Carbon fiber sources

- characteristics of those sources

- (some) bolometer characterizations that have been performed with the fibers

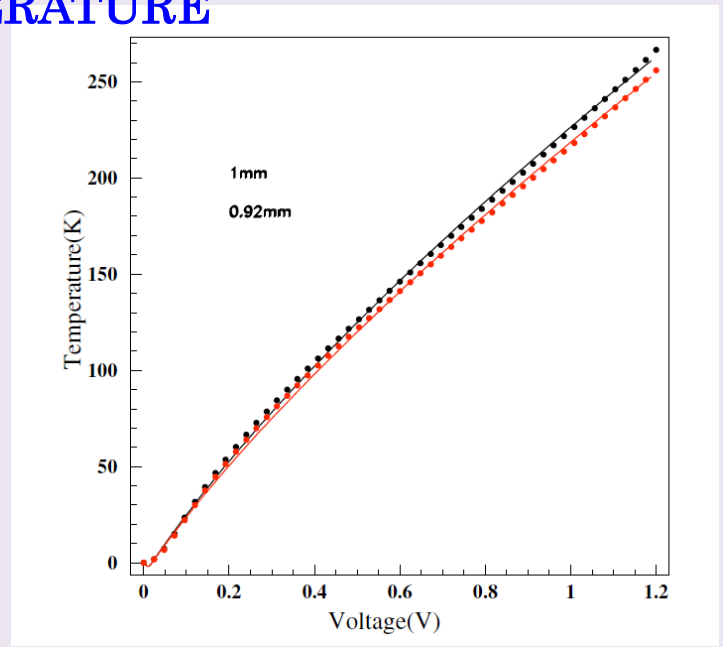
- proposal for QUBIC

Carbon Fiber characteristics

~800 Ohm (room temperature)

Time constants of the fibers:
rise time ~7 ms
decrease ~9ms

TEMPERATURE



Simulation: mean temperature to which the fiber is heated as a function of the applied voltage (fiber reflector @2K)

FLUX

The table has been derived from measurements on Planck-HFI bolometers with the source installed ~ 40 cm from the entrance of the B2B (just to give a rough feeling)

Table 1
Measured flux for each Planck-HFI frequency band for the fibers installed on the mirror and pulsed with 1 V amplitude signals.

	100 GHz	143 GHz	217 GHz	353 GHz	545 GHz
Flux (10^{-3} pW)	11	10	21	117	27

More informations in Infrared Physics & Technology 52 (2009) 159–165

Why those sources ?

Sources that emit in the IR of course (!) and that can be pulsed

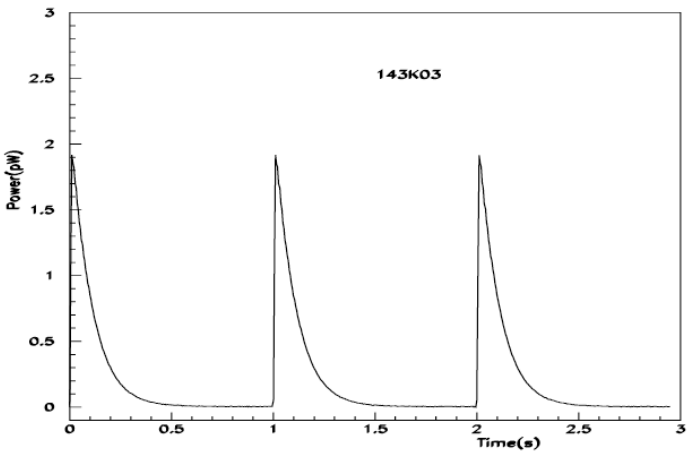
⇒ with different amplitudes

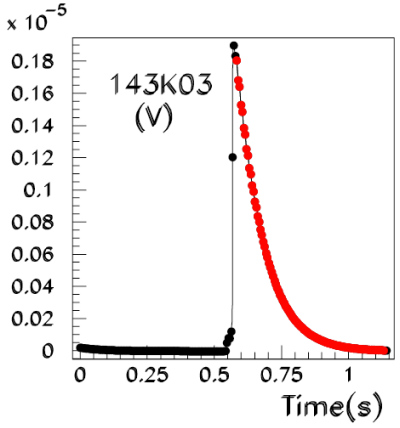
We can vary the signal reaching the detectors

⇒ with different frequencies

Even with signal of small amplitude, one can stack the measurements to obtain a better S/N ratio

& Easy installation





Flux estimation for Qubic (order of magnitude!) with the help of Michel

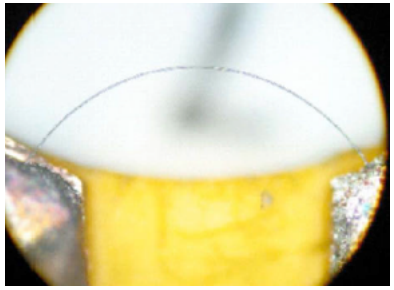
- Assuming that 2 fibers are placed in the middle of the horn array of Qubic
- Using the flux given in the table of the 2nd slide corrected for a factor 350 (dilution due to the placement of the fiber wrt to the entrance of the B2B Planck horns)
- Taking into account ~30% optical efficiency for Planck optics (B2B/filters...)
- Re-using our reflectors (50 degrees aperture)

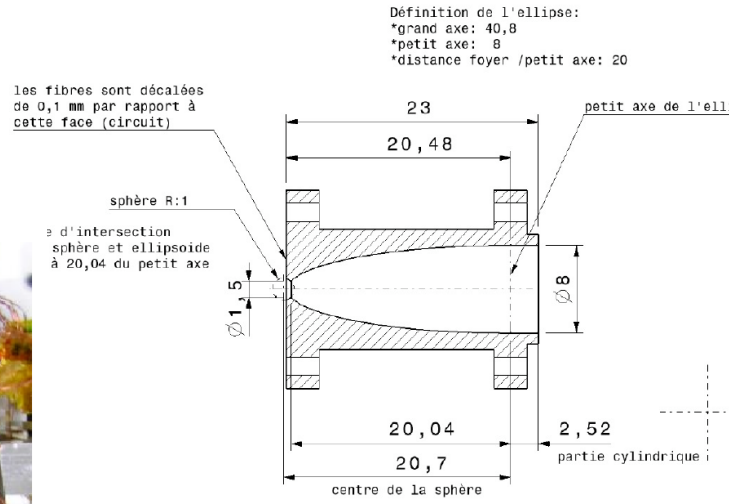
- And considering the transmission of the Qubic elements

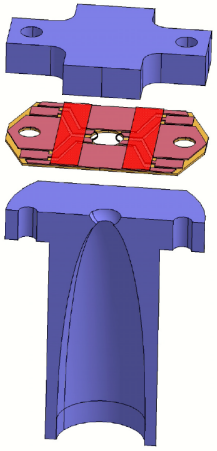
Frequency	GHz	150	220
Total power emitted (from Henrot-Versille 2007)	pW	10,5	22,05
Emitting horn FWHM	degree	50	50,0
Number of fiber		2	
Power on central detector	W	1,7E-15	3,7E-15
S/N for 1s integration time		44	24

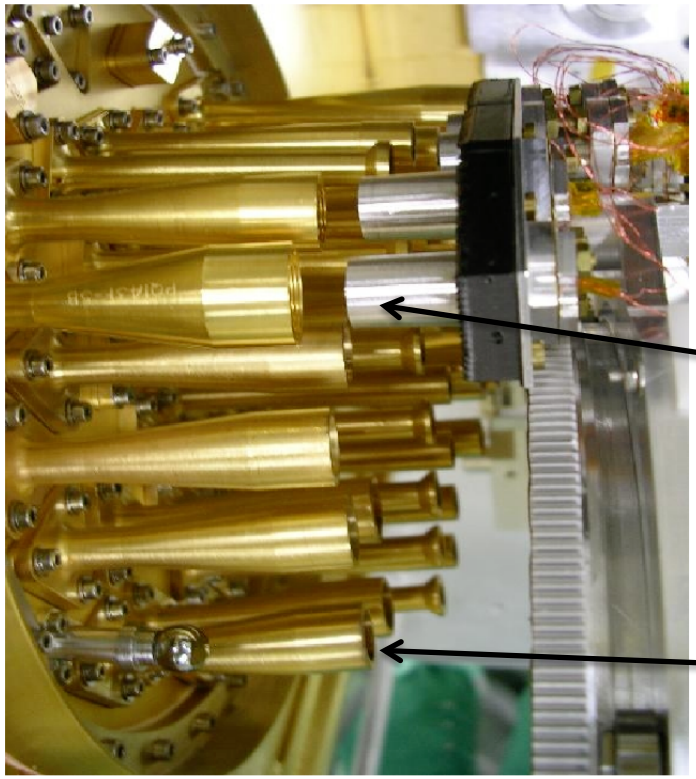
Optical Xtalk setup principle (done on Archeops+Planck-HFI)

Illuminate each bolometer independently and measure the signal on all of them









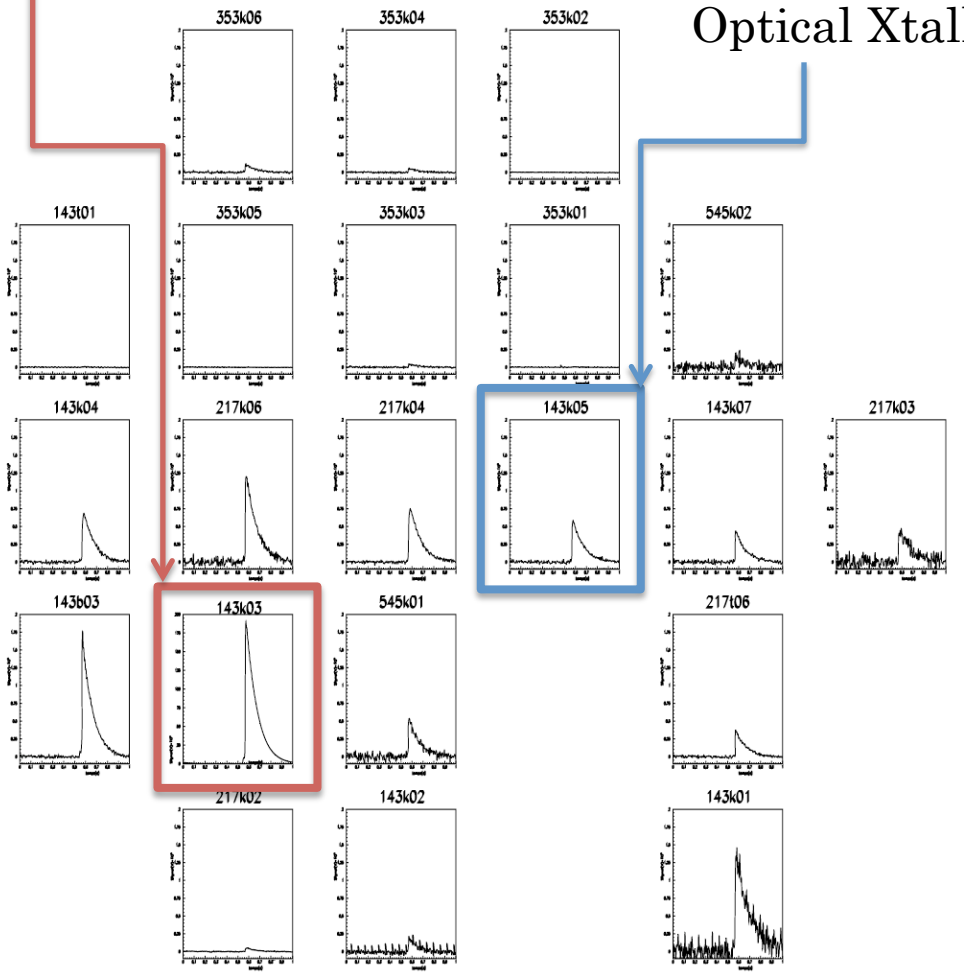
Support for waveguide+fiber

Back to Back horns
Of the instrument

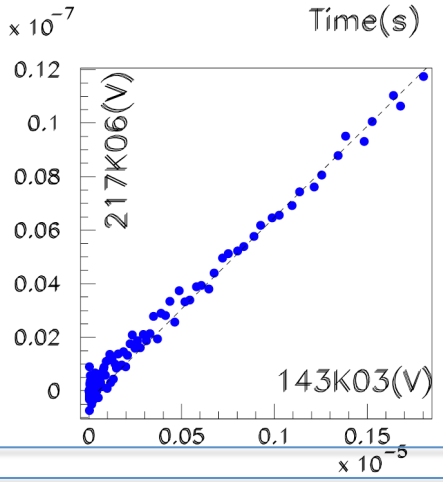
Optical Xtalk measurement (done on Archeops+Planck-HFI)

Direct Illumination

Optical Xtalk

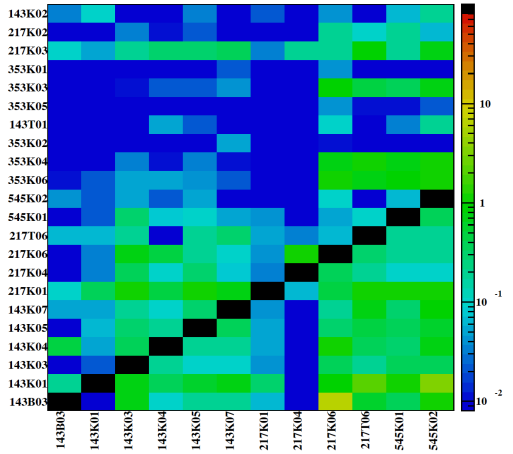


3/ Estimate the correlation



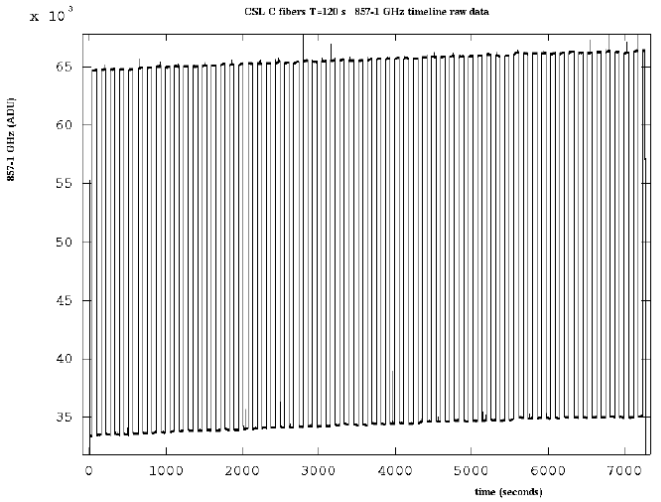
4/ Proceed with each fiber

5/ Build the correlation matrix

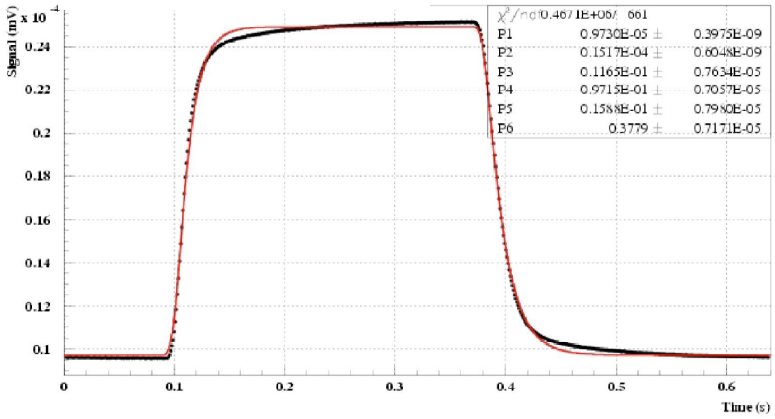


Time Response Measurements

1/ Pulse the fiber with ~1V square signal
2/ measure the response of the bolometer

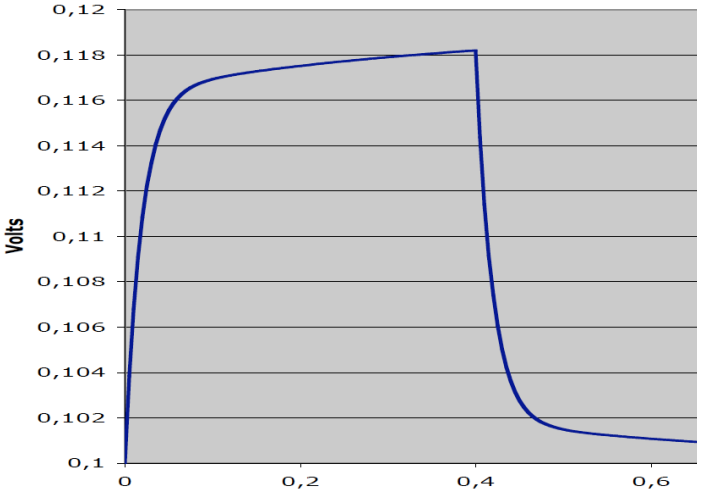


Measurements



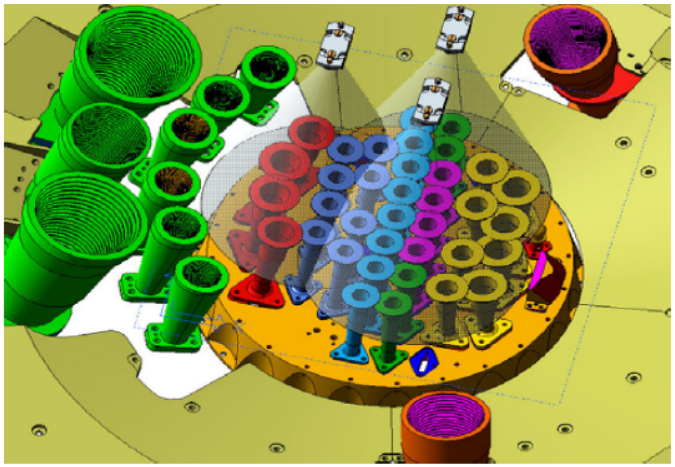
⇒ Can detect if there are different components in the time response
=> Can be done extensively for various configurations (different loads/ different Ibias of the detectors/ different temperatures of the focal plane …) to further understand the bolometer model (exple for Planck →).

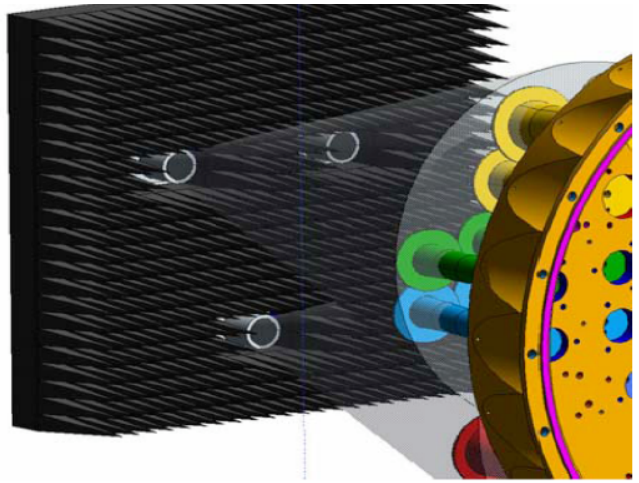
Simulations of the bolo response

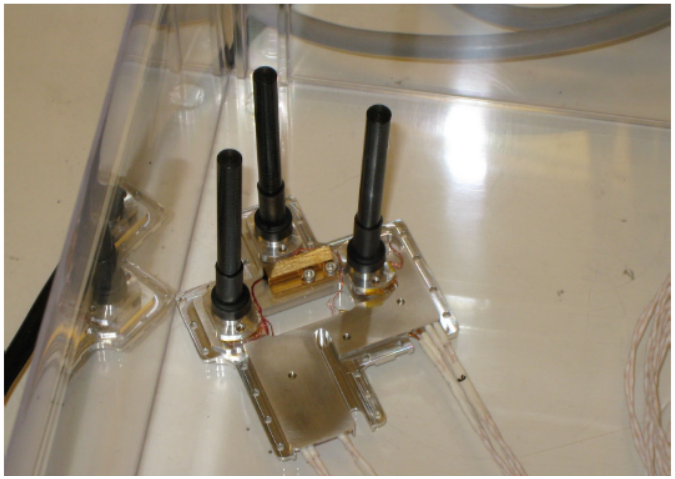


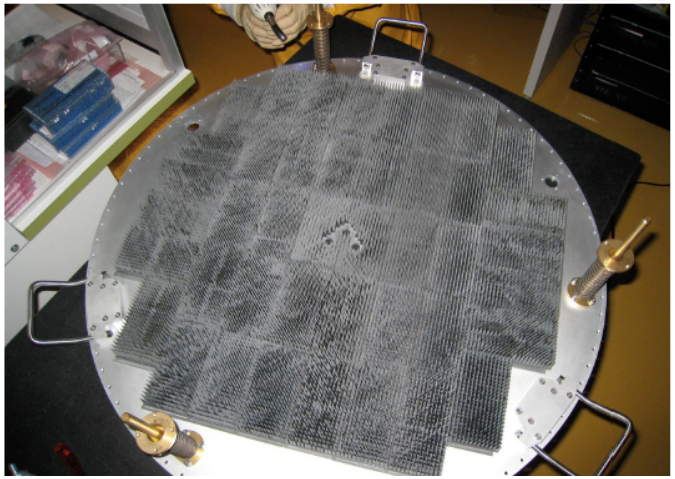
Time response measurements setup @ CSL (Planck-HFI)

Illuminate all bolometers at once with Carbon fibers installed in front of the focal plane









Proposition for QUBIC

=> Easy monitoring of the focal plane illumination pattern as a test of displacement of the elements within the cryostat (before/after moving the instrument, wrt to angle of the platform…)

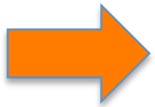
Byproduct : cross-check/tuning of the optical simulations misalignement

⇒ Measurement of Xcalibration of the detectors+electronics:

⇒ Relative monitoring of each detectors' response wrt time if the focal plane is not uniformly illuminated for each detector

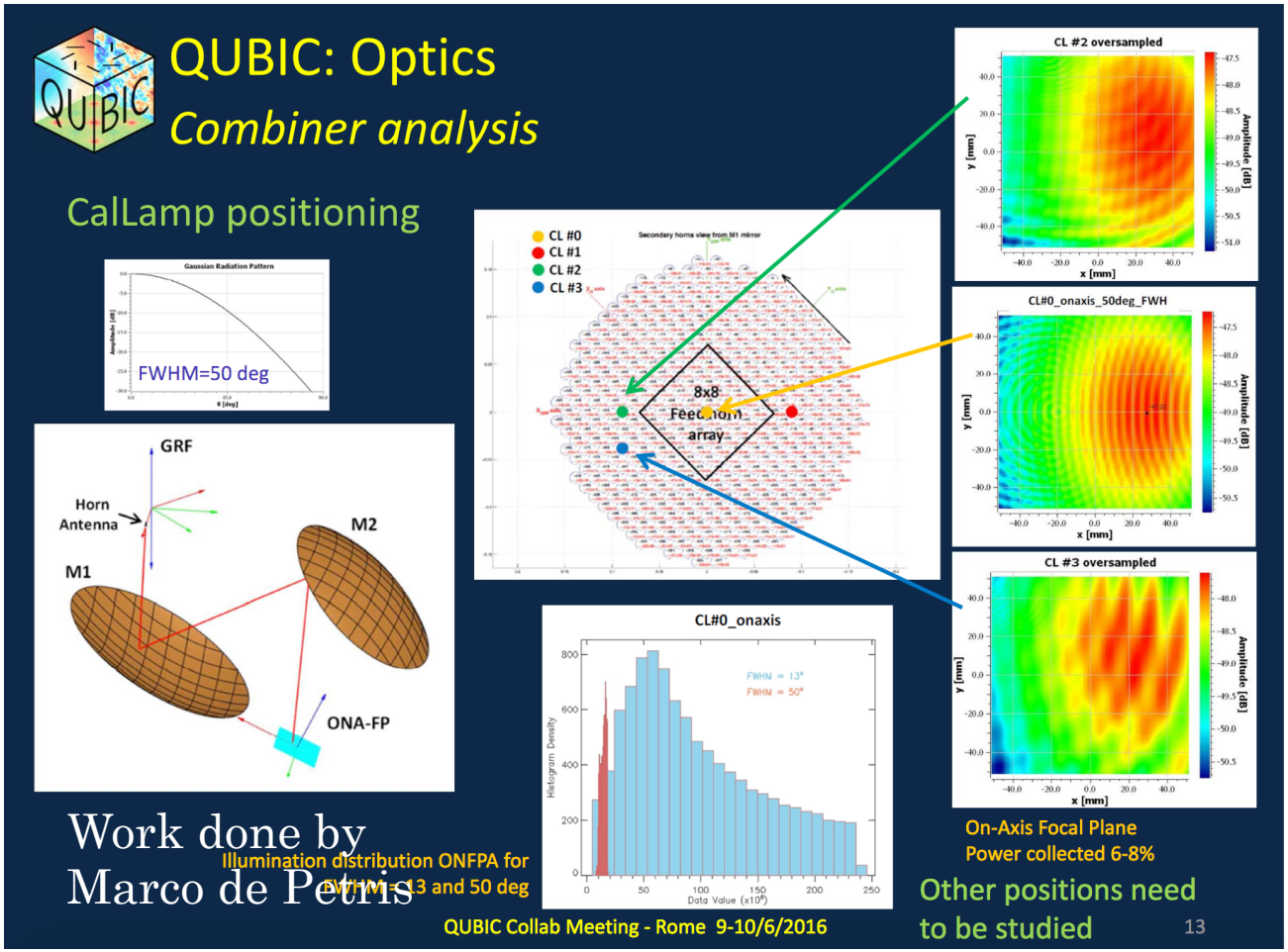
⇒ Absolute Xcalib if we can correct for the non-uniform illumination from optical simulations

⇒ Setting at least upper limits on time response



In any case: no firm need for a uniform illumination of the focal plane if we proceed with those goals, but the closer to uniform as possible would be better !

Where to install the Carbon fibers ?



find a position to install them in the Full Instrument and in the Technological Demonstrator

Need to iterate with Marco, Michel, Nathan and Claude to choose the better position in terms of measurements AND mechanical constraints