

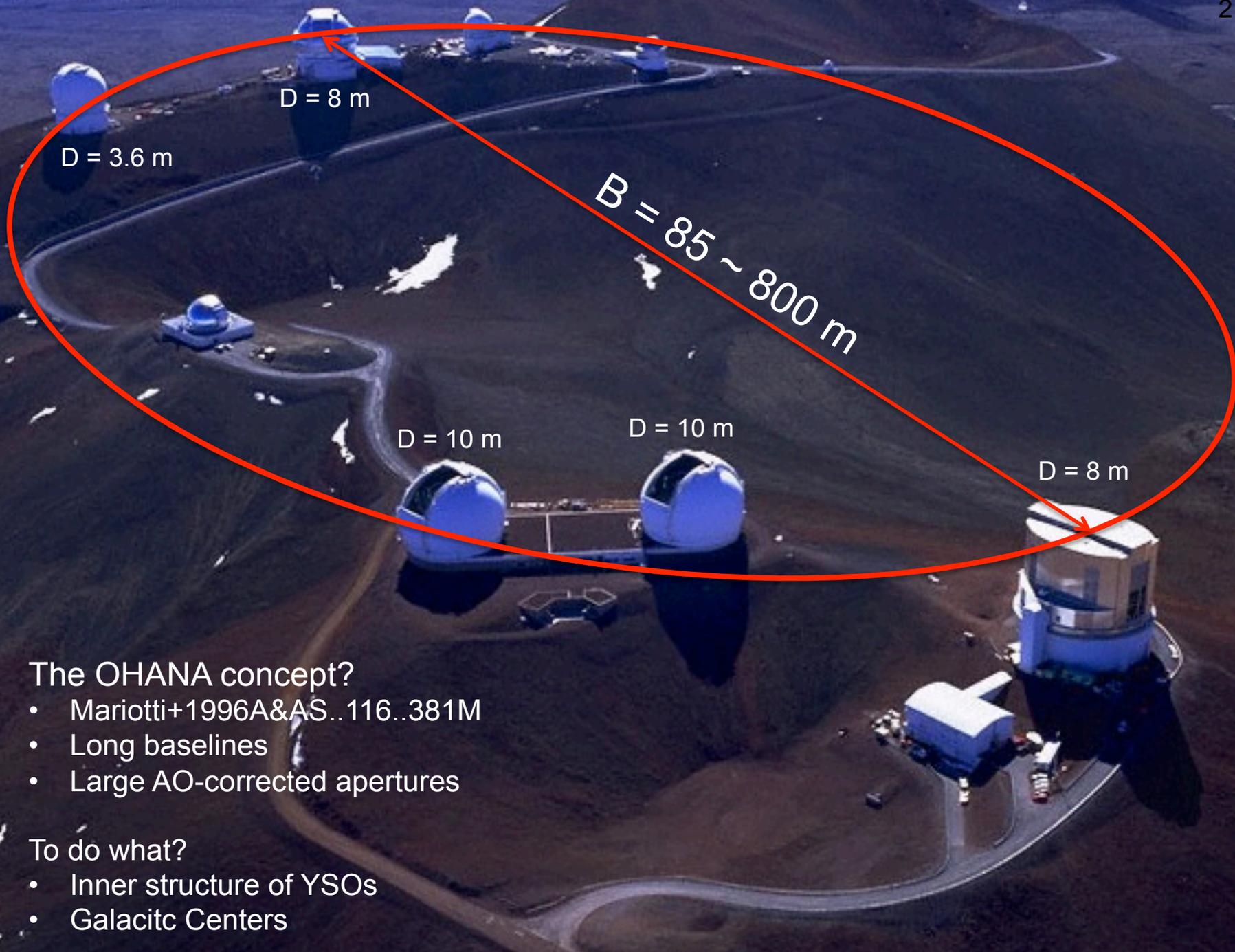
*“Improving the performances of current optical interferometers & futurs designs”
International colloquium at Haute-Provence Observatory, France
23-27 September 2013*

OHANA

Julien Woillez

Guy Perrin, Olivier Lai, François Reynaud





The OHANA concept?

- Mariotti+1996A&AS..116..381M
- Long baselines
- Large AO-corrected apertures

To do what?

- Inner structure of YSOs
- Galactic Centers

Transport with single mode fibers

- **2 x 300 m silicate fibers J and H band (IRCOM, Limoges)**
 - Contrast ~50% for full band, 70% for 100 nm band-path, single polarization.

Vergnole+ 2005OptCo.251..115V

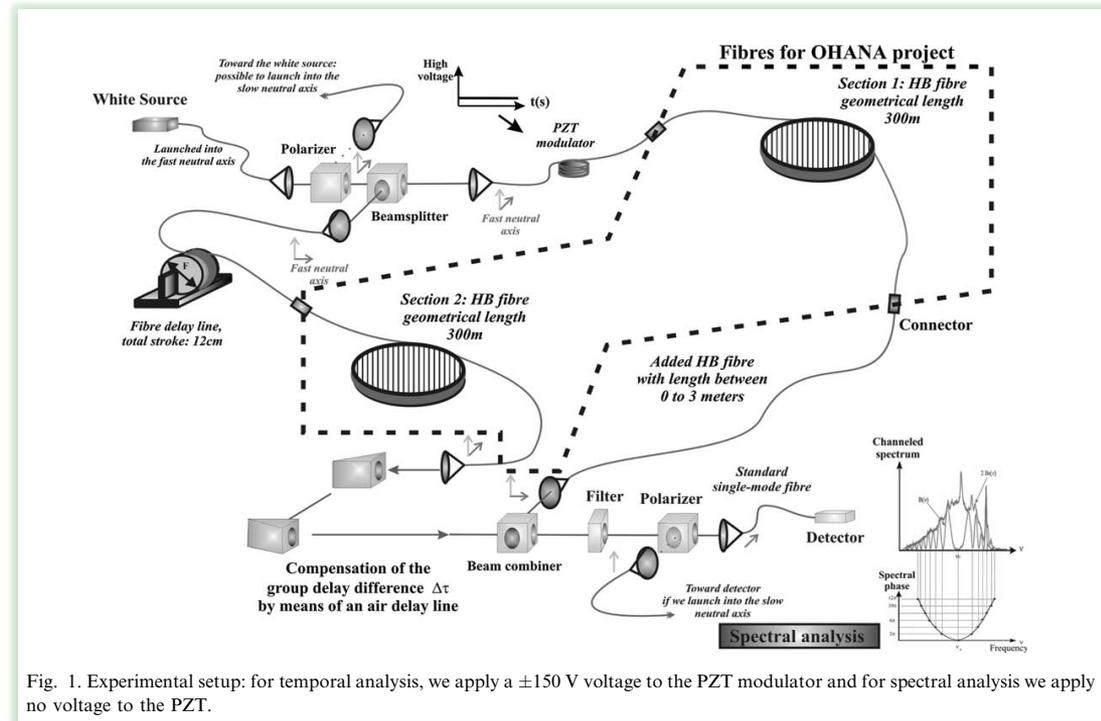


Fig. 1. Experimental setup: for temporal analysis, we apply a ± 150 V voltage to the PZT modulator and for spectral analysis we apply no voltage to the PZT.

Transport with single mode fibers

- **2 x 300 m silicate fibers J and H band (IRCOM, Limoges)**
 - Contrast ~50% for full band, 70% for 100 nm band-path, single polarization, transmission 95%.
- **2 x 300 m fluoride glass fibers K band (Le Verre Fluoré)**
 - Contrast ~90% for full band, two polarizations, transmission 60%.
 - Temperature dependence.

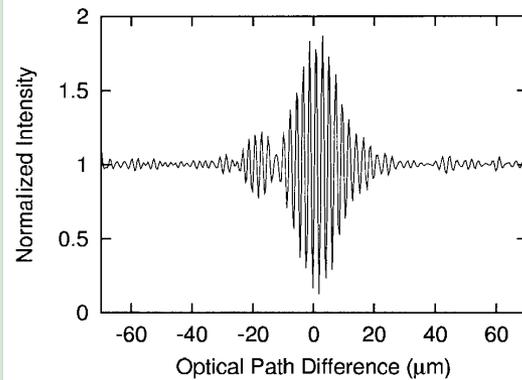
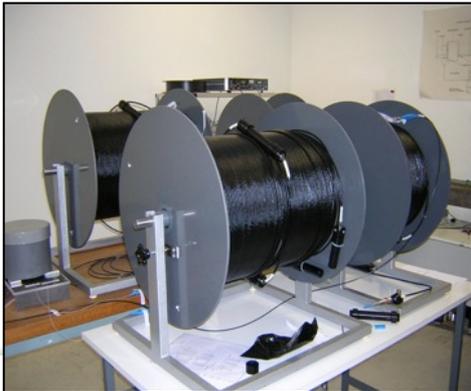


Fig. 2. Laboratory interferogram.

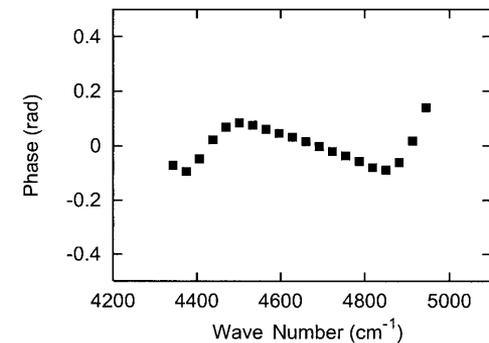


Fig. 3. Spectral phase of laboratory interferogram.

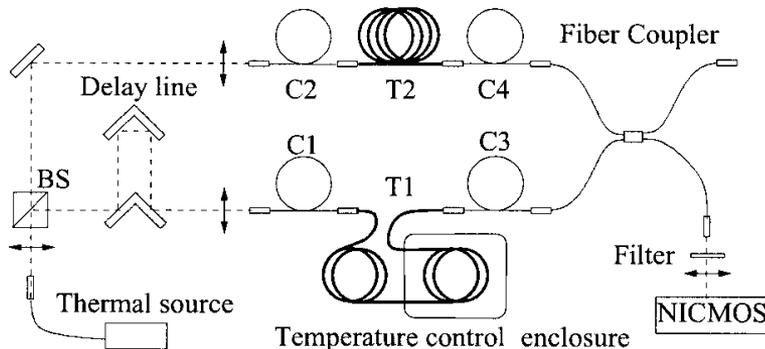
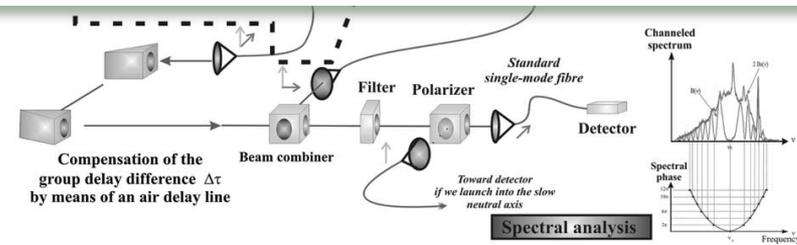


Fig. 1. Experimental setup. C1, C2, C3, C4: dispersion compensation fibers. T1 and T2: 300 m long transmission fibers. C3 and C4 are used for polarization control. BS, beam splitter.



Experimental setup: for temporal analysis, we apply a ± 150 V voltage to the PZT modulator and for spectral analysis we apply the PZT.

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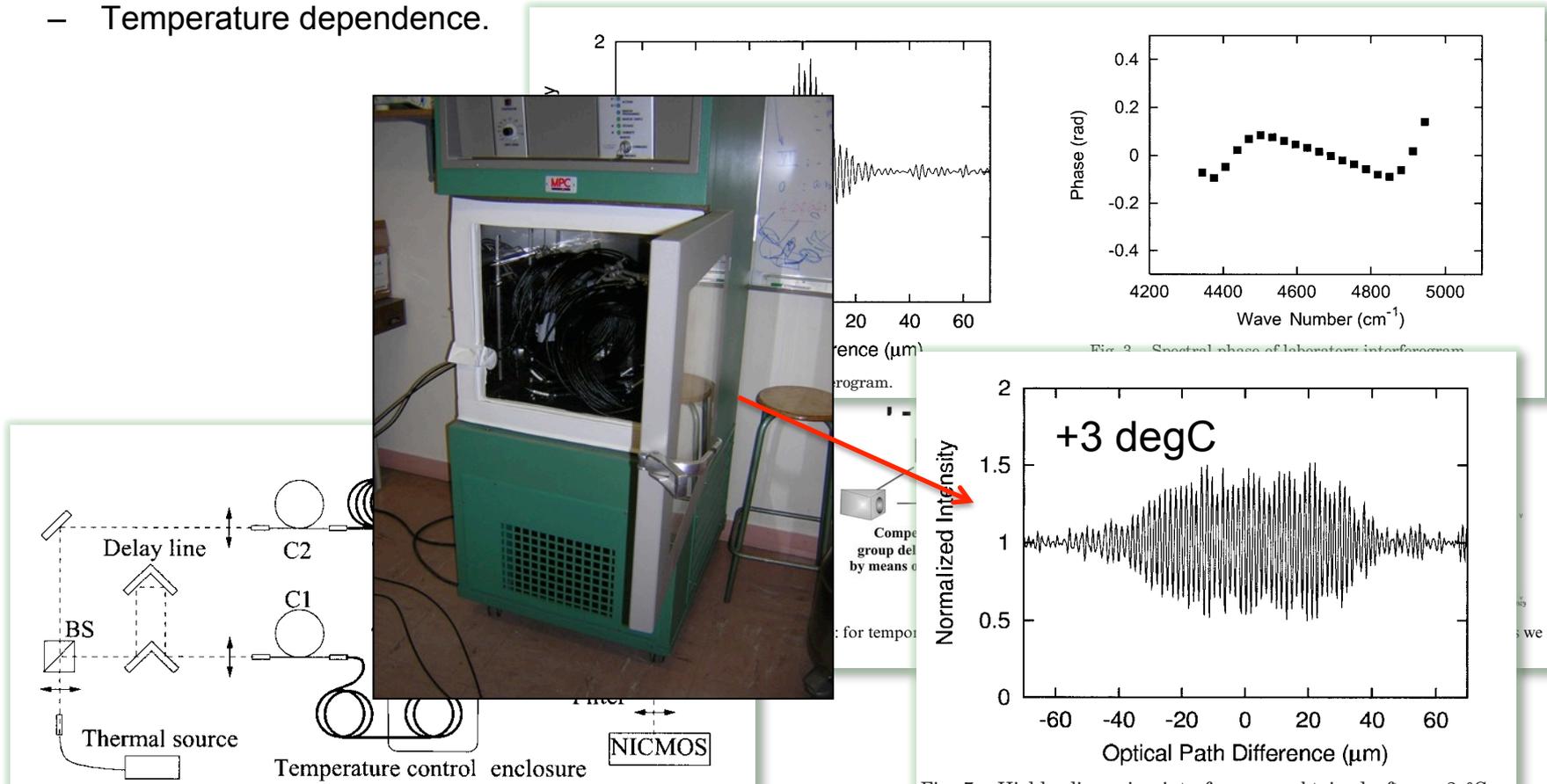
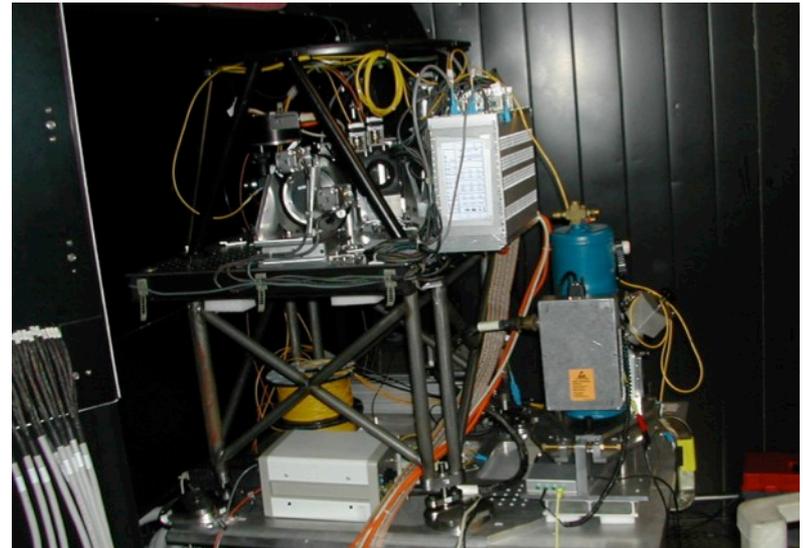
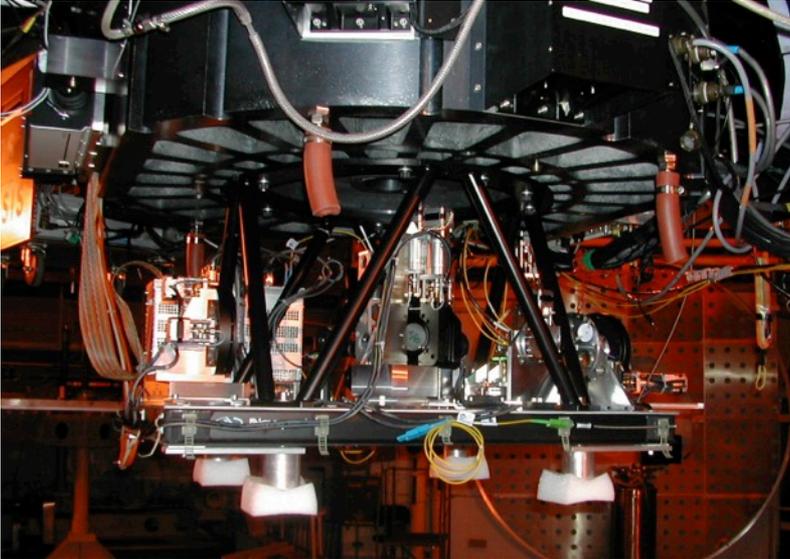


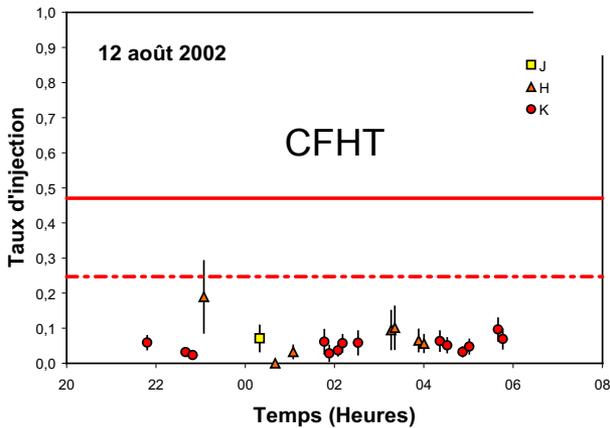
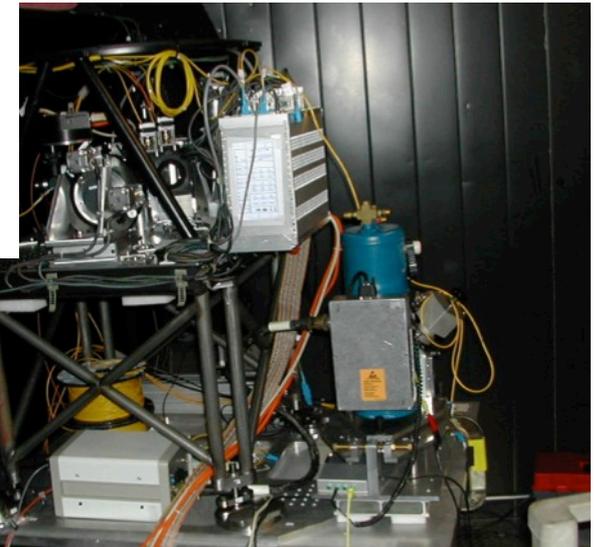
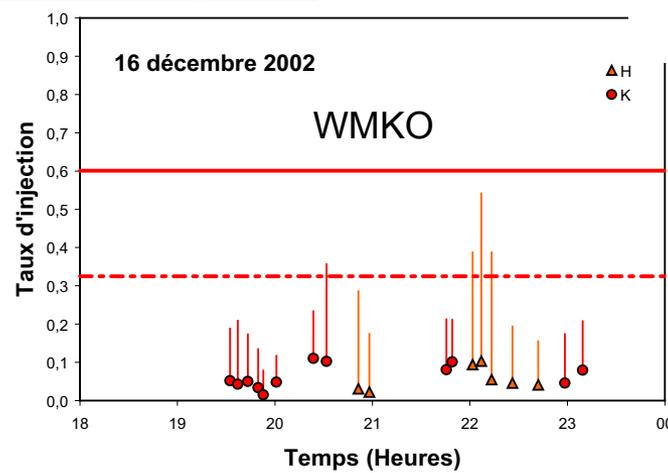
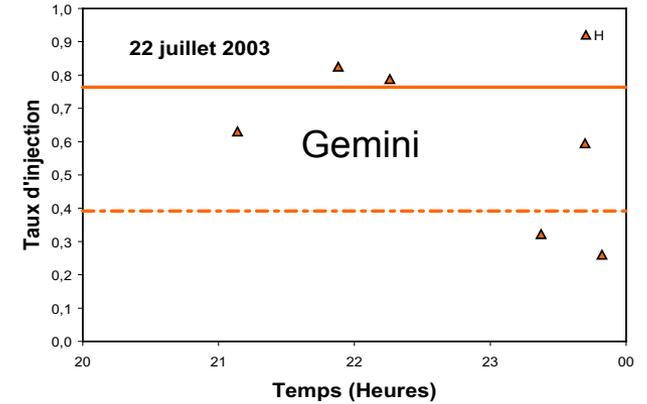
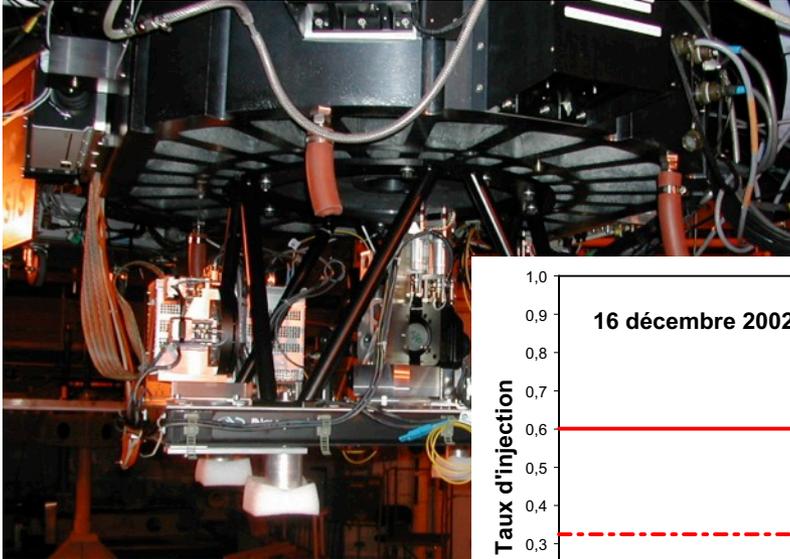
Fig. 1. Experimental setup. C1, C2, C3, C4: dispersion compensation fibers. T1 and T2: 300 m long transmission fibers. C3 and C4 are used for polarization control. BS, beam splitter.

Fig. 7. Highly dispersive interferogram obtained after a 3 °C temperature difference was set between the fibers.

- **Performed on CFHT, WMKO, and Gemini**

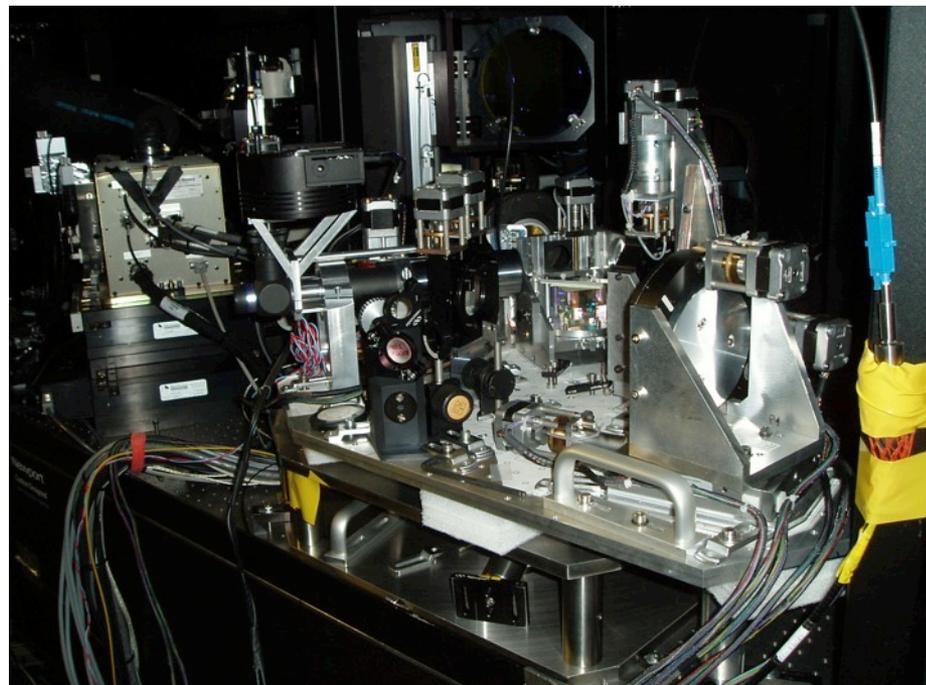
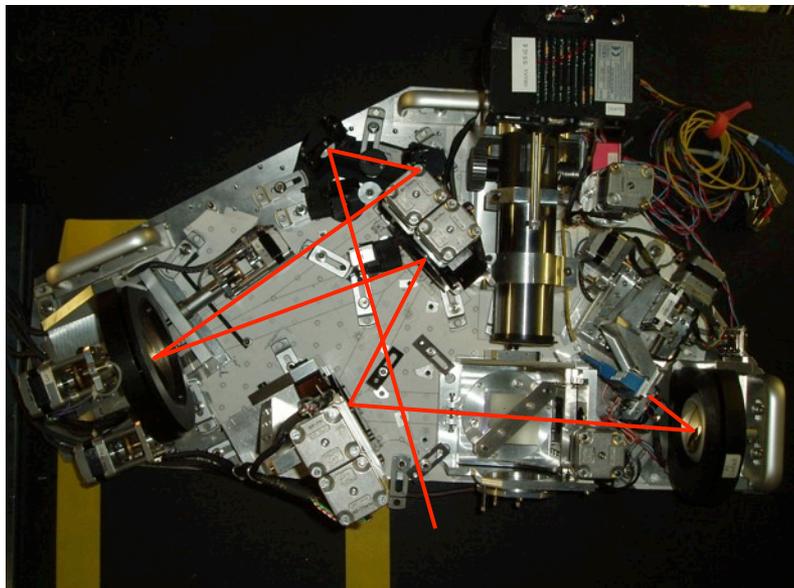


- Performed on CFHT, WMKO, and Gemini

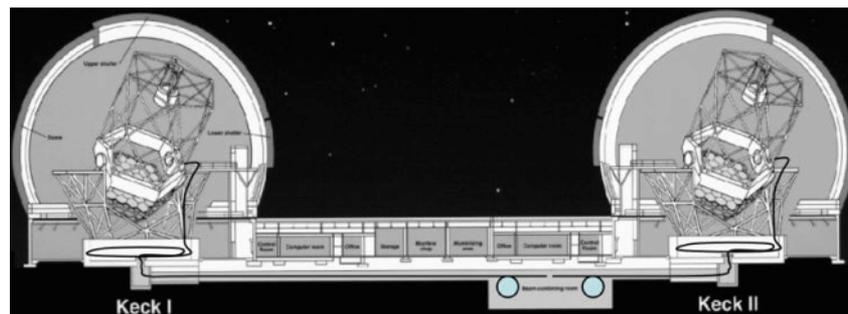


First demonstration on Keck Interferometer

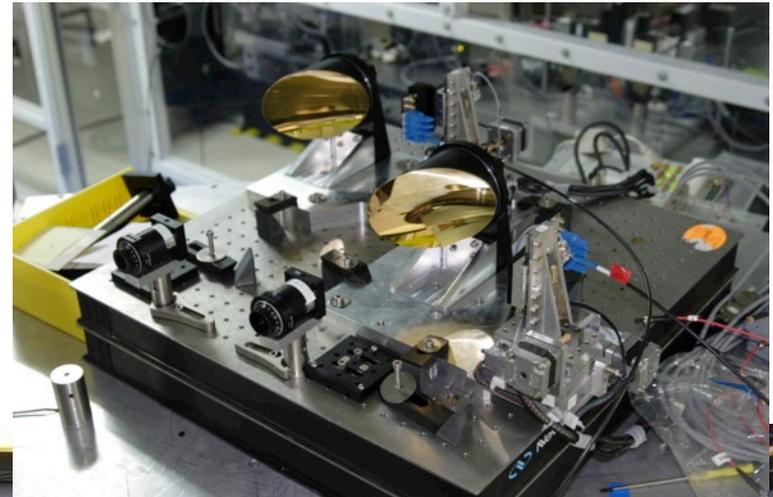
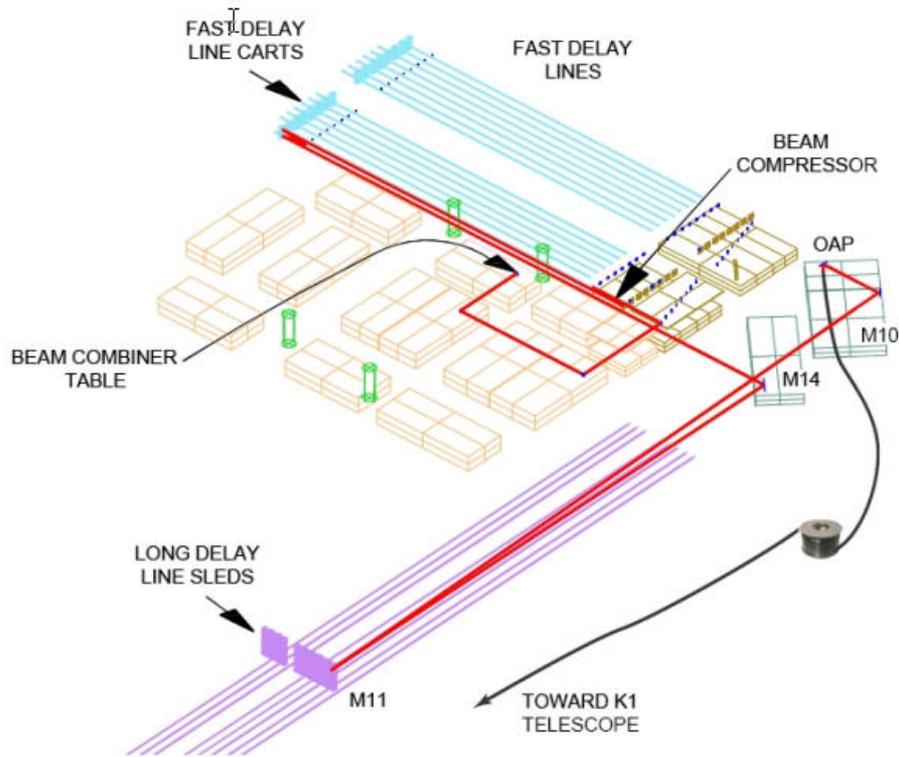
- **Injection at AO focus**



- **Routing through cable trays, azimuth cable wraps**



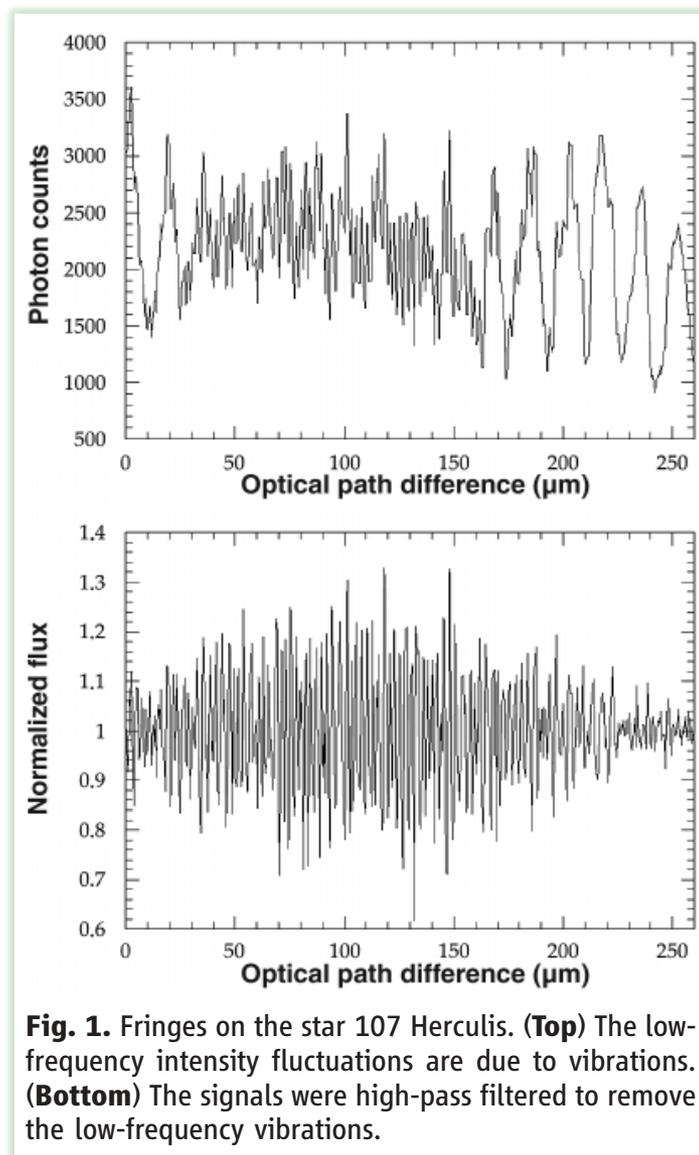
Extraction before long delay lines



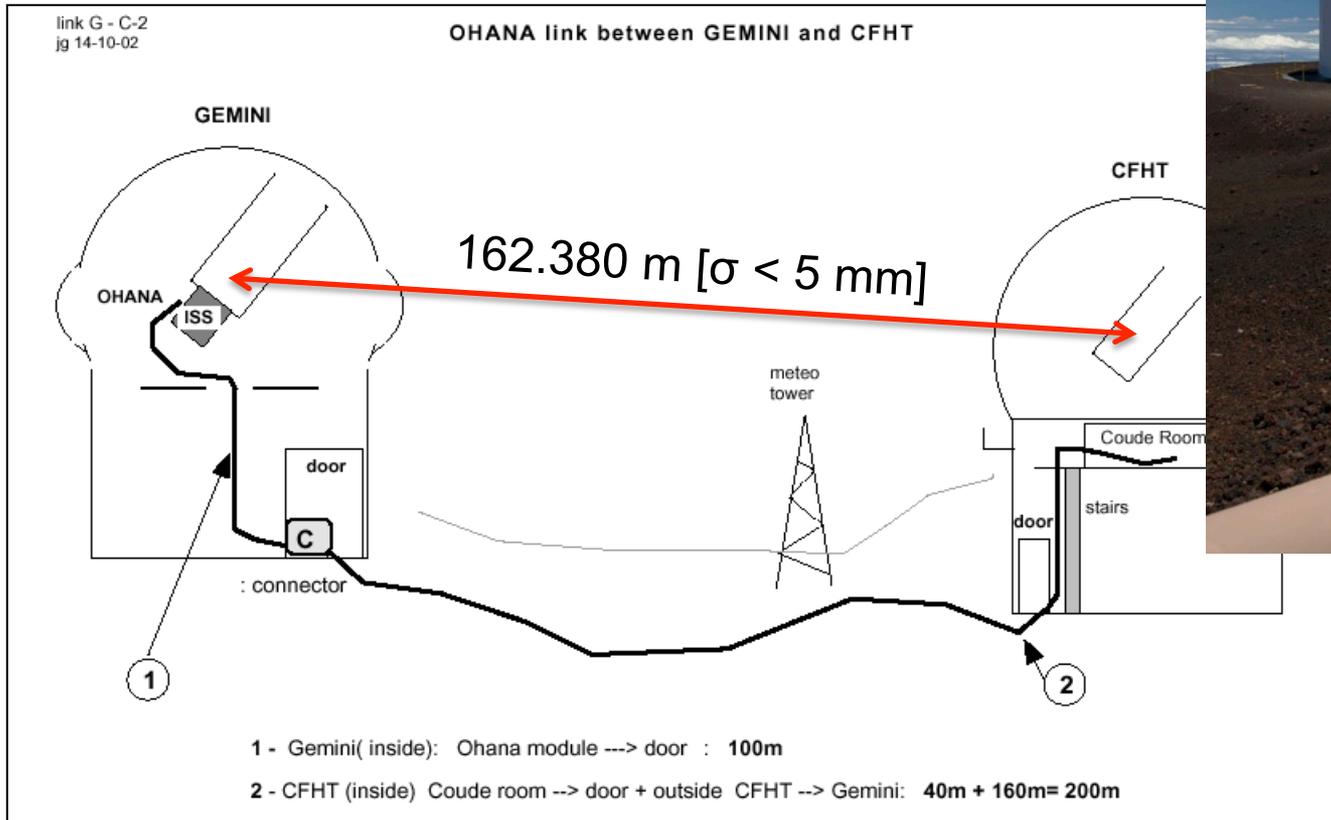
Identical path to Fringe Tracker

And it worked on 18 June 2005!

- Some vibrations in the injection
- Lots of piston vibrations
- Some dispersion (from AO dichroics)
- Overall transmission 0.5~1.0% (KI = 1.1%)



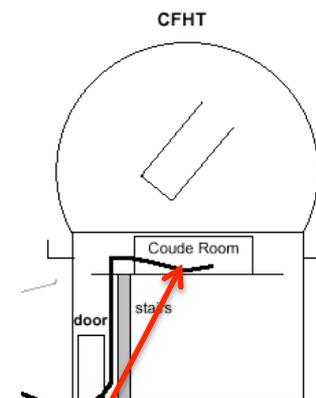
An insulated pipe, to pull the fibers in
A baseline vector measurement by IGN



Meanwhile, for Canada-France-Hawaii - Gemini

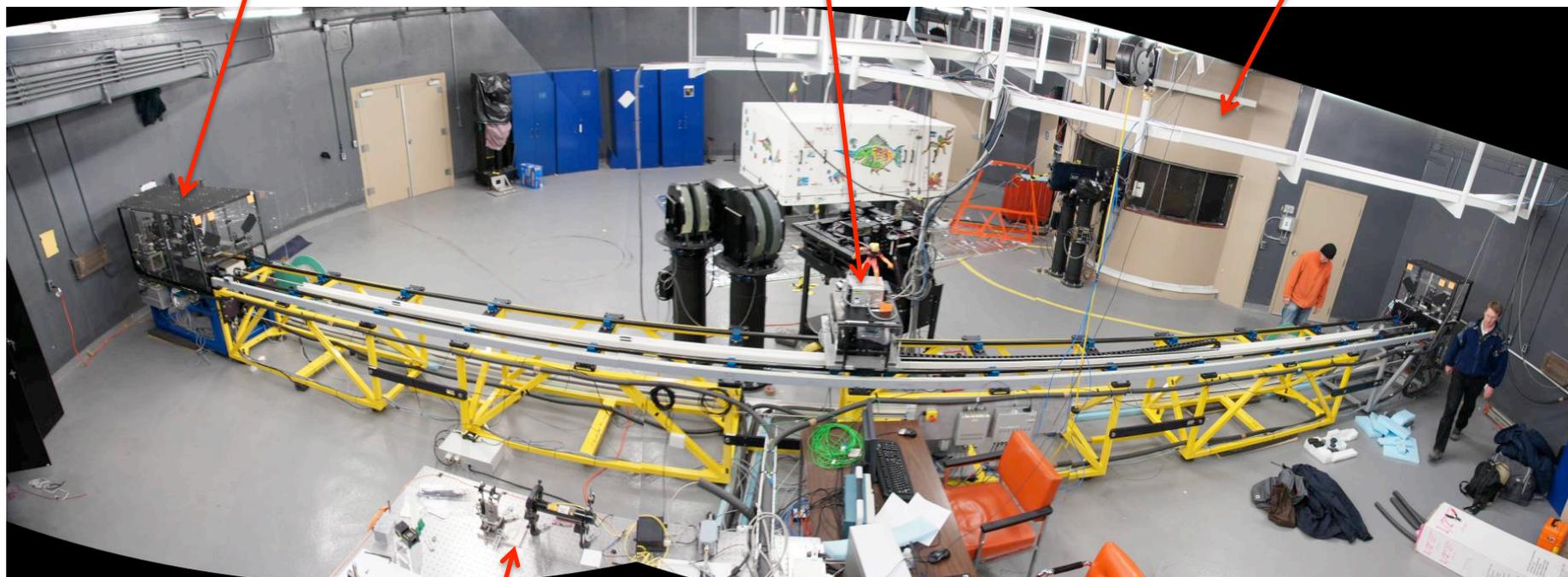
Delay lines, installed inside CFHT

- Physical length: 14 m
- Central carriage in multiple pass (x8)
- Continuous delay with double pass translation stage
- Correct for 160 m baseline (CFHT-Gemini)

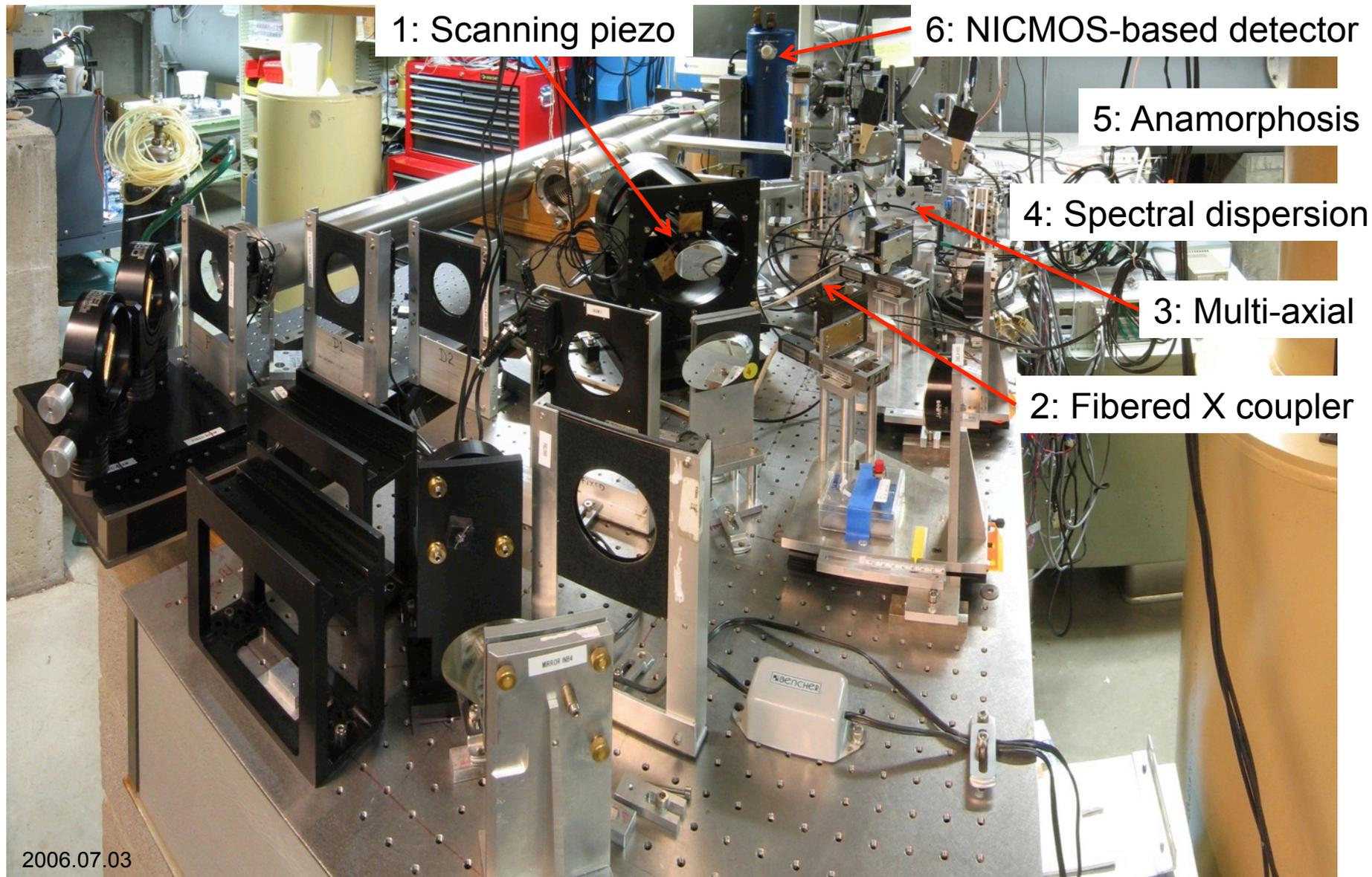


Continuous delay translation table

Central carriage



Beam combiner optical table



A multi-coaxial beam combiner, developed at Obs. Paris, tested on IOTA

Where were we then?

- **Injection arc**
 - 2002.08: CFHT
 - 2002.12: WMKO
 - 2003.07: Gemini
- **Beam combiner arc**
 - 2003.06: First IOTA run
 - 2004.10: Second IOTA run
 - 2006.06: Third IOTA run (last IOTA run)
- **Keck Interferometer arc**
 - 2004.08: Installation
 - 2004.12.01: Weathered out
 - 2005.01.31: Weathered out
 - 2005.06.17: Full night, cloudy, but first fringes on 17 Her ($K=4.6$), AO dichroic dispersion
 - 2006.05.08: No fringes, polarizations were crossed
 - 2007.11.19: Good injection, then lost to high humidity
 - 2009.03.07: Weathered out (staring Jean Cavé)
 - 2009.08.09: Failed to inject in fibers (staring Mr Perrin)

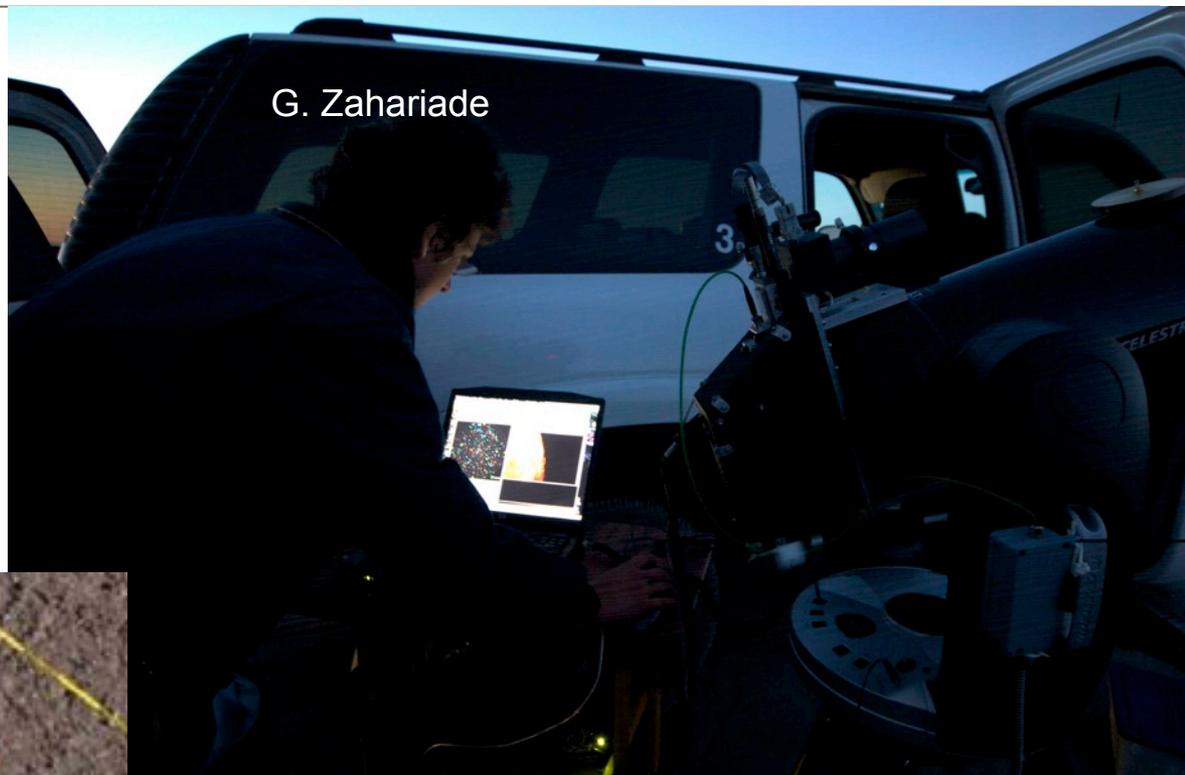
Maybe not too wise to go for CFHT-Gemini right away...

How can we validate our interferometer independently?

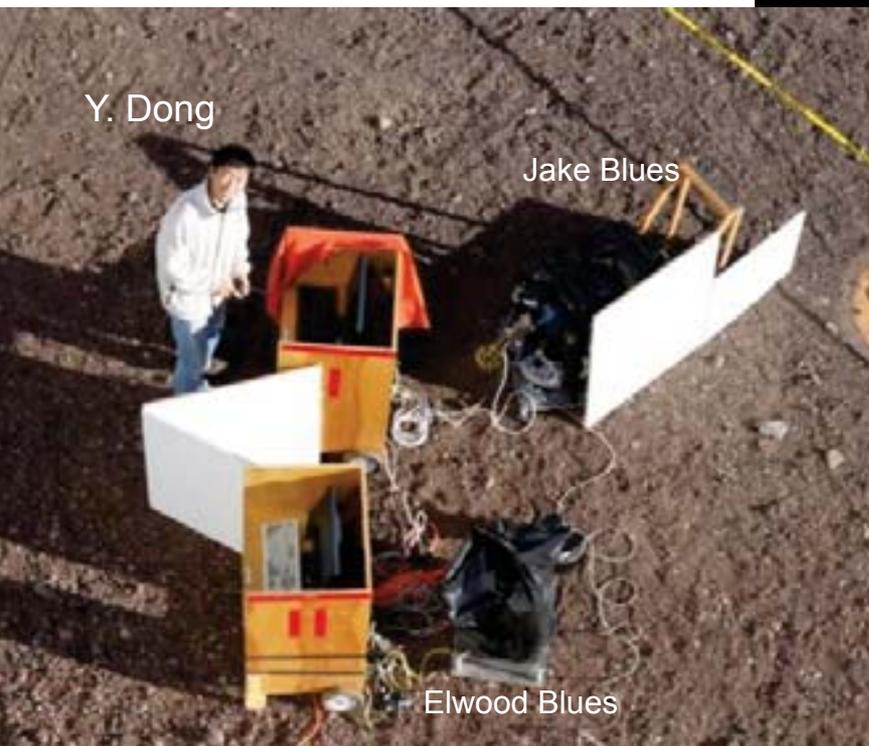
OHANA IKI

Meet the IKIs!

2x Celestron 8" (CPC 800 GPS XLT)



G. Zahariade



Y. Dong

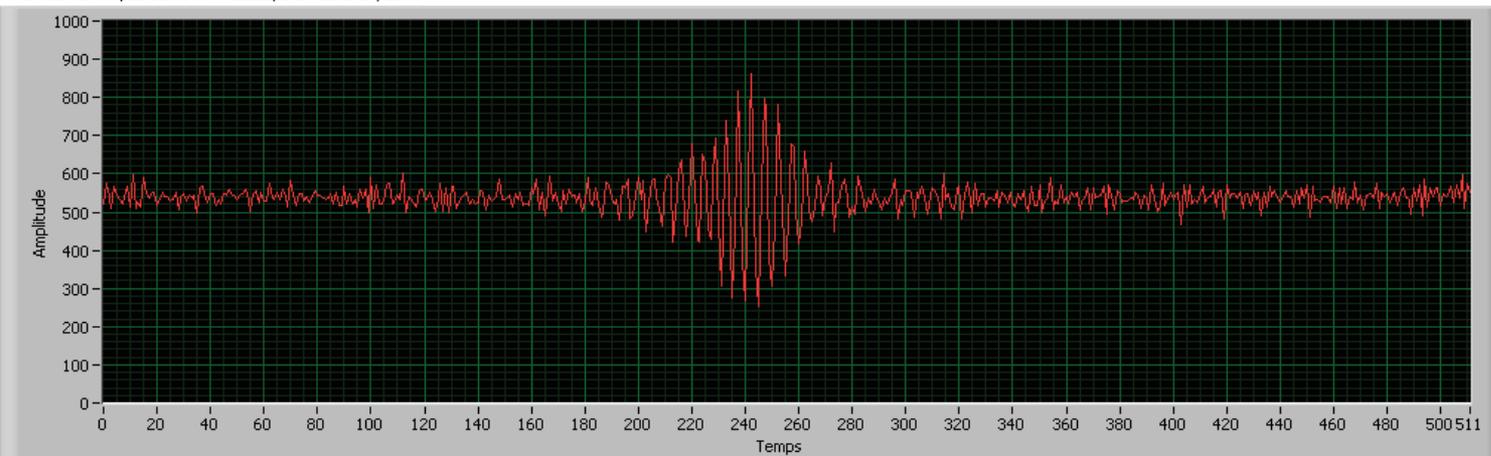
Jake Blues

Elwood Blues

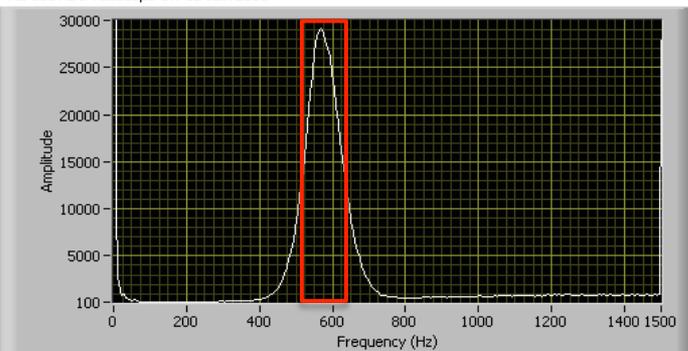
F-ratio adaptation to fiber mode
Tip/tilt servo with visible camera and voice coil
Control loop and acquisition from PC
Baril+ 2010SPIE.7734E..72B

OHANA IKI

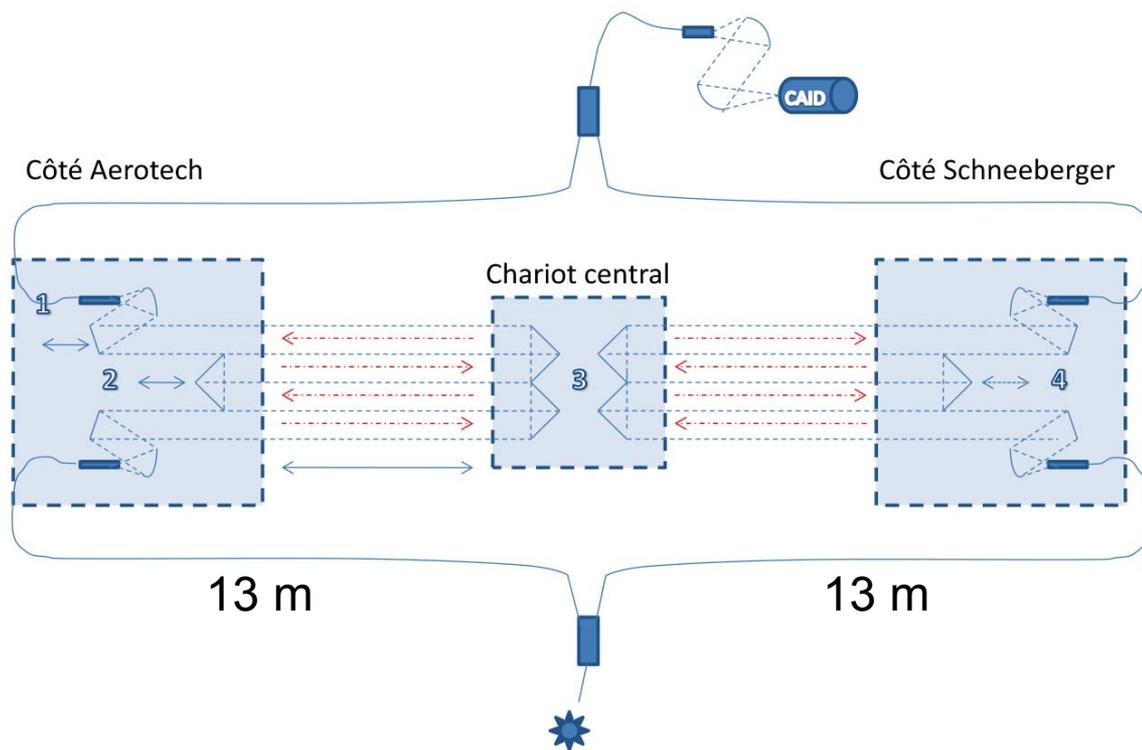
MZ 600 Hz Pompes Dome On Telescope On June 14, 2010



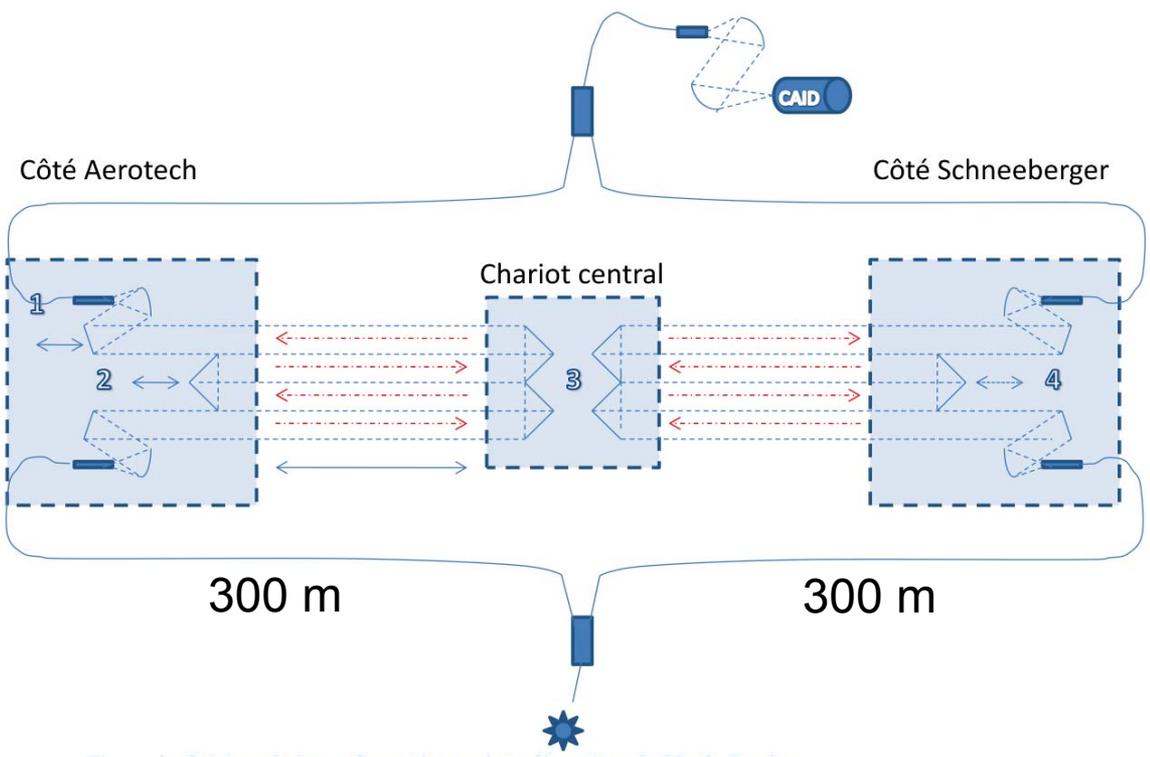
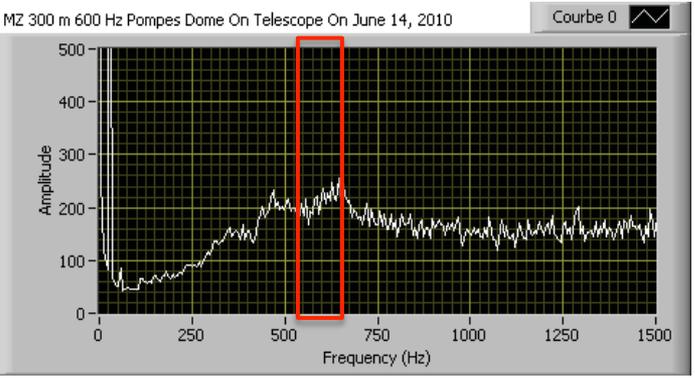
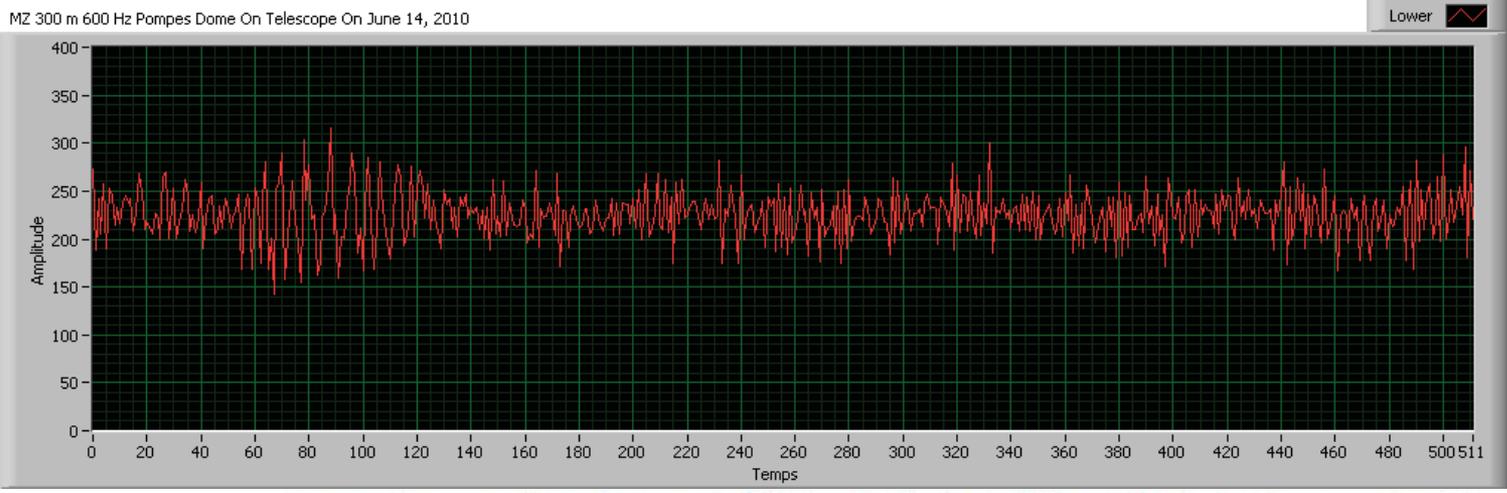
MZ 600 Hz J Telescope Off 12 Juin 2010



Mach-Zender with 13 m fibers

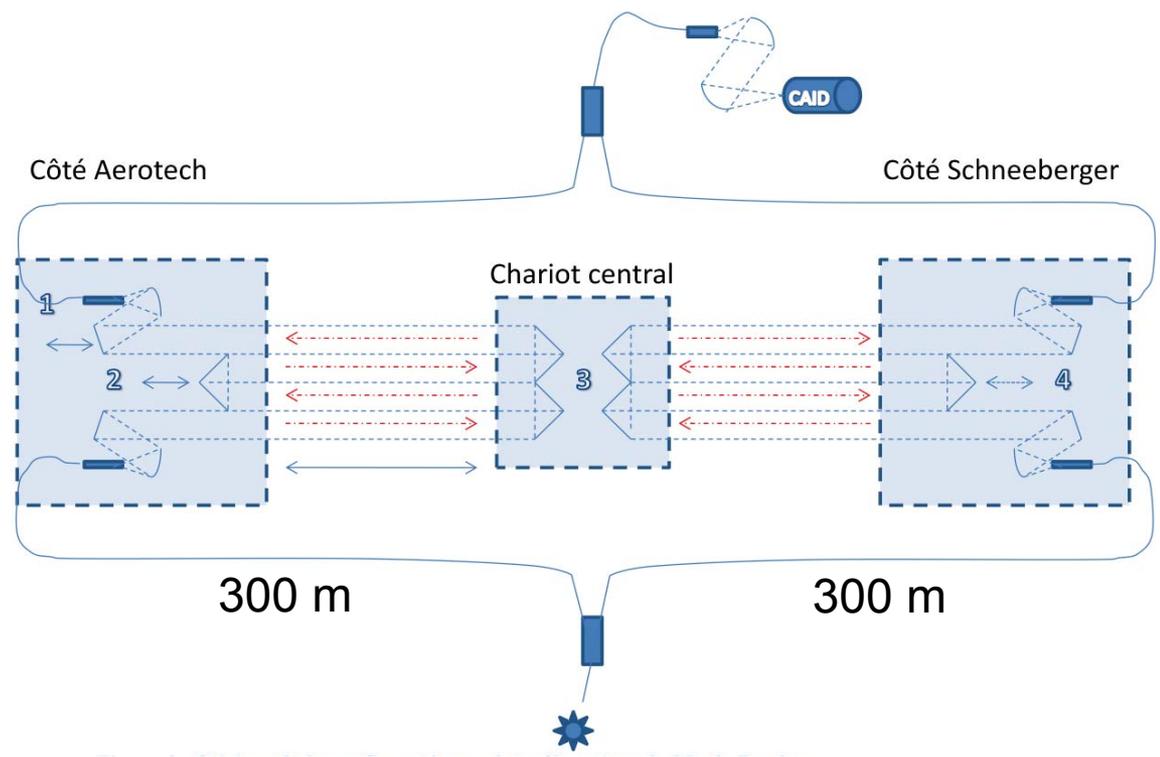
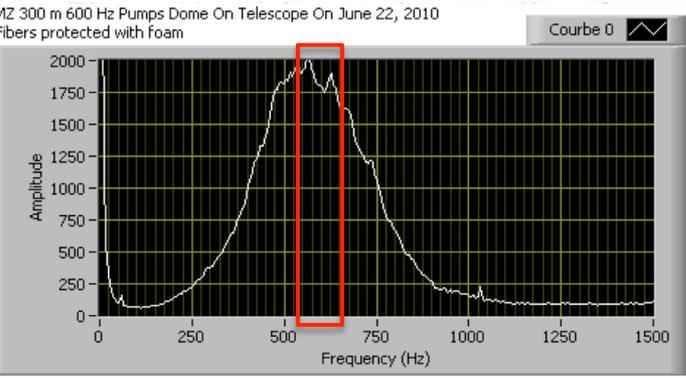
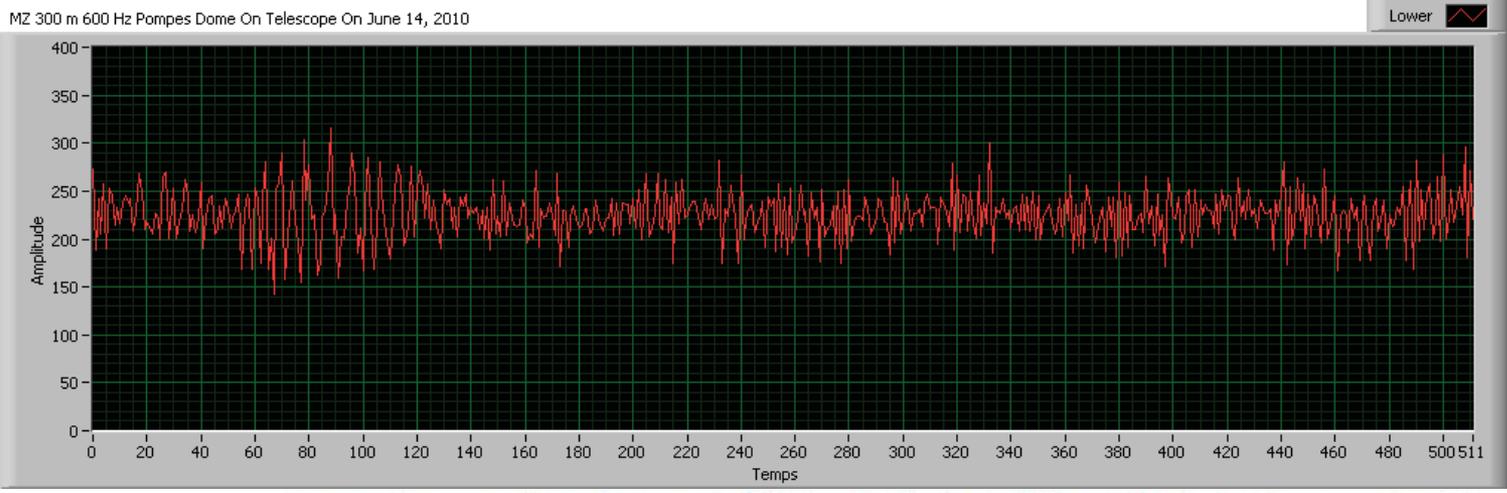


OHANA IKI

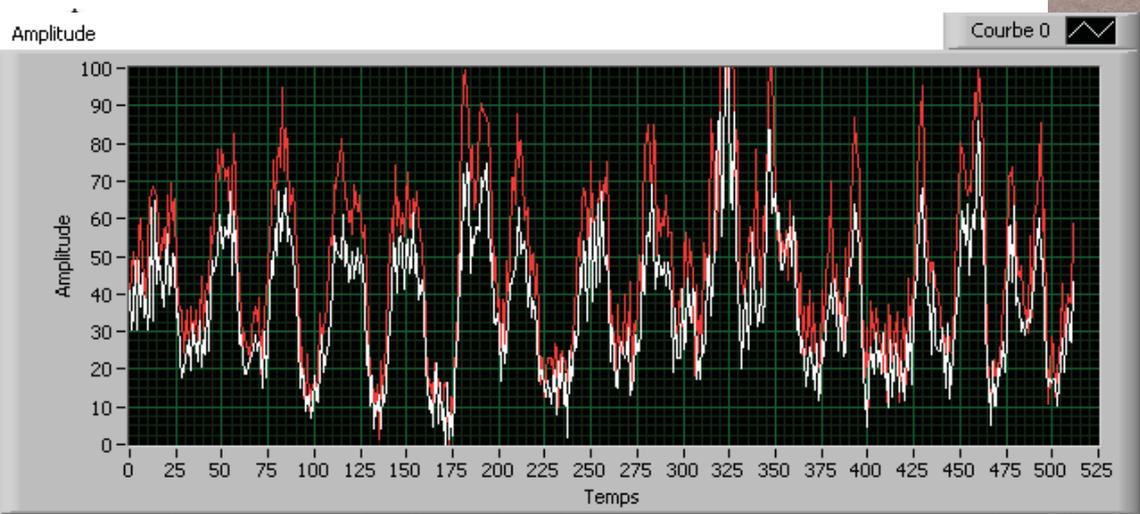


Mach-Zender with 300 m fibers

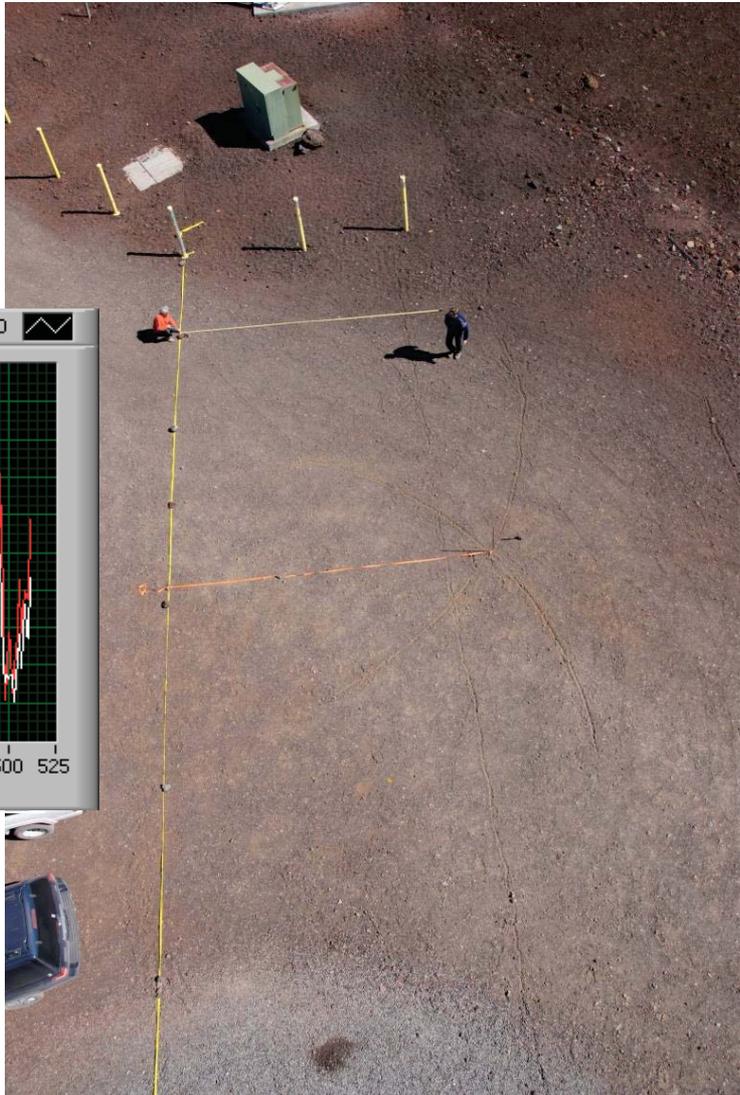
OHANA IKI



Mach-Zender with 300 m fibers and passive isolation



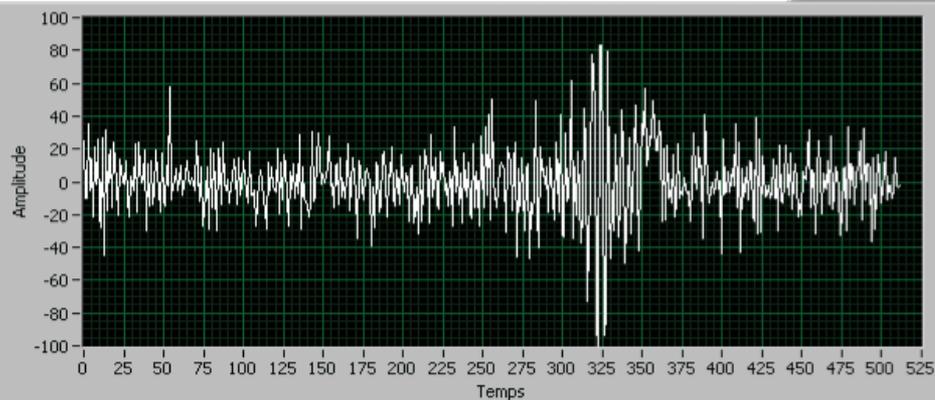
Checking injection stability



Measuring a baseline

Optical (not so) Long Baseline Interferometry

Antares, J band, late June 2010

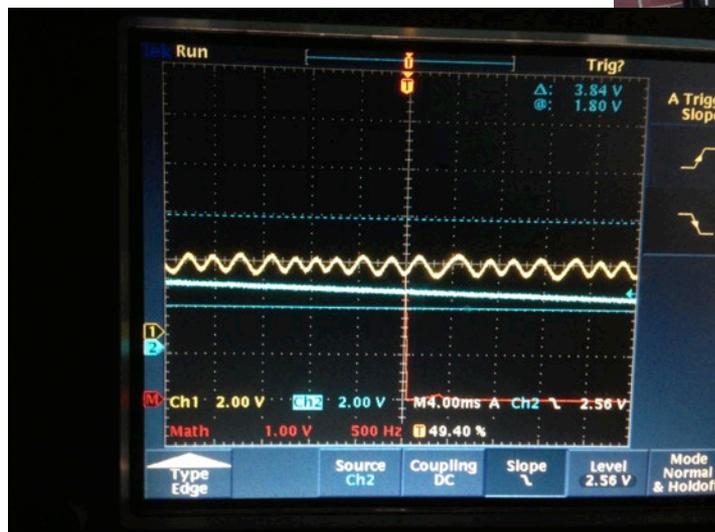


Followed by Antares vs Arcturus on 1 m baseline...

There is a future

From OHANA IKI to many telescopes for imaging
AGILIS: Agile Guided Interferometer for Long baseline Imaging Synthesis

Fibers are being prepared for coherent transport somewhere else



Somewhere in Michigan...



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- **OHANA IKI arc**
 - 2007.04: Delay line installation
 - 2008.04~07: CFHT – Gemini baseline measurement [5 mm] (internship: B. Lenoir)
 - 2009.04~05: Delay line commissioning
 - 2009.04~07: IKI telescope injection tests (internship: F. Bouchacourt & G. Zahariade)
 - 2010.04~07: IKI fringes (internship: Y. Dong)