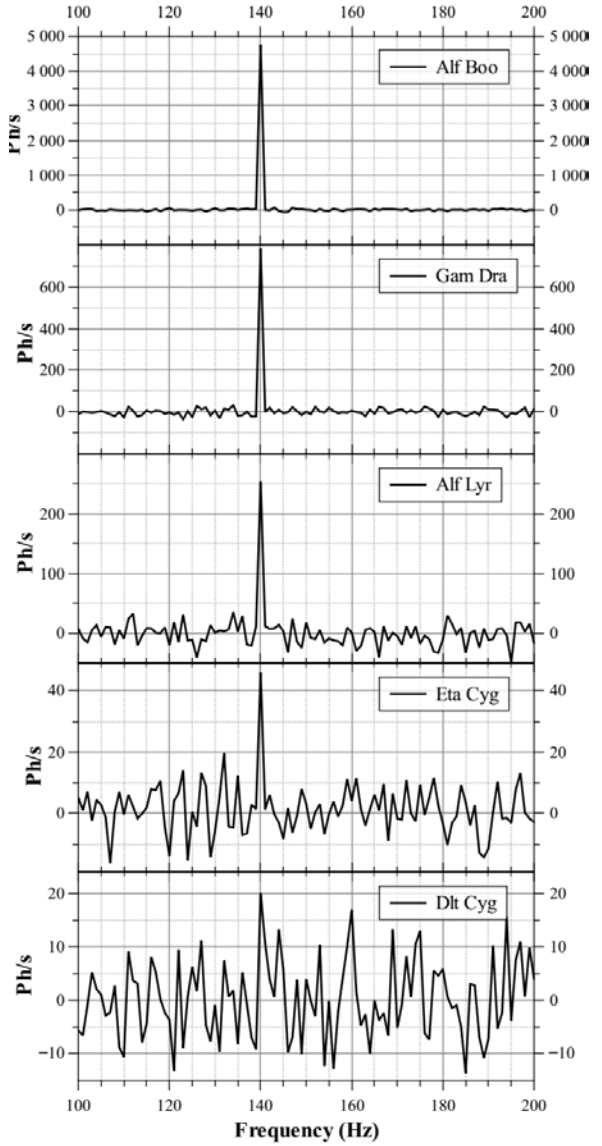
[b] Spectral flux density on a single polarisation

Limiting Lmag = 2.8

Despite the 1% telescope to ALOHA transmission

Sky + tel + Chopper background

Internal source > calibration of the detector



"Toward a mid-infrared L band up-conversion interferometer:
First on-sky sensitivity test on a single arm",
Accepted for publication in Monthly Notices of the Royal Astronomical Society

3) In lab Tests

Test at XLIM in L band

* Black body source
- Fluoride optical fiber>> unresolved object
- Adjustable spectral resolution.

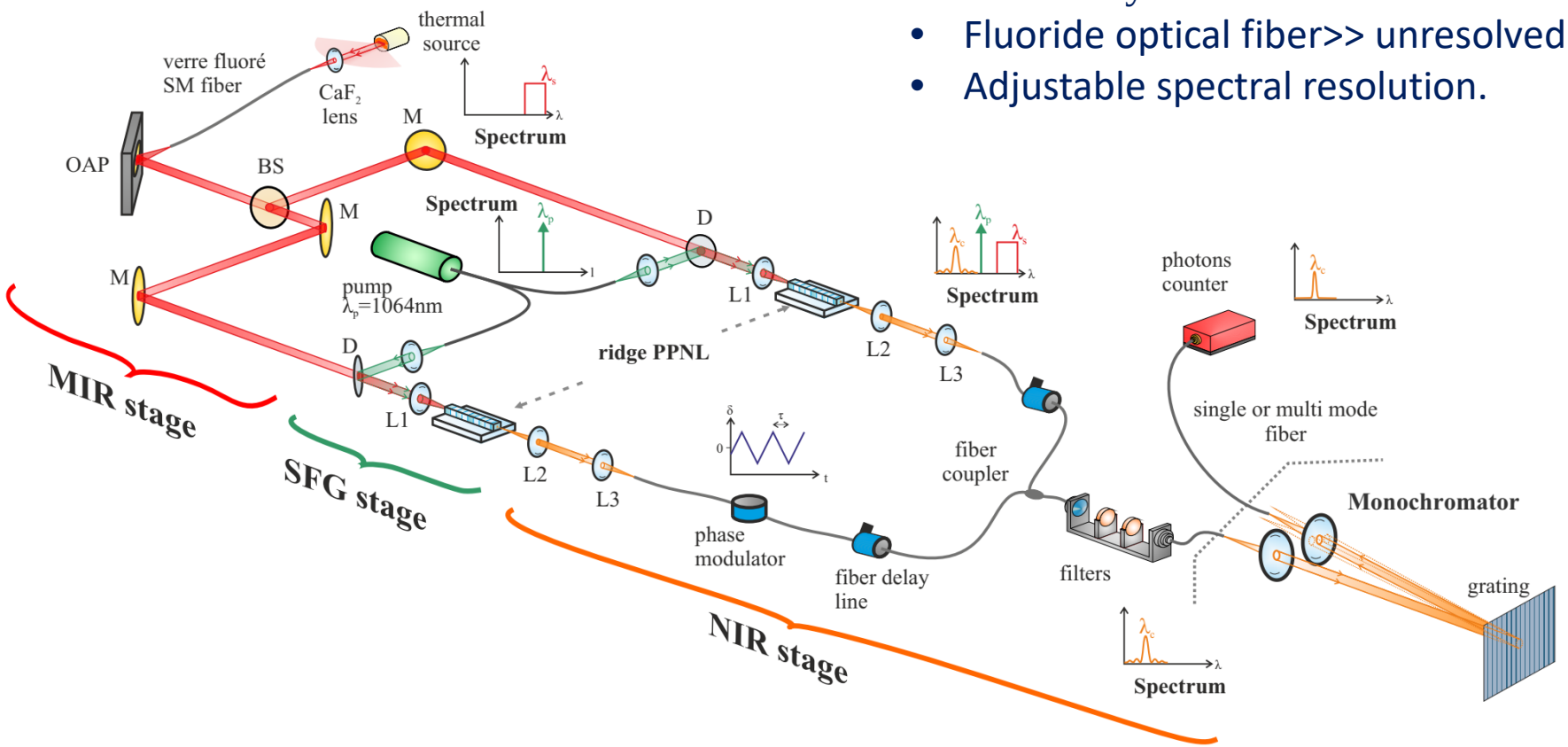


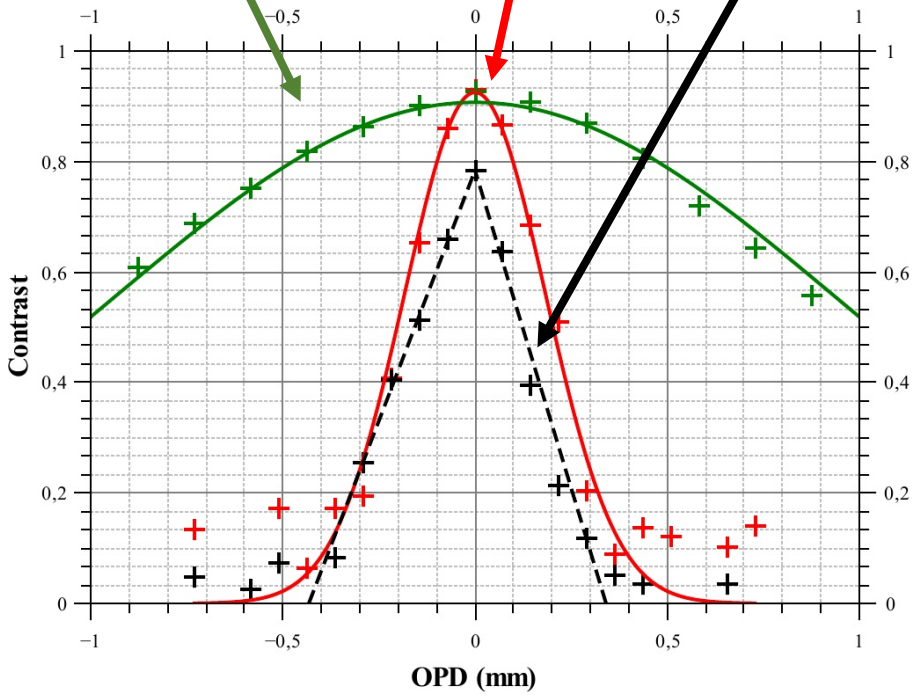
Figure 1. Description of the experimental setup. OAP: Off-Axis Parabolic mirror ; BS: beam slitter 50/50 ; M: gold coated mirror ; D: dichroic mirror (AR@3.5μm HR@1064nm) ; L1: Off-Axis Parabolic mirror ; L2-L3: microscope objective. The monochromator can be removed by connected together its input and output fibers.

Test at XLIM in L band

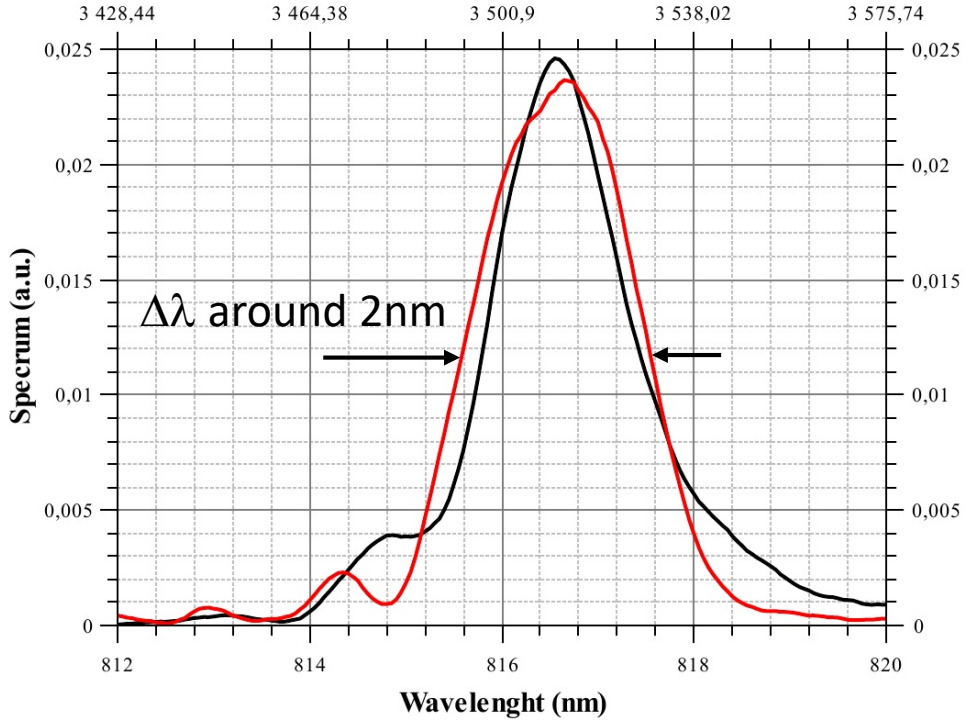
Full spectrum Δλ around 2nm

Resolution Δλ = 1.5 nm

Resolution Δλ = 0.25 nm



* Black body source at 40°C full spectrum (acq 100 ms x 2400 frames C= 80 % SNR 7)
eq Lmag around 4 -5 for a 1m telescope (TBC)



Δλ around 2nm @817 nm >> Δλ around 40nm @ 3.5 µm

Thank you