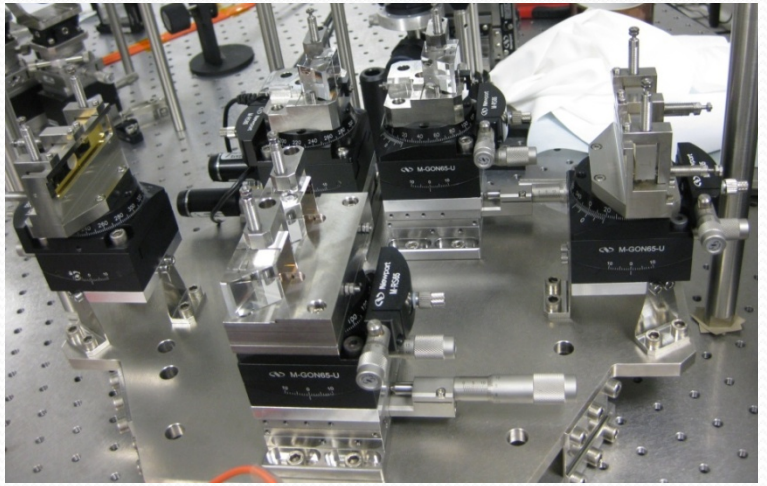
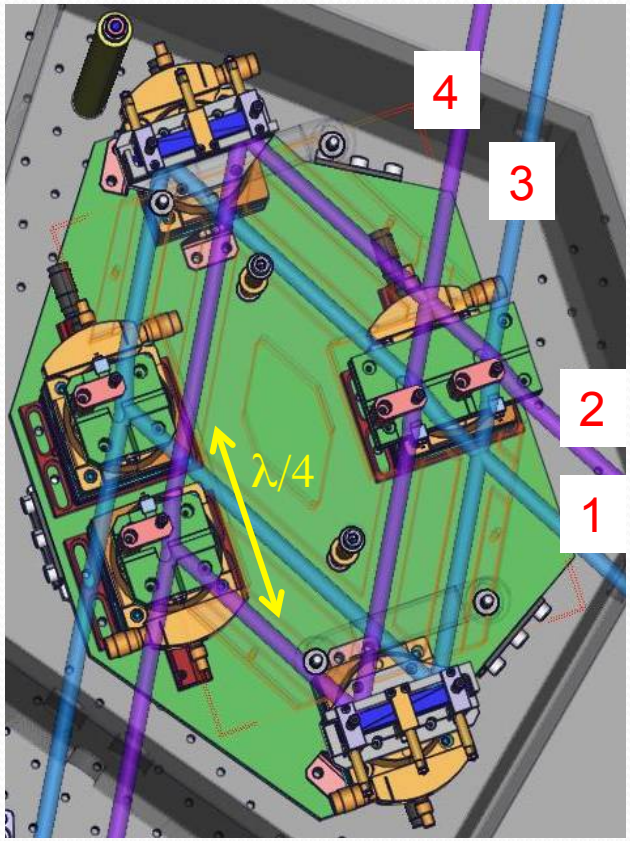
Main bench - MMZ

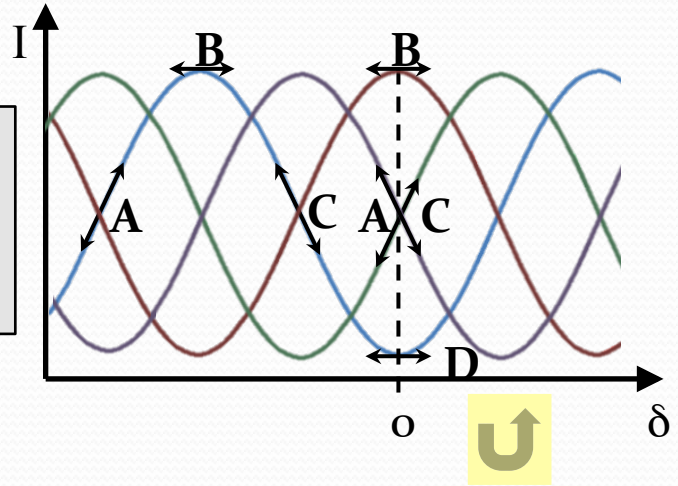
- Mach-Zehnder Modifié
  - 2 entrées - 4 sorties, AOI=30°
  - Recombinaison symétrique + optimisation des lames pour la sortie dark
- Principales difficultés: stabilité et dérive thermique



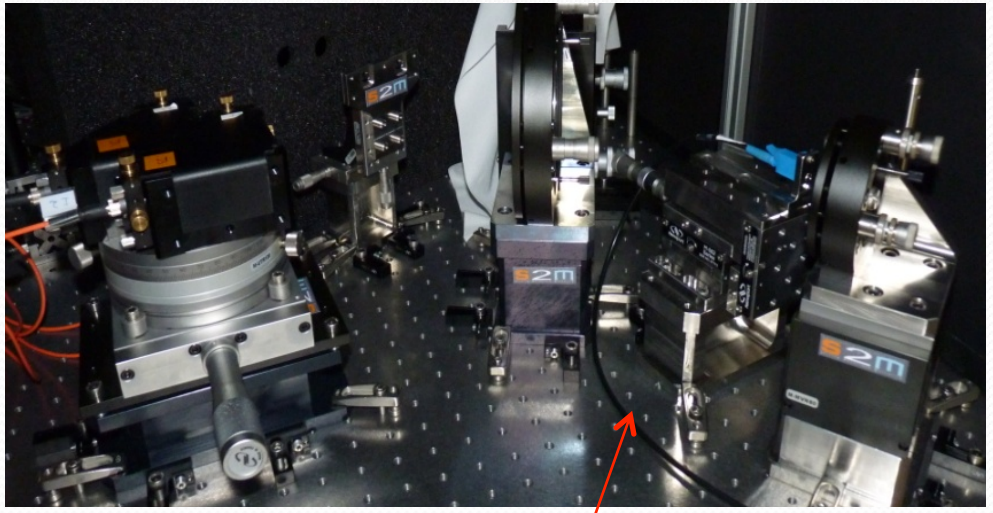


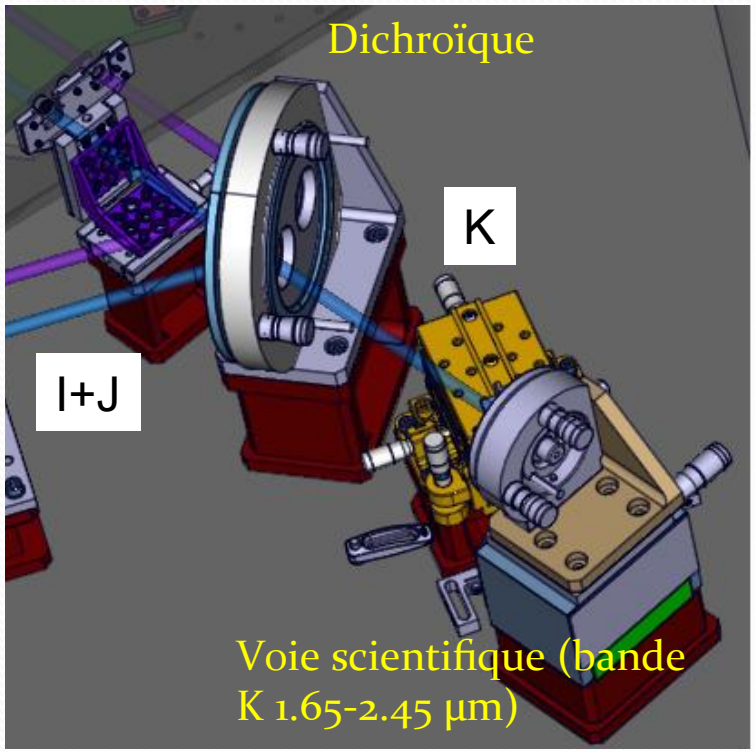
I : A ou C,I et J
II : frange blanche (B), IJK
III : frange noire (D), IJK
IV : A ou C, I et J

Modulation ABCD=> quadrature de phase



Main bench - Dark channel

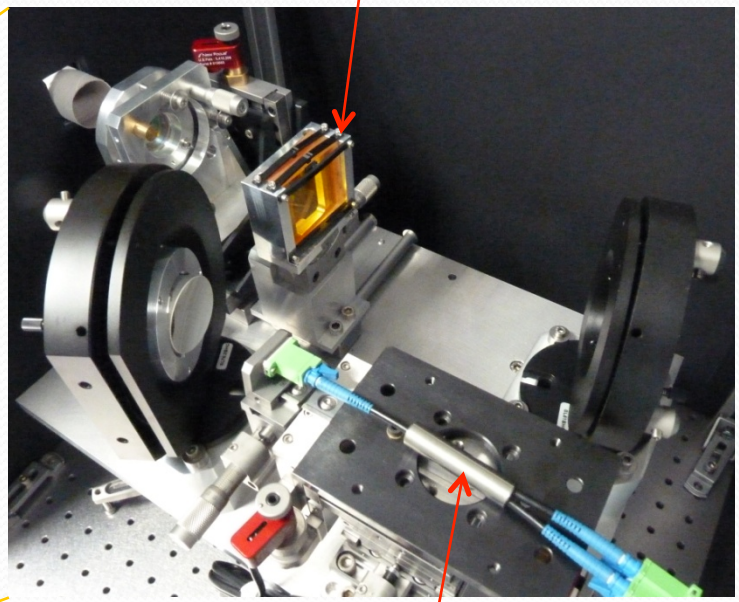




Fibre otique Le Verre Fluoré
=> Monomode en K

Detection bench

Biprisme: 9 canaux, de 1.65µm à 2.45µm

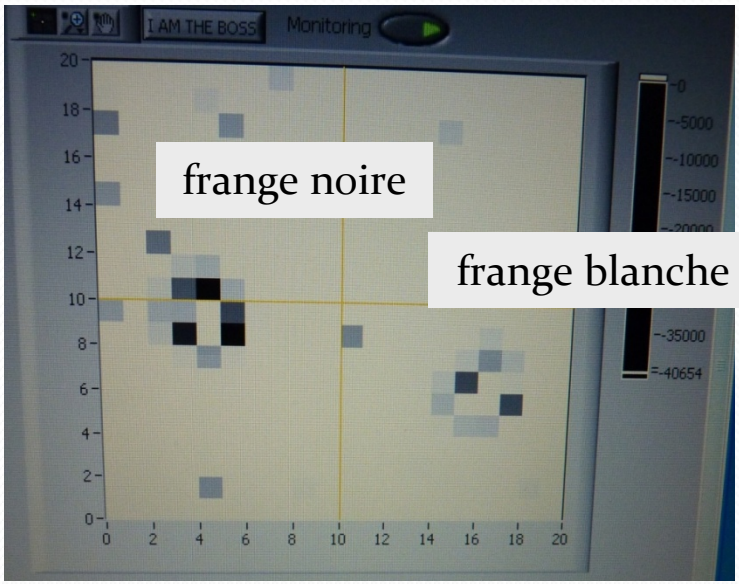


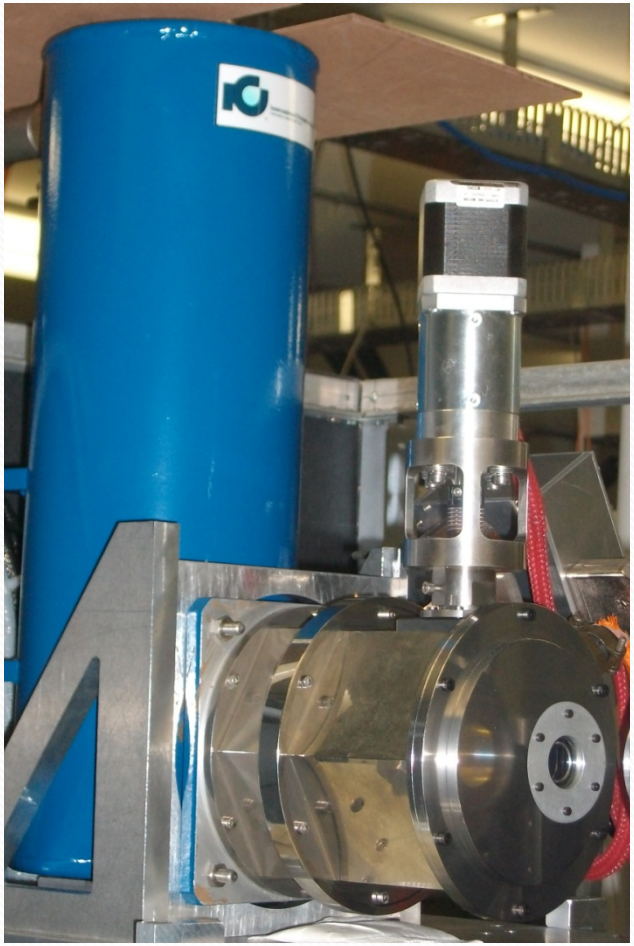
Toron de fibres à 125µm

Detection bench

IR camera (LESIA development)

- LN2 (77K) automatic cooling
- Ethernet communication
- Filter wheel
- PICNIC detector
- 4 quadrants of 128 x 128 pixels (40µm)
- 16 bits, RON @ 250kHz: 18 e-





User interface

Performances et résultats de PERSEE

Outline

Caractérisation

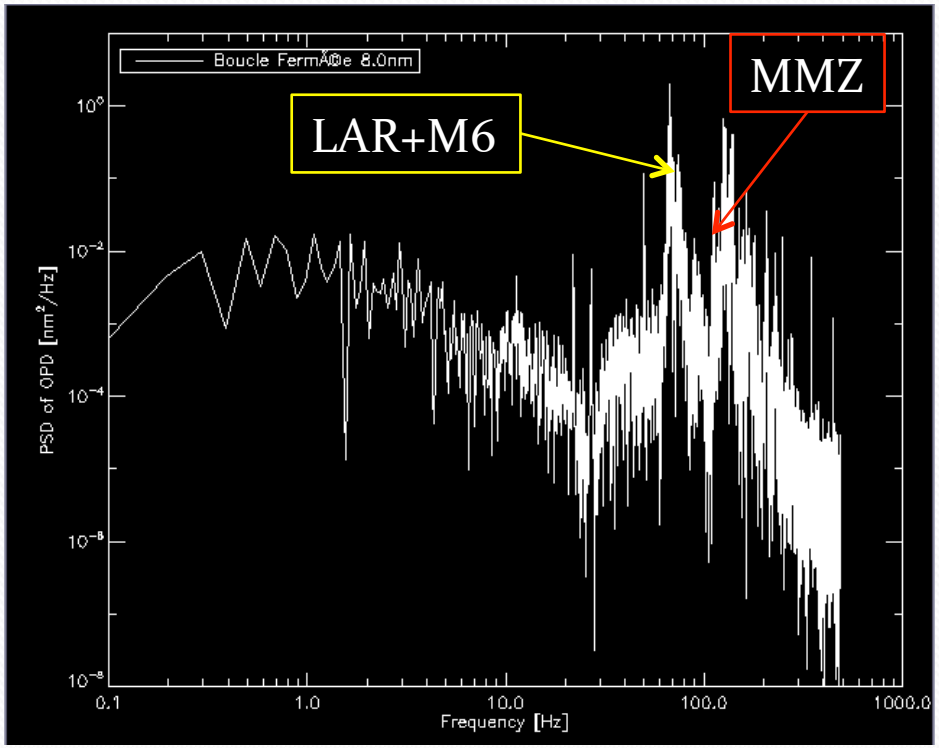
Performances des boucles de contrôle et du taux de nulling

Améliorations: filtre Kalman + commande LQG

Conclusion et perspectives

Caractérisation

Caractérisation du banc => étude fréquentielle et analyse des vibrations



Contributeurs:

-**Électronique** => pic @ 50Hz

-**Mécanique**: M6, LAR, MMZ

-**Acoustique**: clim & surpression sur la même dalle

-**Sismique**: table sur coussins d'air

-**Thermique**: dérive du MMZ sur plusieurs heures (600nm/°C)

-**Turbulence**: soufflerie au dessus du banc

Solutions:

⇒Déport des électroniques

⇒Capotage spécial

⇒Eteindre clim & surpression pendant les mesures

Loops performances

- En différence de marche
  - Spécifié à 1 nm rms
  - Meilleur résidu obtenu :

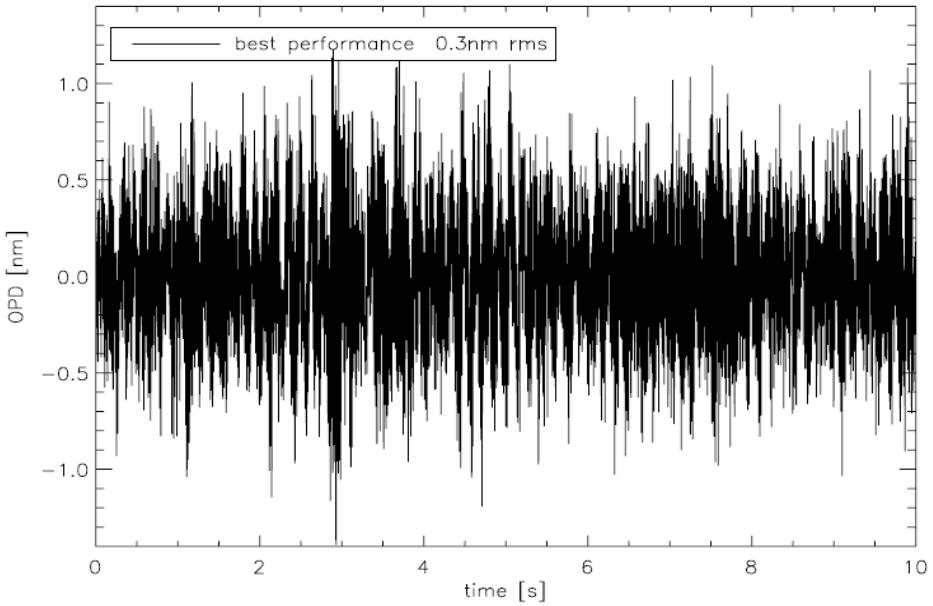
  σ_δ = 0,3 nm rms

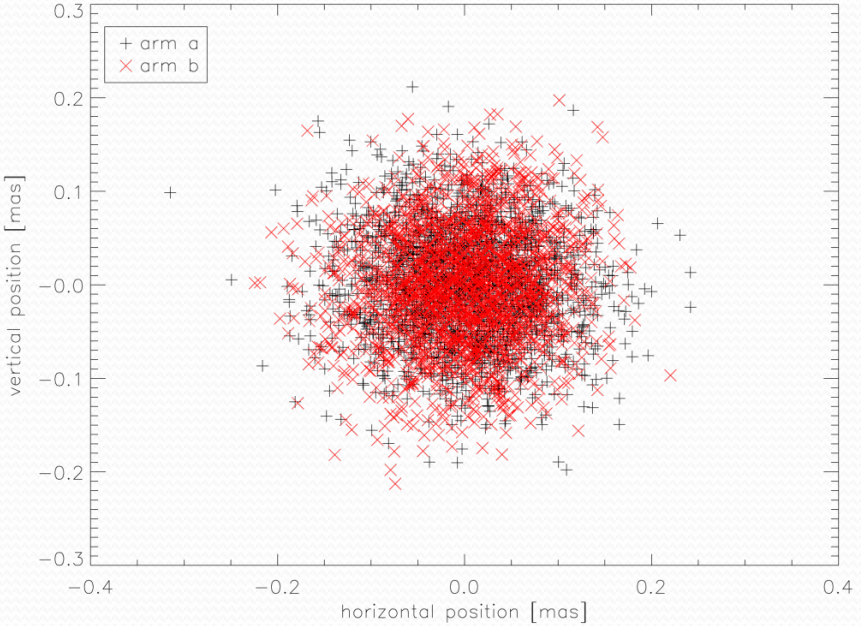
  = λ/6700 @ 2 µm

- En tip/tilt
  - Spécifié à 100 mas rms
  - Meilleur résidu obtenu :

  $\sigma_{tip/tilt}$ = 56 mas rms

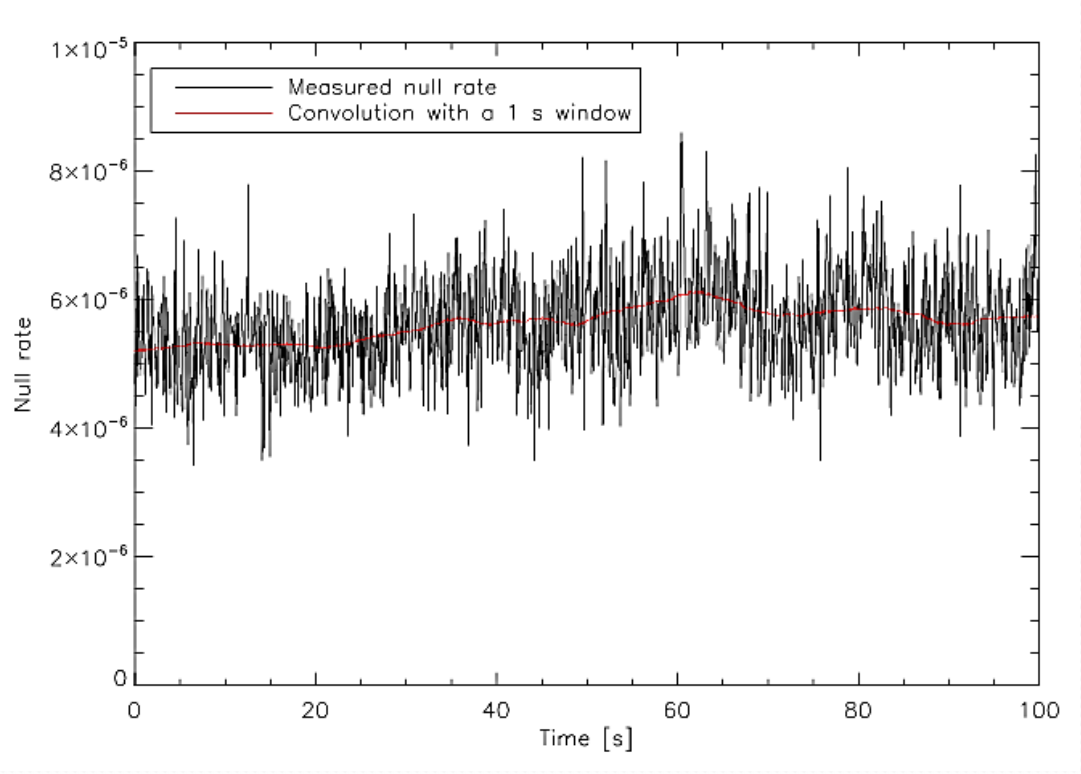
  = 0,4 % de la tache d'Airy





Nulling performances

Monochromatic and polarized light (2.3µm): $5.6 \times 10^{-6} \pm 2 \times 10^{-7} << 10^{-4} \pm 10^{-5}$



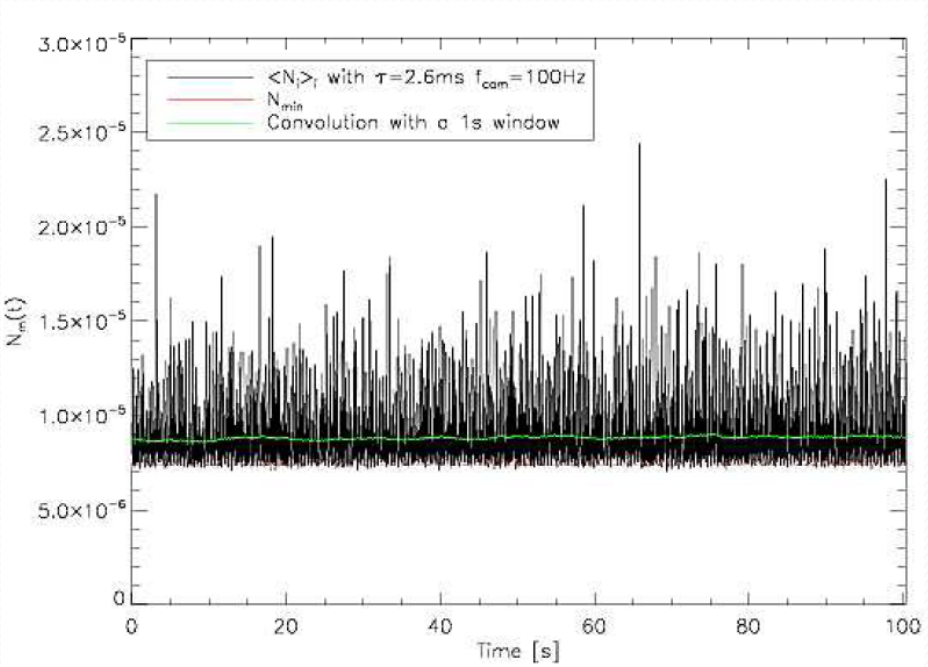
Nulling performances

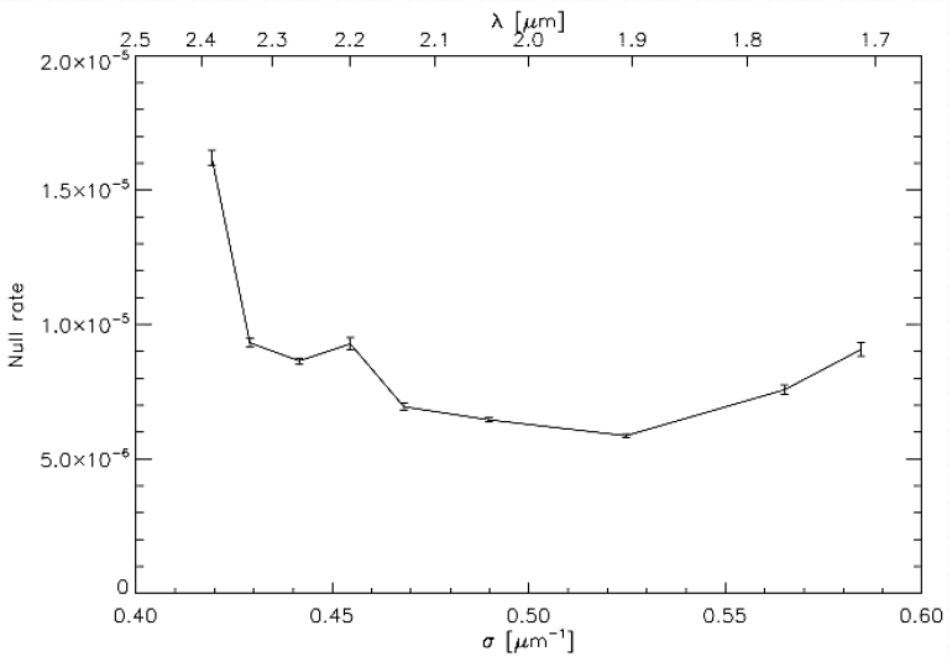
Polychromatic and non-polarized light: $8.8 \times 10^{-6} \pm 1.5 \times 10^{-6}$ $<< 10^{-4} \pm 10^{-5}$

Spectral band: [1.65-2.45]µm (~40% width)

➔Stabilized over 100s (validated over 7h thanks to automatic calibration process)

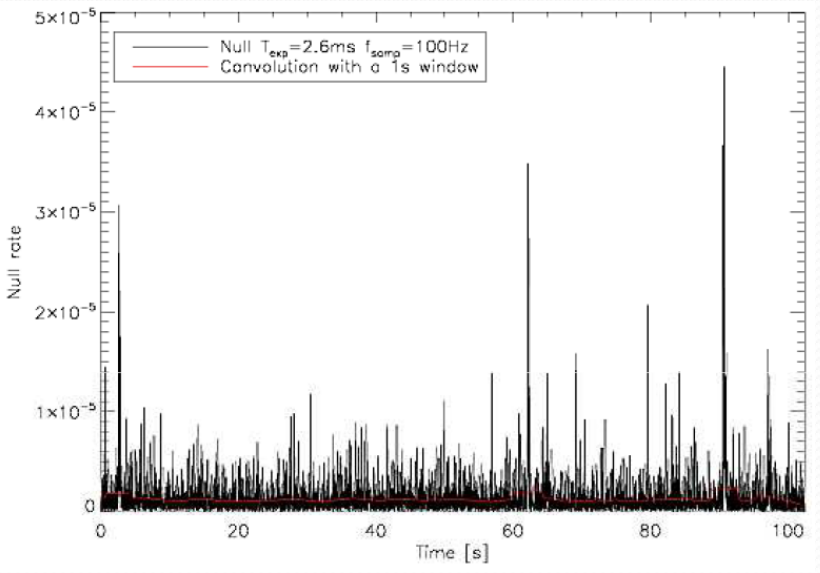
➔no perturbation injected, quiet lab environment (no machines, under enclosure…)

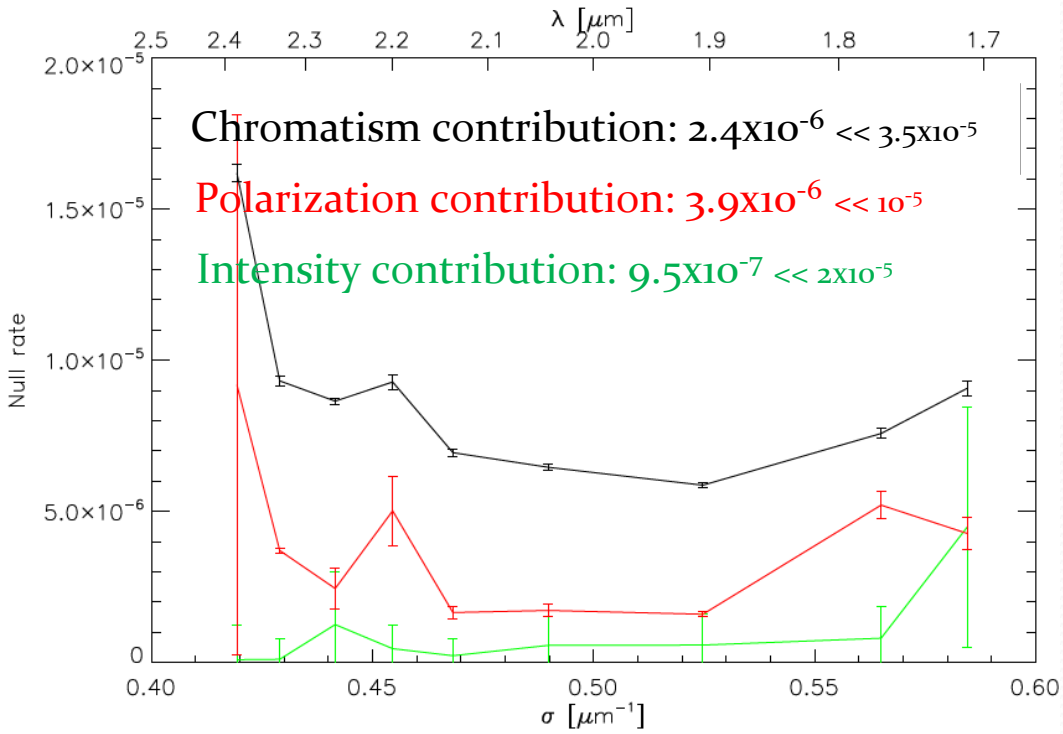




Nulling performances

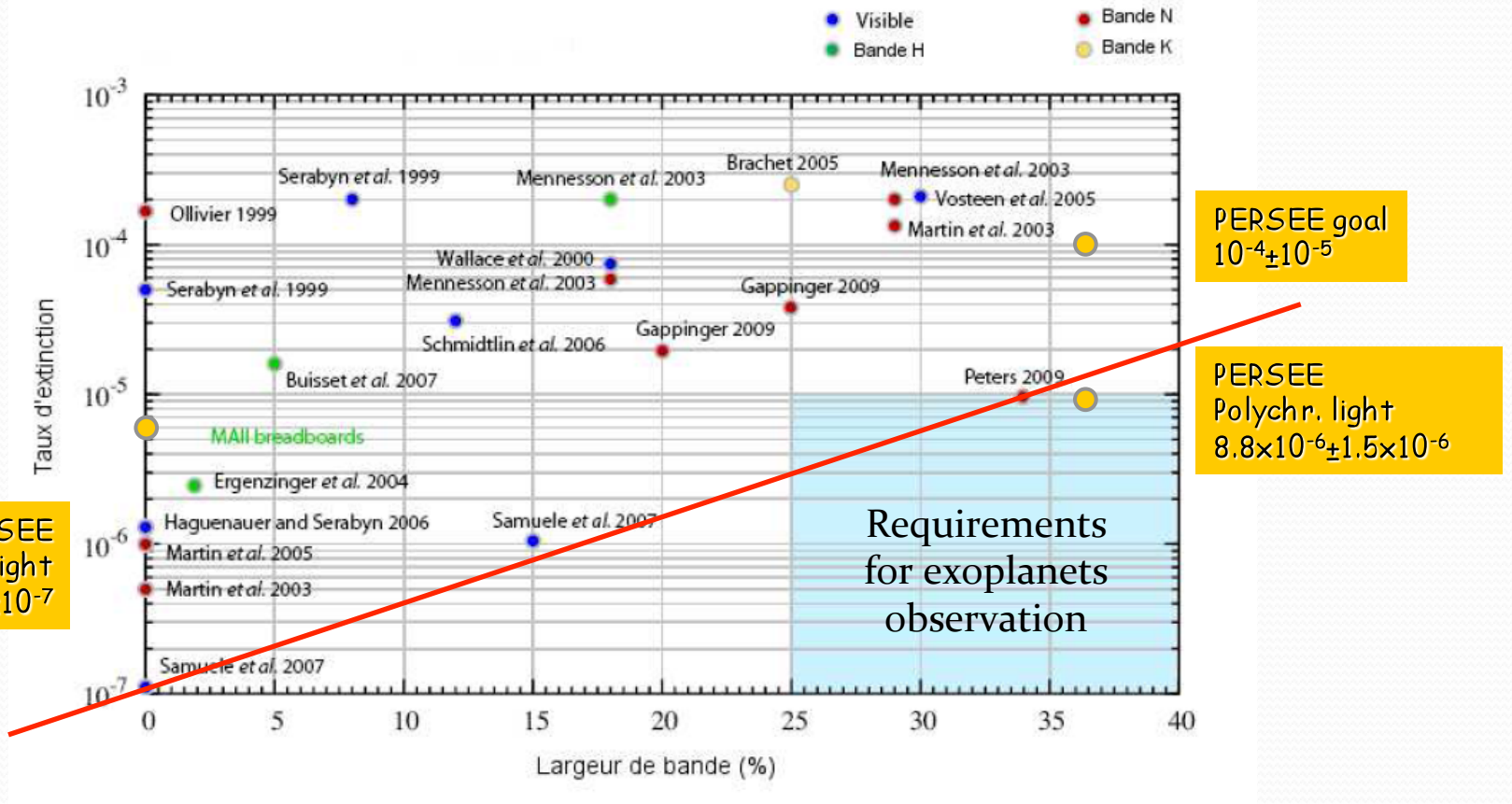
- OPD noise (LQG in closed loop, 1kHz): 0.74nm rms << 1nm rms
- Tip/Tilt noise (integrator in closed loop, 200Hz): 65 mas rms << 100mas rms
- Intensity mismatch: 0.1% rms << 1% rms





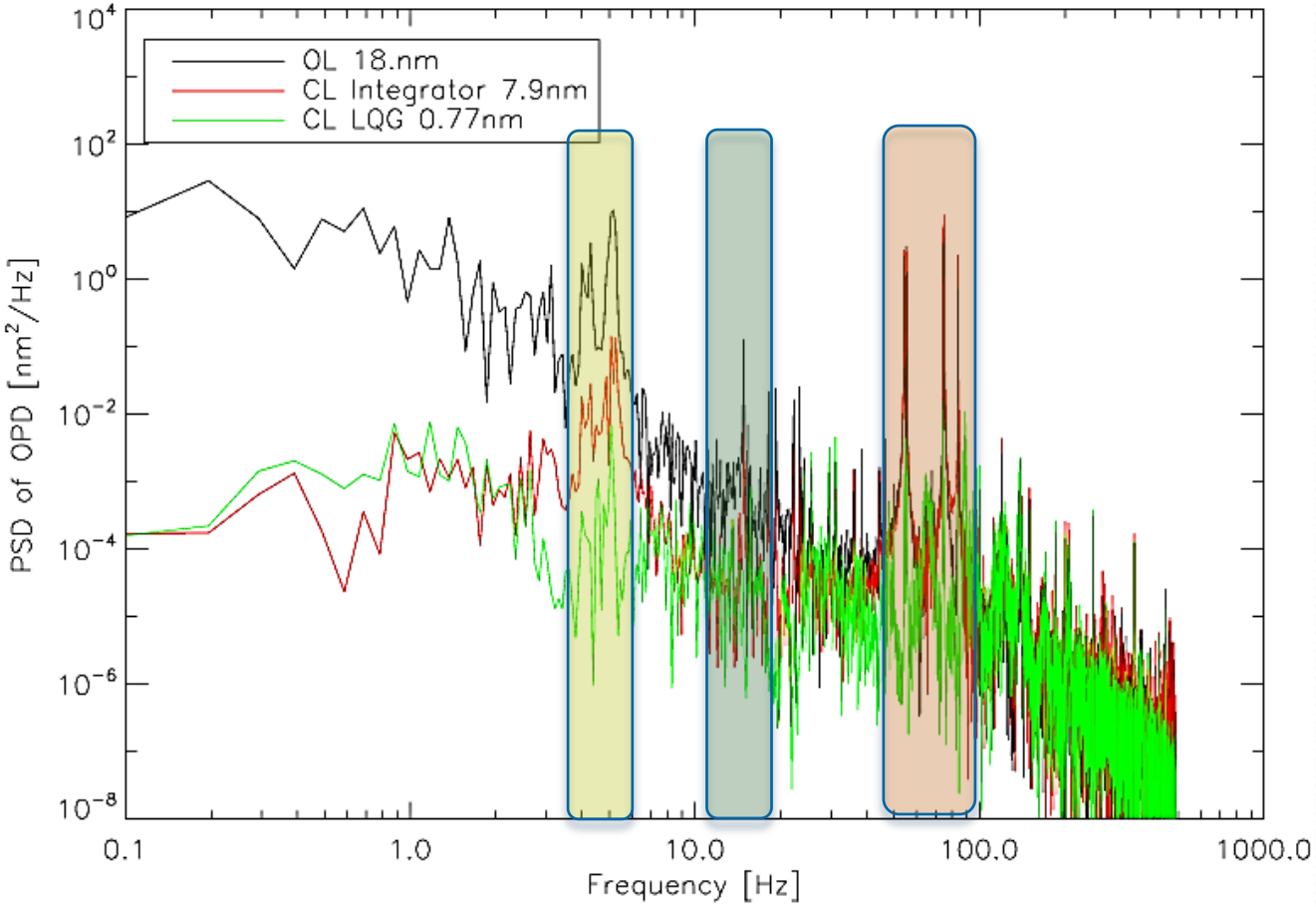
OPD contribution: 1.4x10^{-6} << 3.5x10^{-5}

Worldwide performances



Injection of calibrated noise

Injection of calibrated OPD noise + LQG controller (*Linear Quadratic Gaussian*) coupled with a Kalman filter (AO heritage) for correction.



GNC (TAS study):

- Wheel speed: 4.5Hz
- Solar array: 15Hz
- Siderostat: 55-75-85Hz

Nulling ratio:

- Goal: 10^{-4}
- Integrator: 8.5×10^{-5}
- LQG: 1.1×10^{-5}

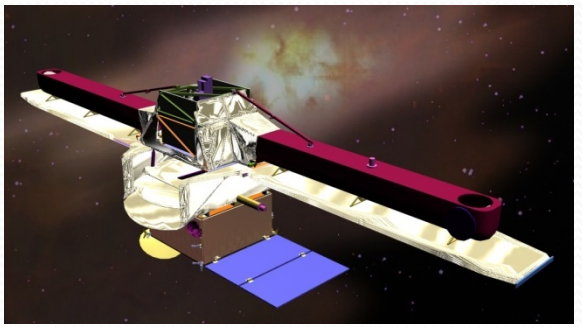
Conclusions and perspectives

Already done

- PERSEE achieves very efficient polychromatic null in non-polarized light
- LQG control loop maintains OPD at less than 1nm rms in presence of representative disturbances induced by reaction wheels (high frequency) with a significant amplitude

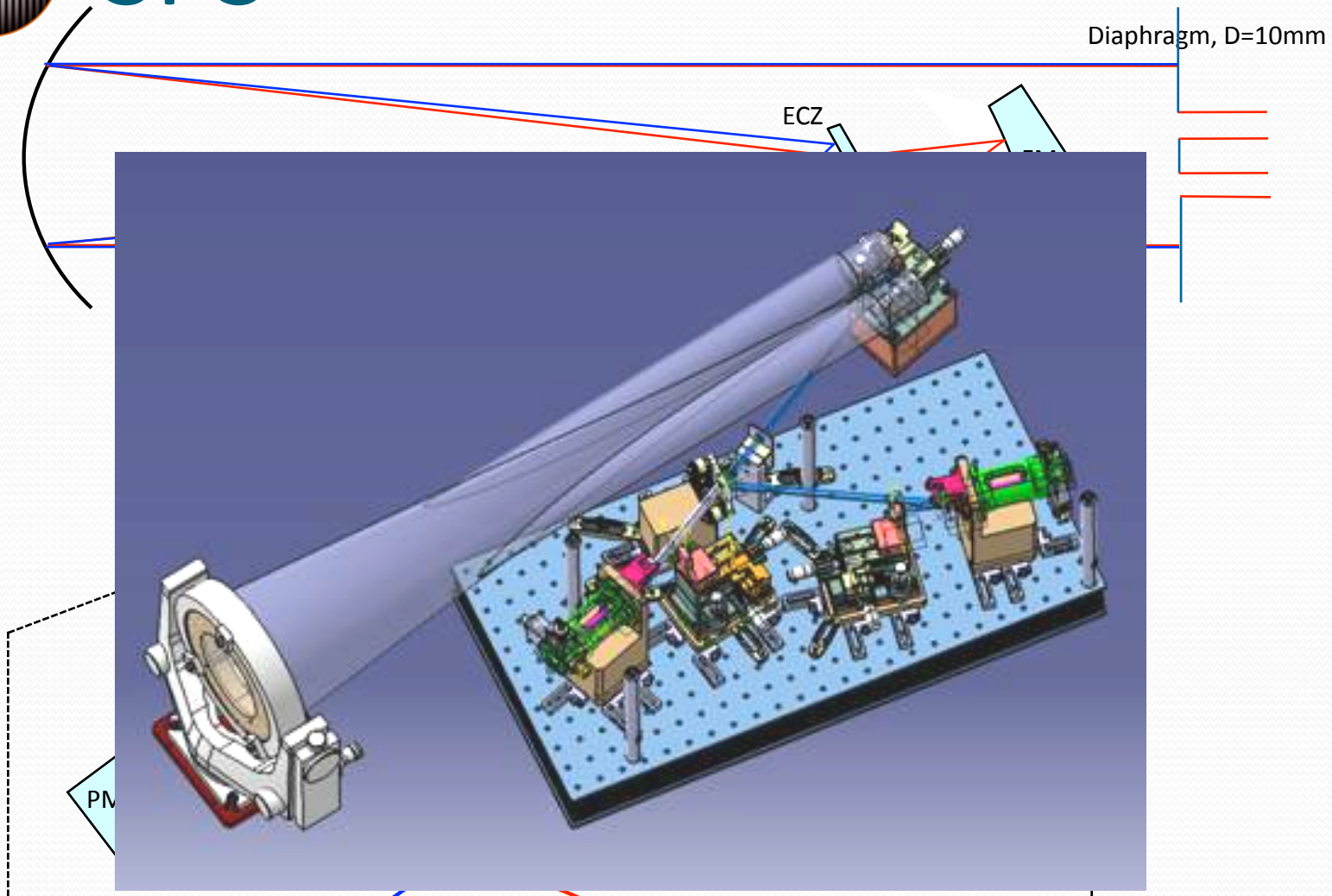
Still to be done

- Fringes acquisition with a initial drift speed (150µm/s) ➔ *in progress*
- Simulated complex targets (star + faint planet + exozodi) ➔ *PhD starting*
- Simulation of FKSI disturbances ➔ *coming soon ?*



Exploitation en cours

SPS



*: motorized mount