LOOPS

WOLF

AGENCE NATIONALE DE LA RECHERCHE
ANR

SEEKING FOR THE ULTIMATE WAVEFRONT SENSOR

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LAM
LABORATOIRE D'ASTROPHYSIQUE DE MARSEILLE

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THE FRENCH AEROSPACE LAB

Wavefront sensing in the VLT/ELT era
Florence, 28/10/2019

The genesis of the LOOPS testbed

The genesis of the LOOPS testbed - The goals

I. Provide a well-characterized R&D bench

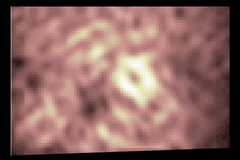
LOOPS

Strehl ratio

Wavefront error

Turbulence control

Propose innovative ways to operate the pyramid

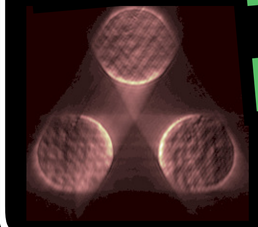


Gain tracking

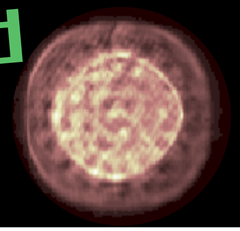
Reconstructors

Propose and study new masks

3PWFS



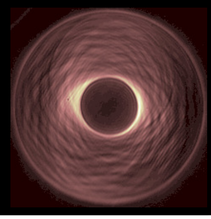
Flattened pyramid



iQuad

INGOT

Axicone



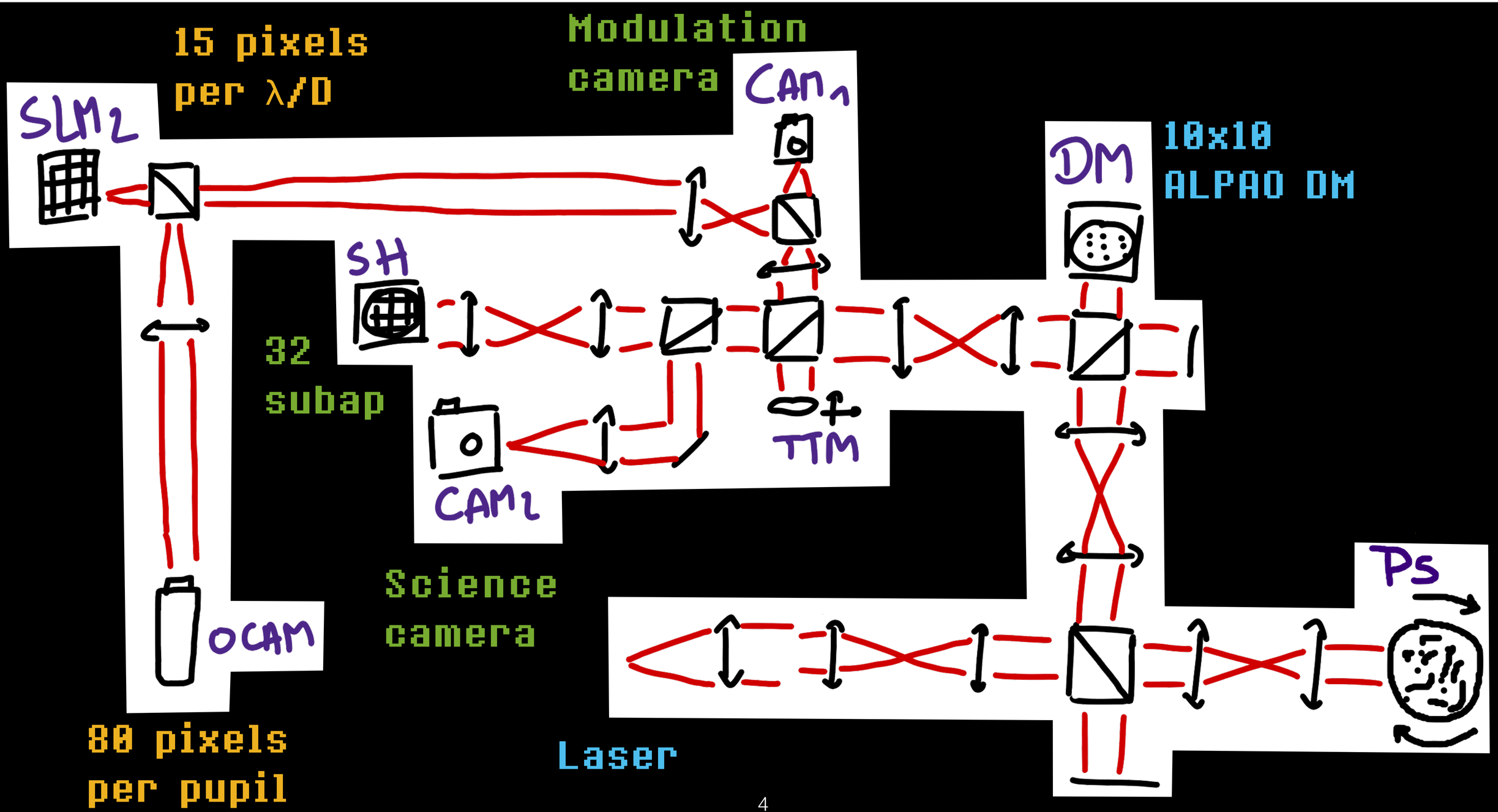
Improve the capabilities of Fourier-based WFS

Higher dynamic

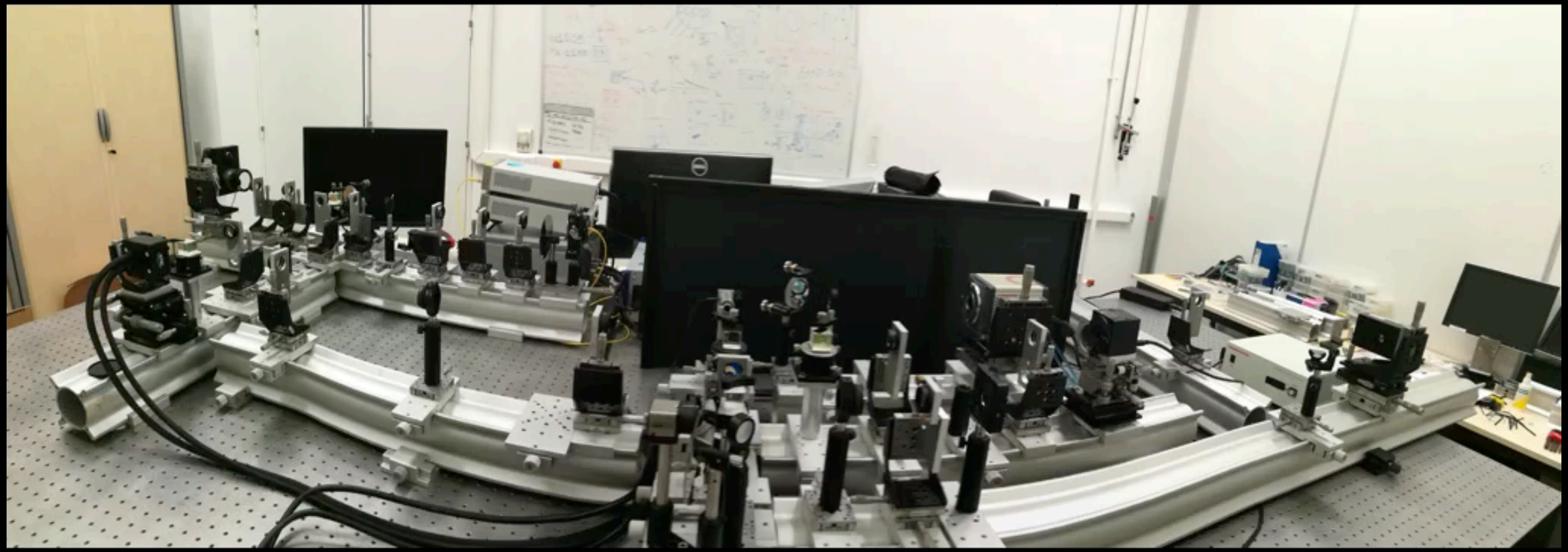
More sensitivity

More linearity

The genesis of the LOOPS testbed - The bench (1/2)



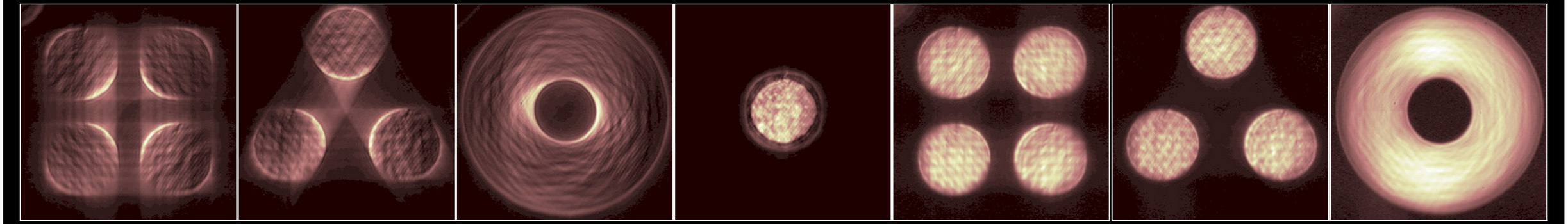
The genesis of the LOOPS testbed - The bench (2/2)



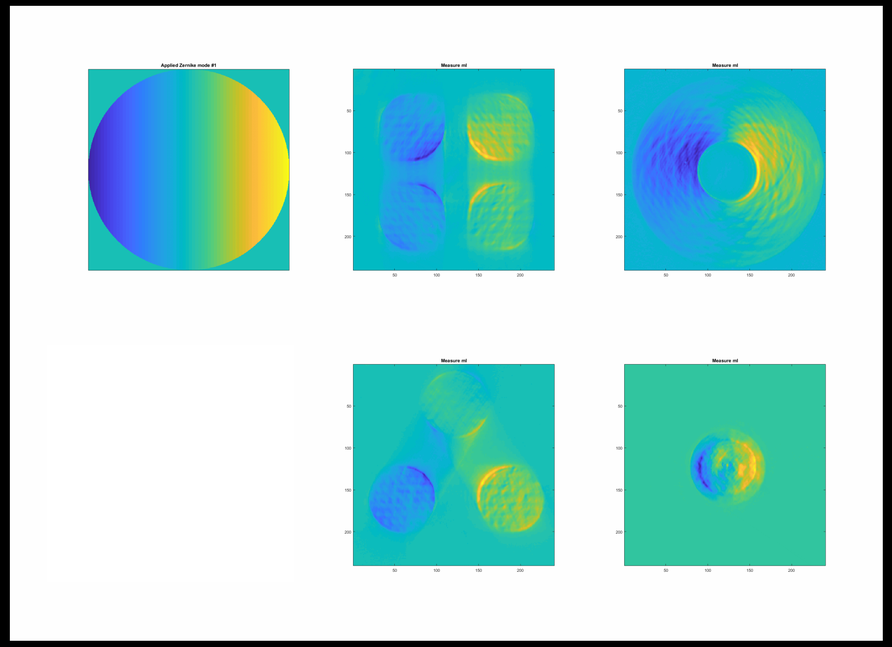
THE ALMIGHTY LOOPS !
Attack "SLM in da face" !
LOOPS

The almighty LOOPS ! - Demonstration of the bench

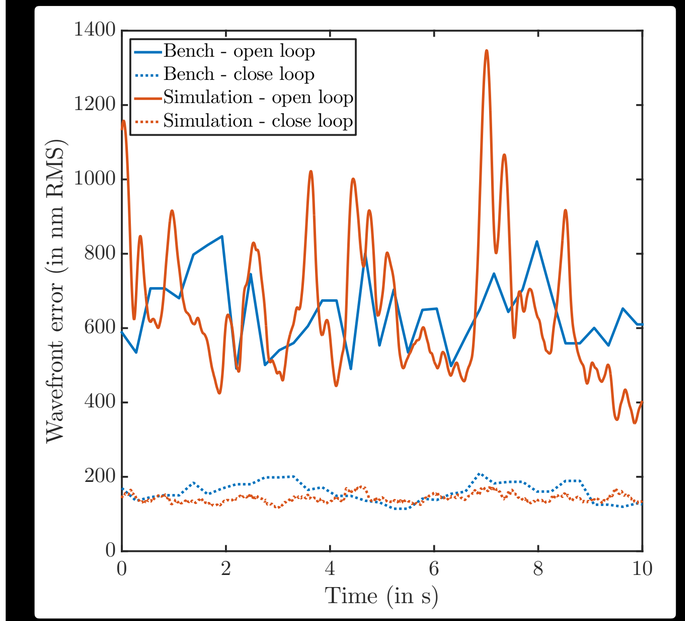
Produce any kind of Fourier-based WFS

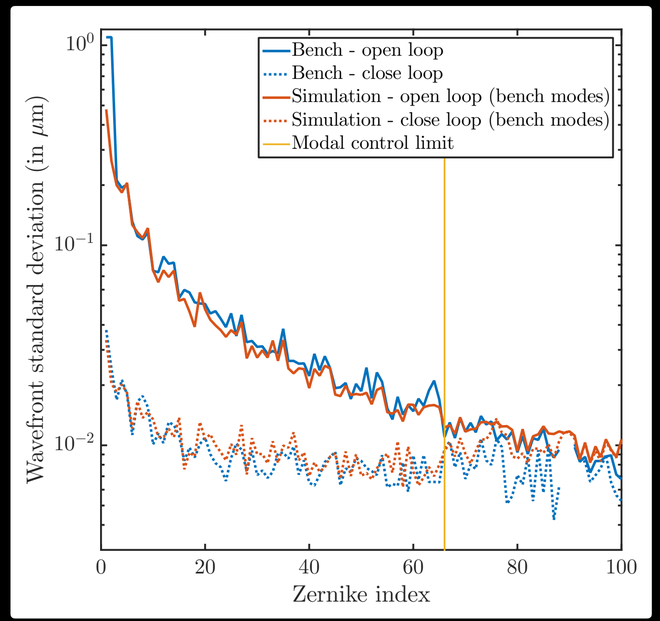


Calibrate



Study a known system

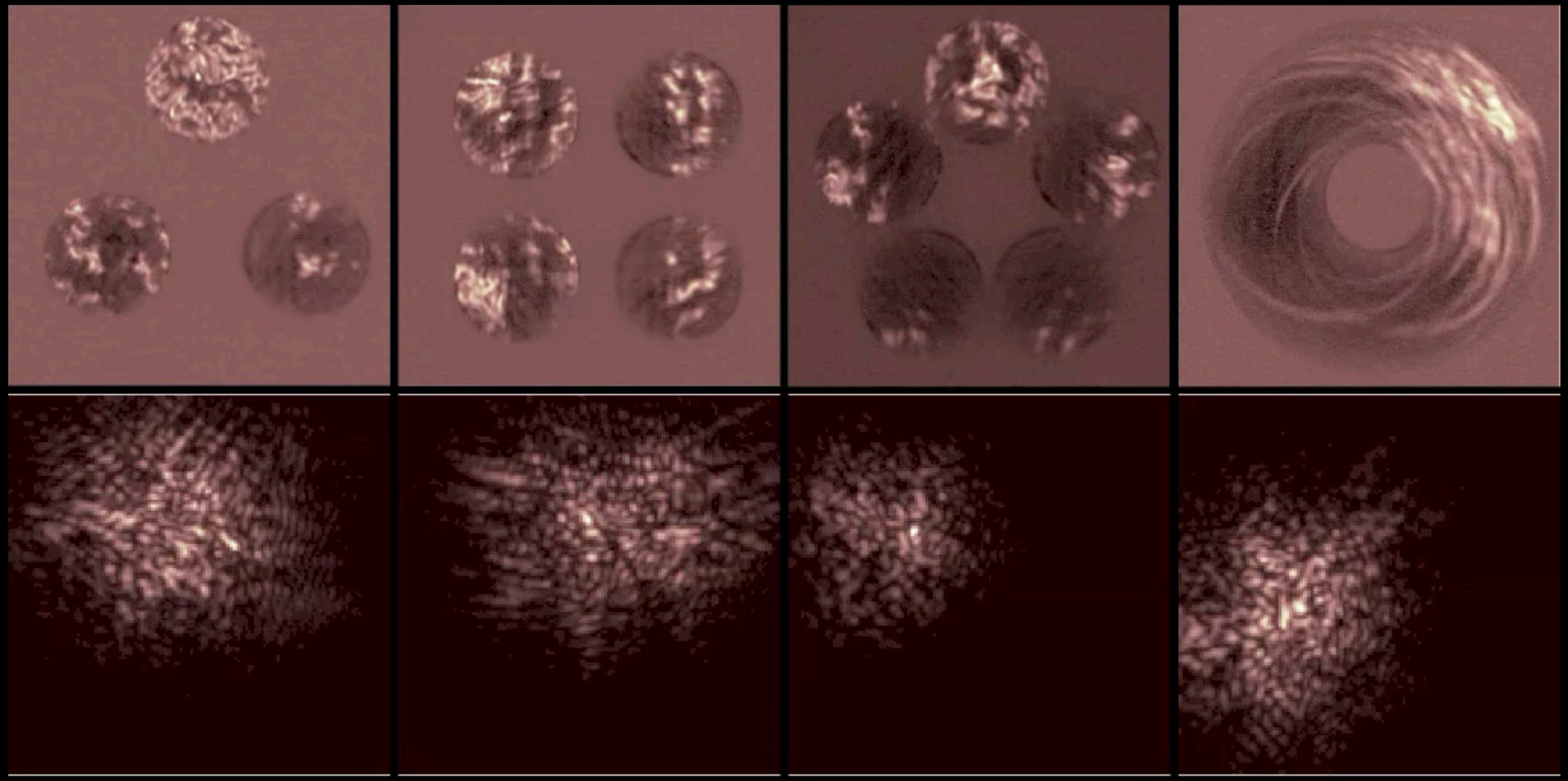




Janin-Potiron et al. (2019)

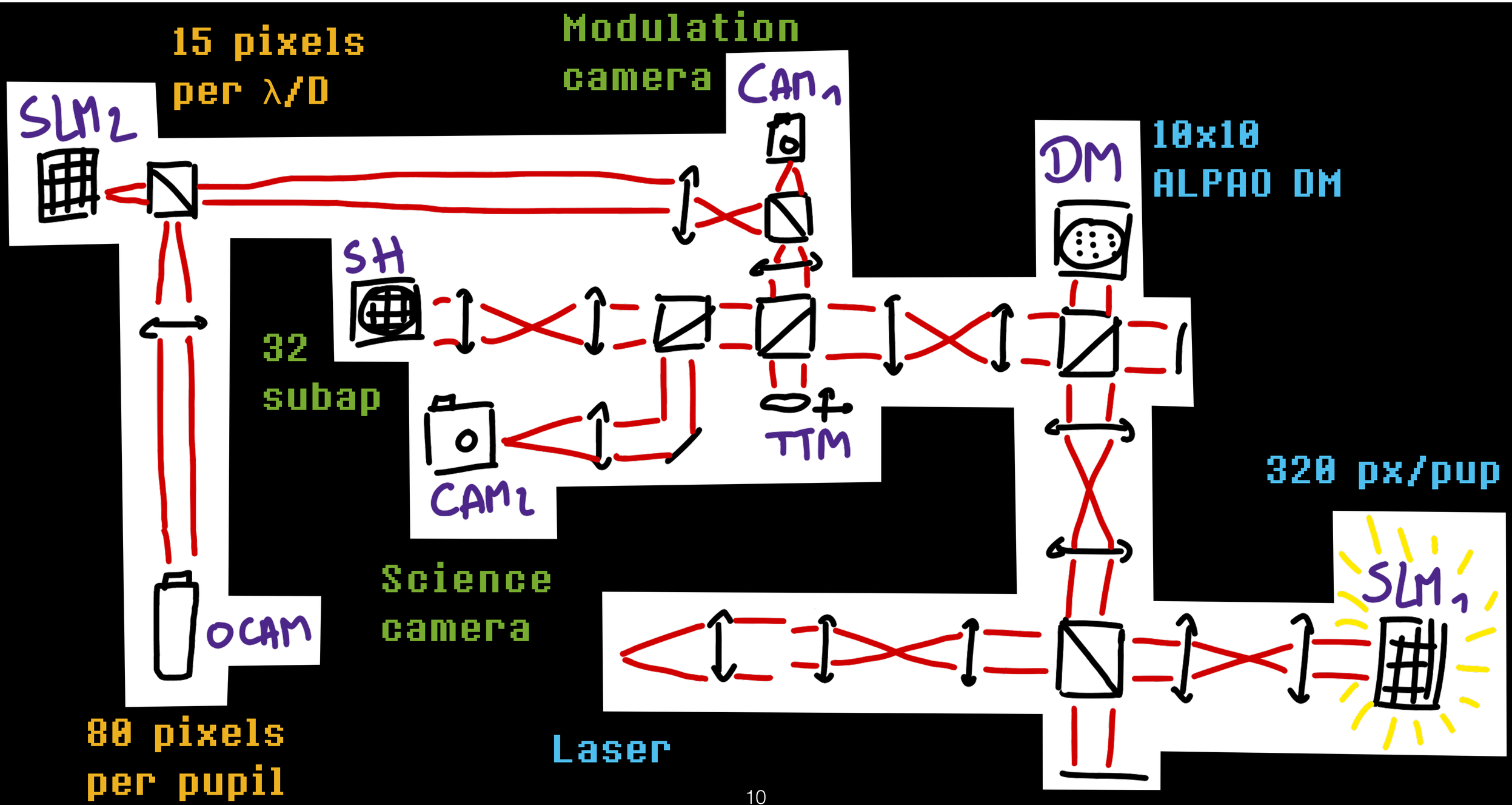
The almighty LOOPS ! - Demonstration of the bench

And finally have fun !



THE LOOPS EVOLUTION

The LOOPS evolution - The bench v2.0



The LOOPS evolution - Fourier-based WFS comparison

THE DYNAMIC

How far can it reach?

Does it show a saturation regime ?

THE LINEARITY

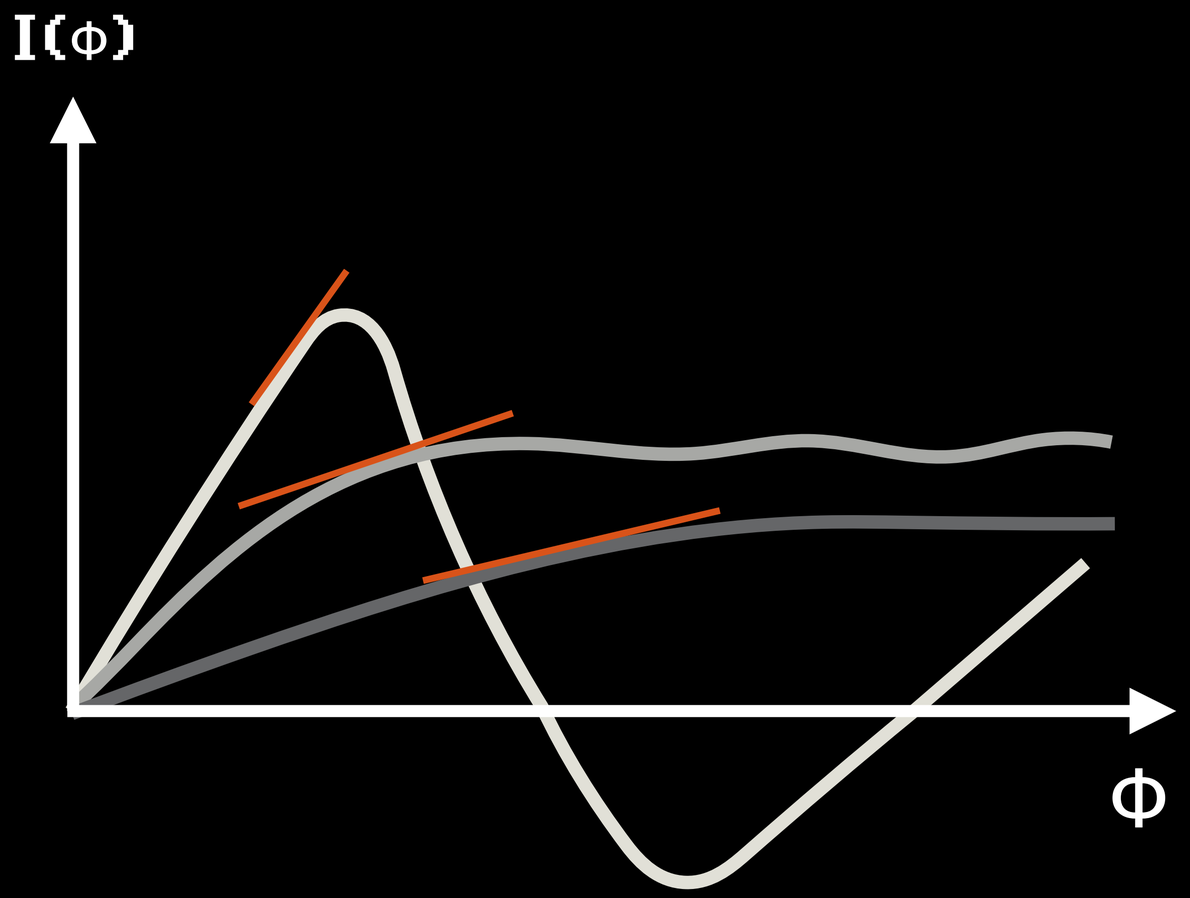
How close to a linear behavior it is?

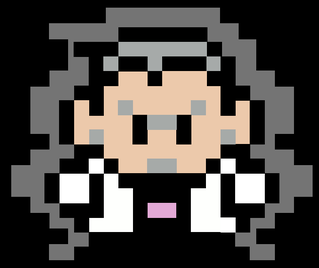
How does it performs using a linear reconstructor ?

THE SENSITIVITY

How accurate will the measurement be?

How does the sensor performs at low flux?

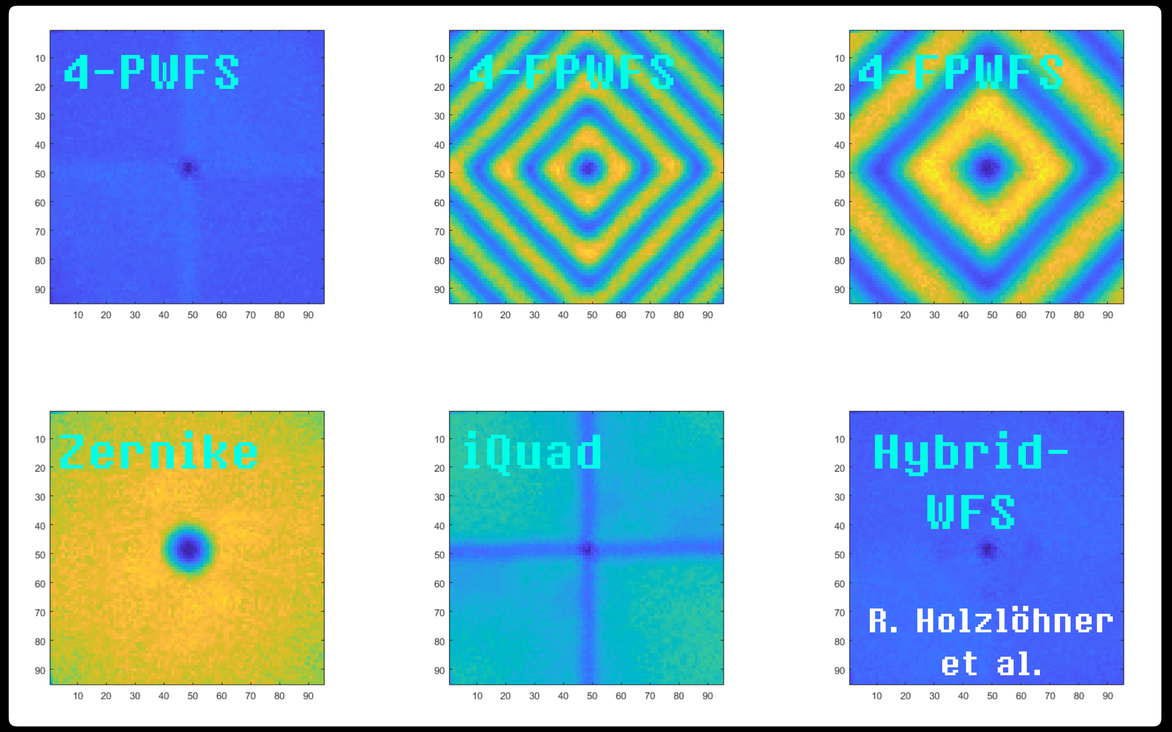


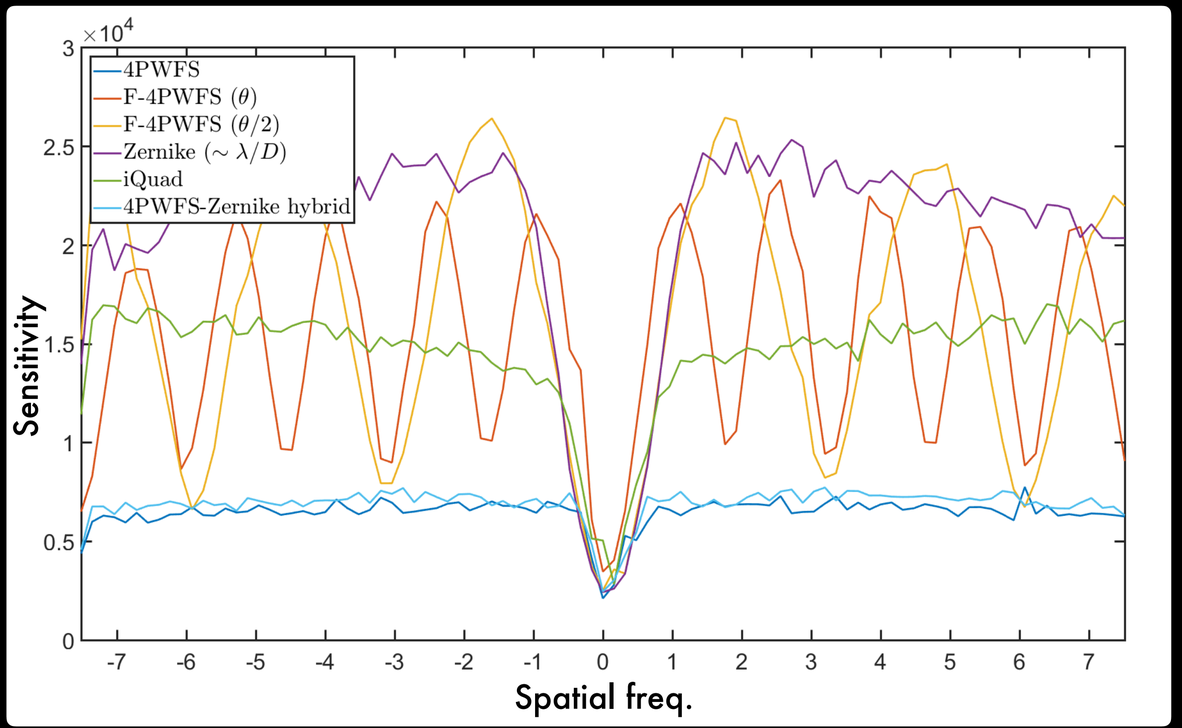


The LOOPS evolution - Sensitivity measurement

Transfer function HowTo

$$TF = diag(D^t D)^{1/2}$$





The LOOPS evolution - Sensitivity measurement

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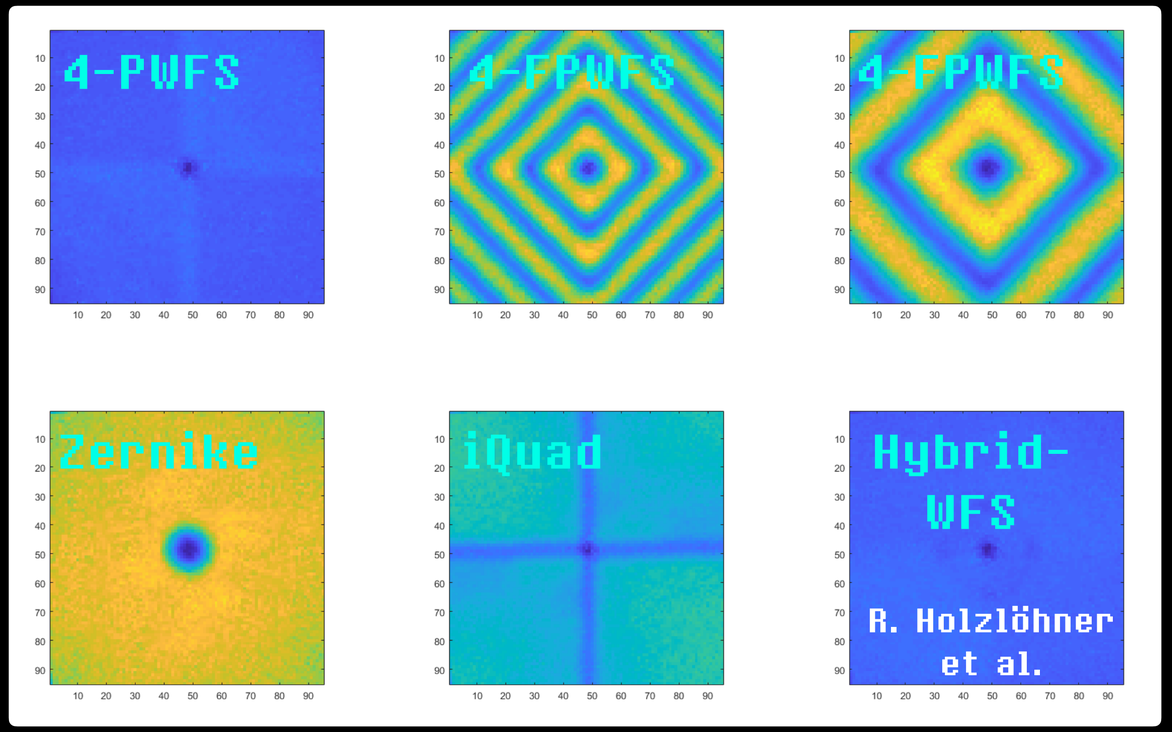
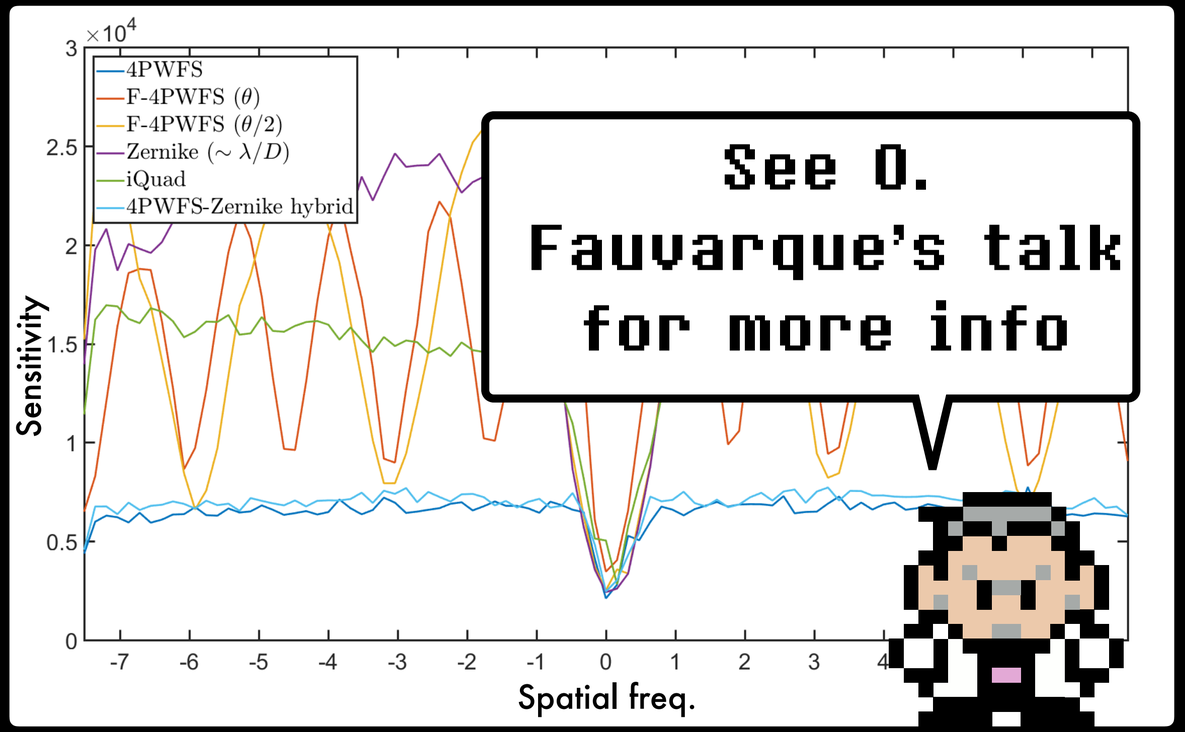
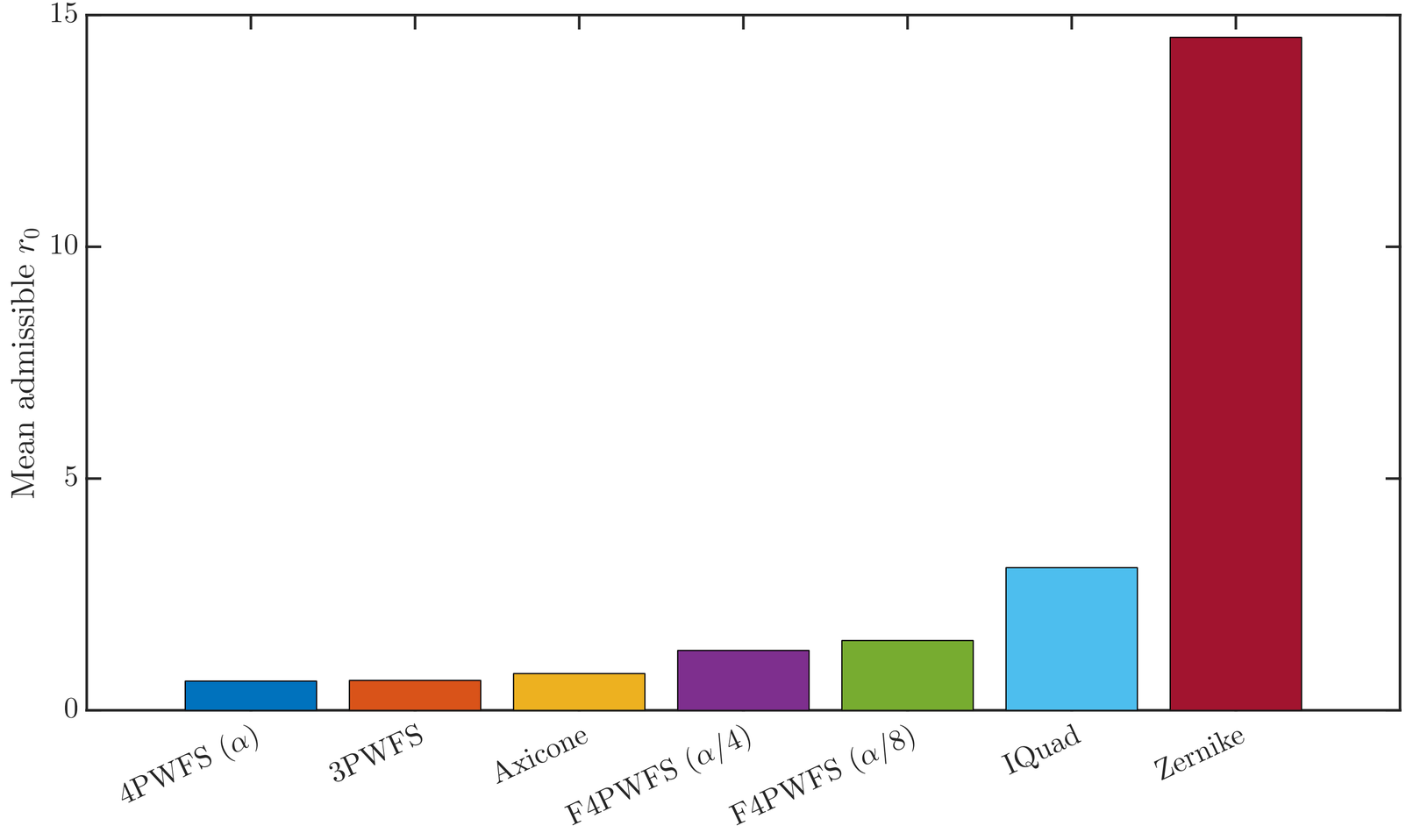




Bootstrap limits

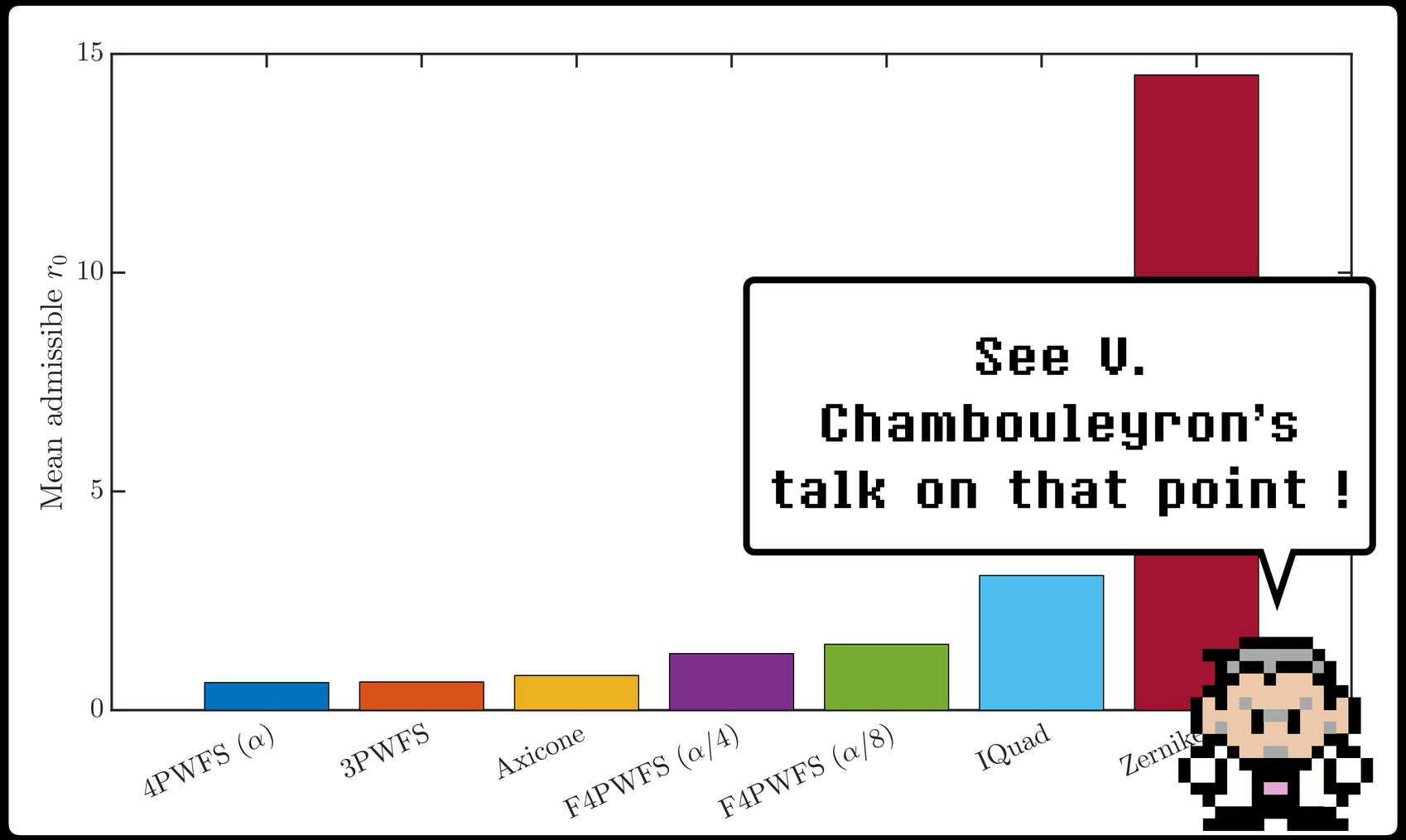


Obtained on 10 random atm. realizations

Representative of converging limits

Still a valid test to assess dynamic if OG are applied ?

Bootstrap limits

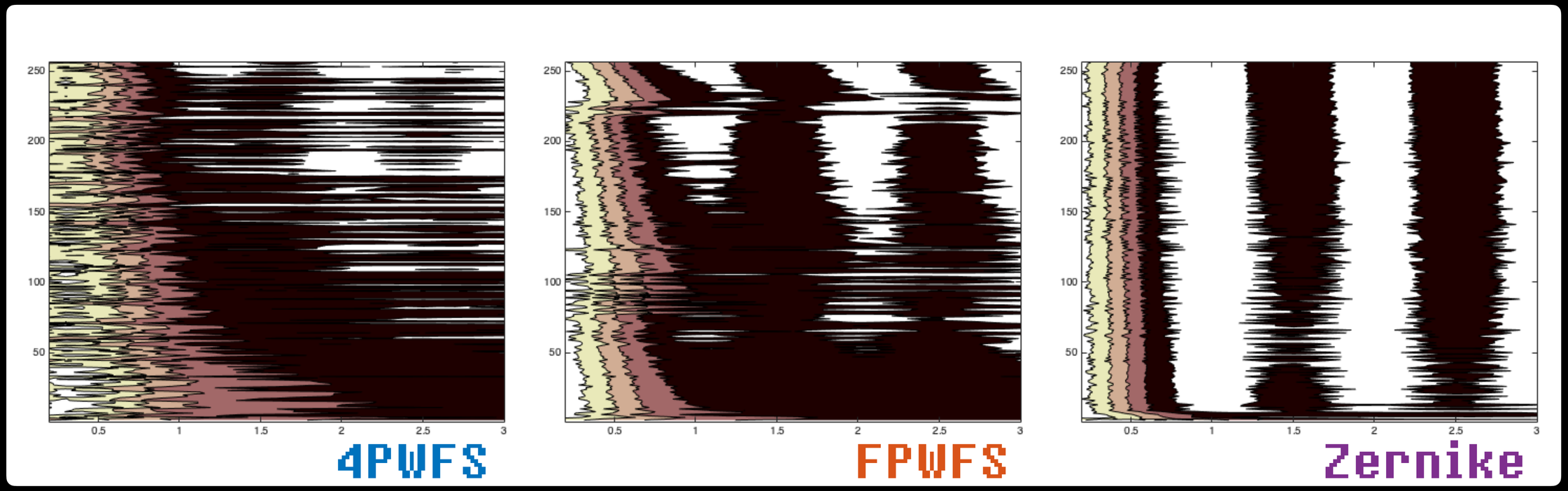


Obtained on 10 random atm. realizations

Representative of converging limits

Still a valid test to assess dynamic if OG are applied ?

Push-pull calibration with increasing amplitude



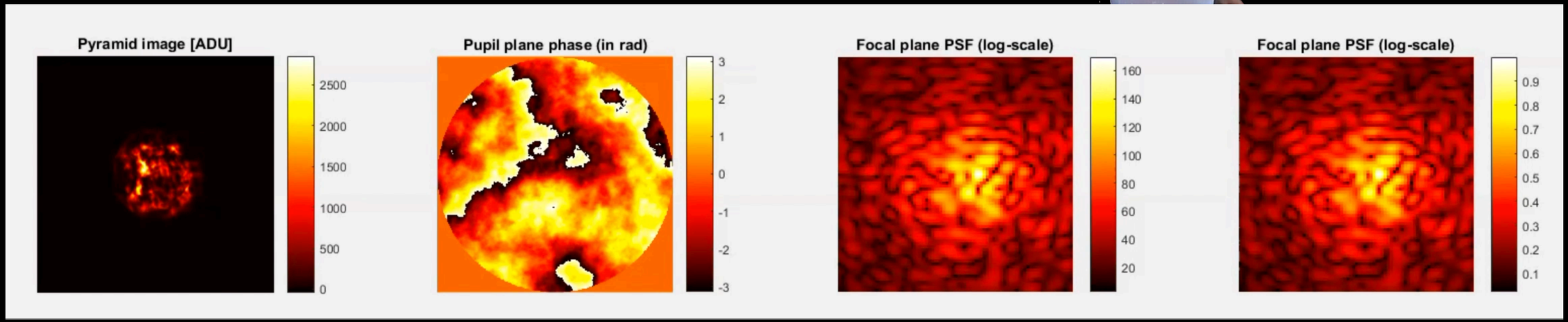
$D \propto \mathrm{diag}[I_{calib}(Amp).I_{lin}]$

Mode #

Amplitude

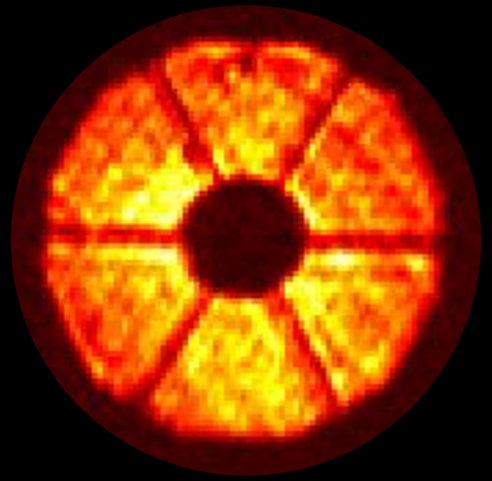
The LOOPS evolution

Closed-loop with the flattened pyramid



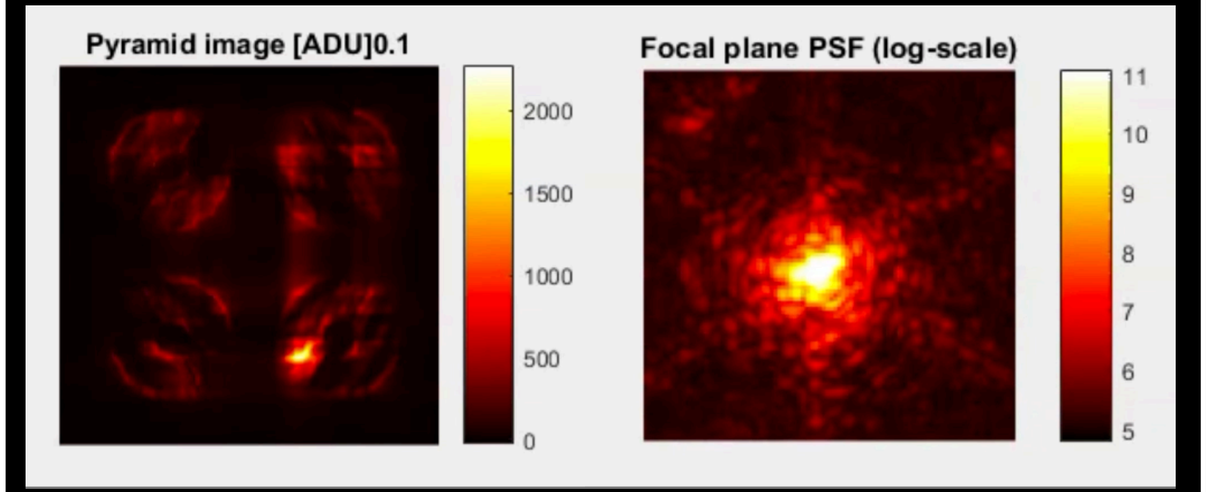
The LOOPS evolution - Amplitude modulation with SLM

Amplitude with crossed polarizers and SLM



Toward complex obscuration masks and some island effect !

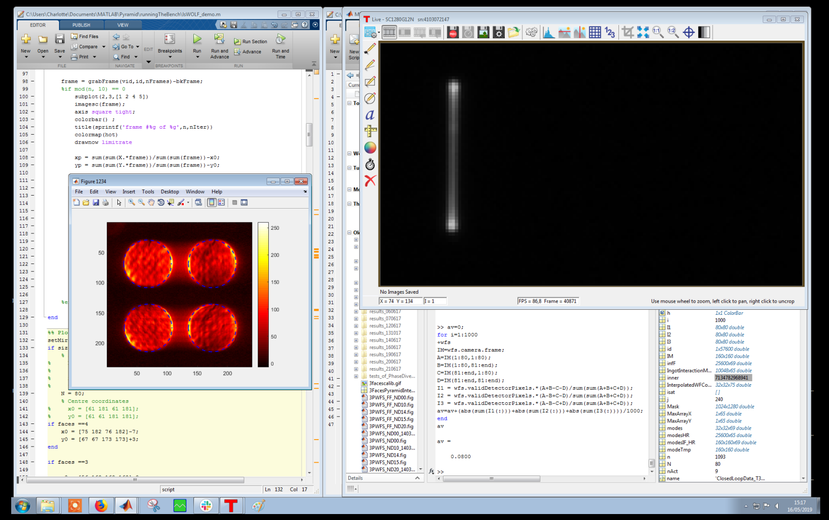
Closed-loop

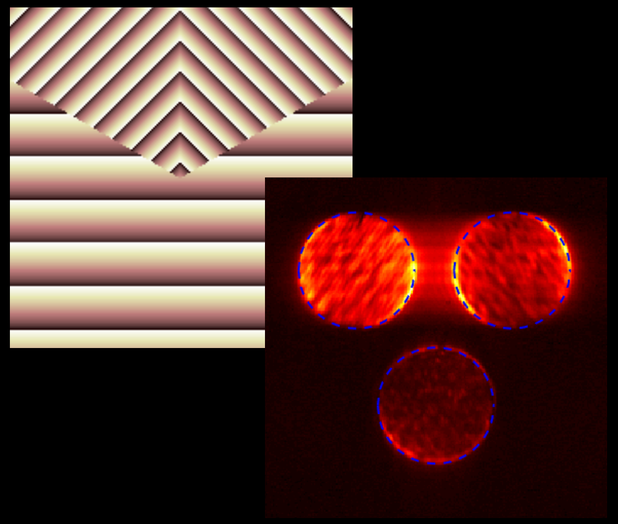


Feat. Mojtaba Taheri, Univ. of Victoria

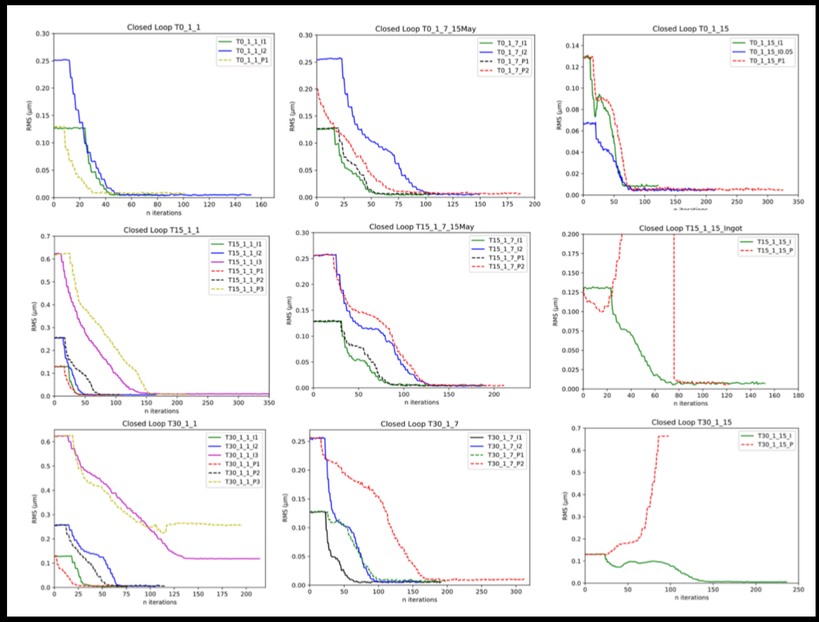
THE LOOPS EVOLUTION - INGOT ON LOOPS

Bench setup for INGOT



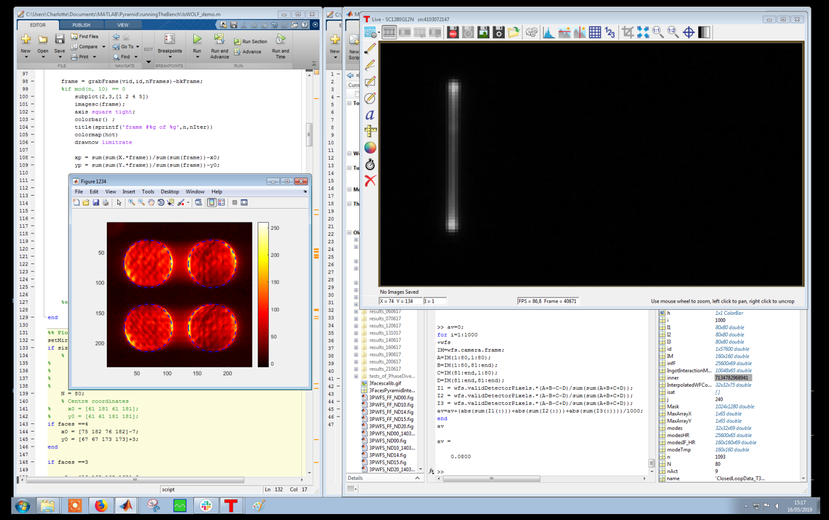


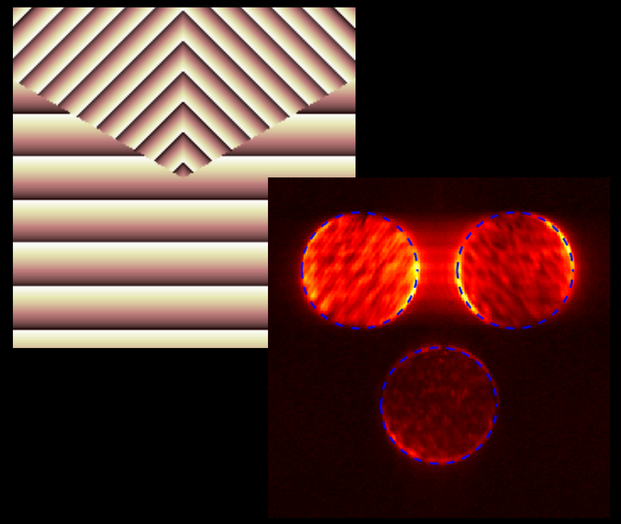
Closed-loop on DM generated turbulence



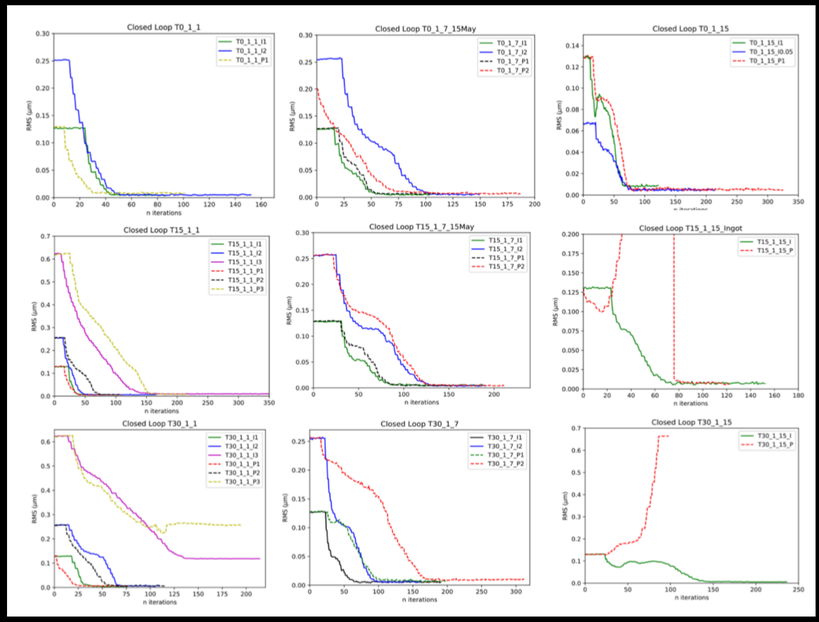
THE LOOPS EVOLUTION - INGOT ON LOOPS

Bench setup for INGOT

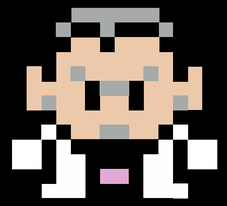




Closed-loop on DM generated turbulence



Hear more from S. Di Filippo's talk on INGOT !



Ciao !

Thank you all !
And don't hesitate to see with the team to test your projects on LOOPS !