

The Segmented Pupil Experiment for Exoplanet Detection (SPEED)

Advances and first light with segments cophasing.

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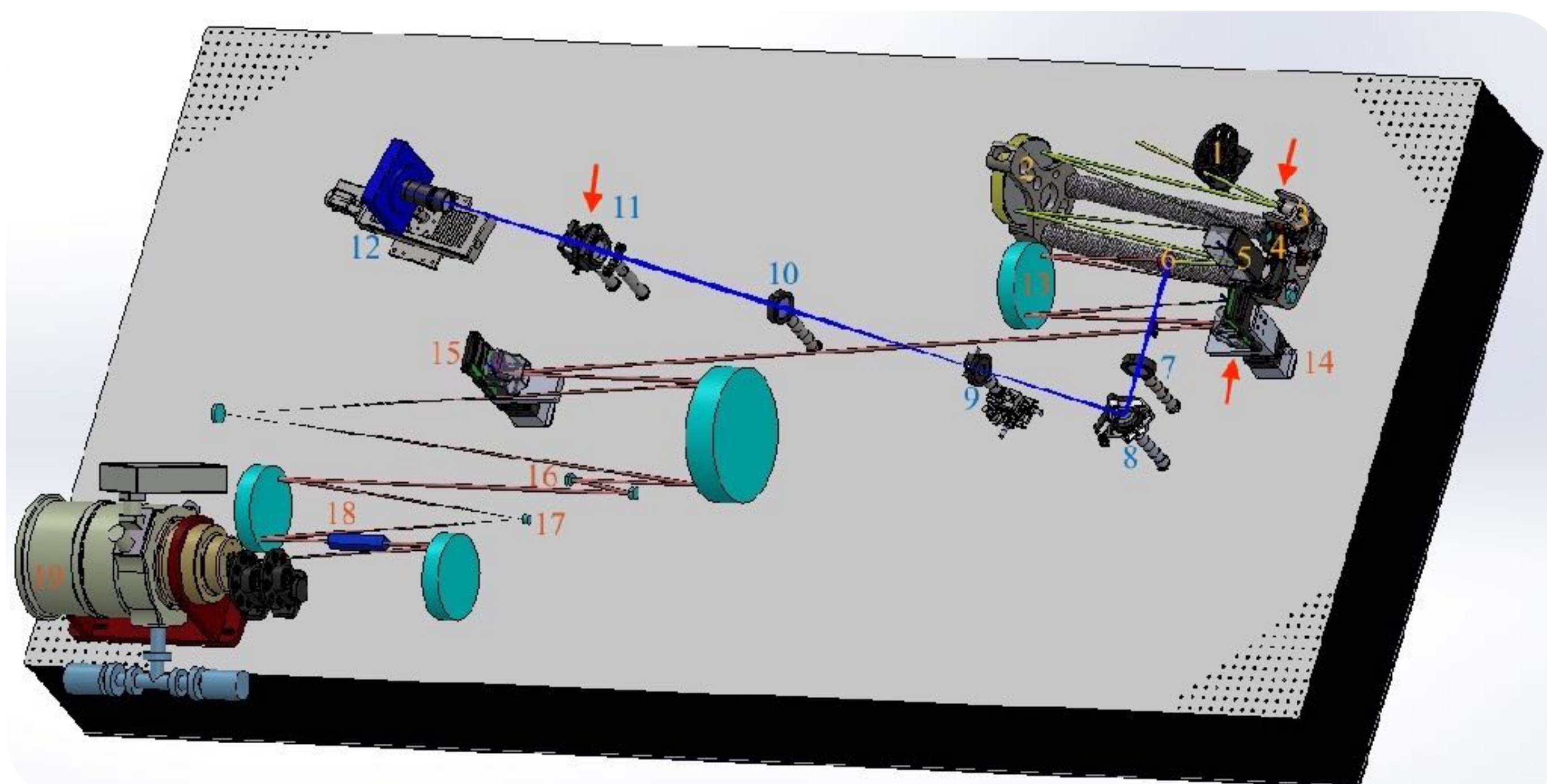
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^{*} See paper (1) for full references

SPEED
Segmented-Pupil Experiment for Exoplanet Detection

THE SPEED RECIPES



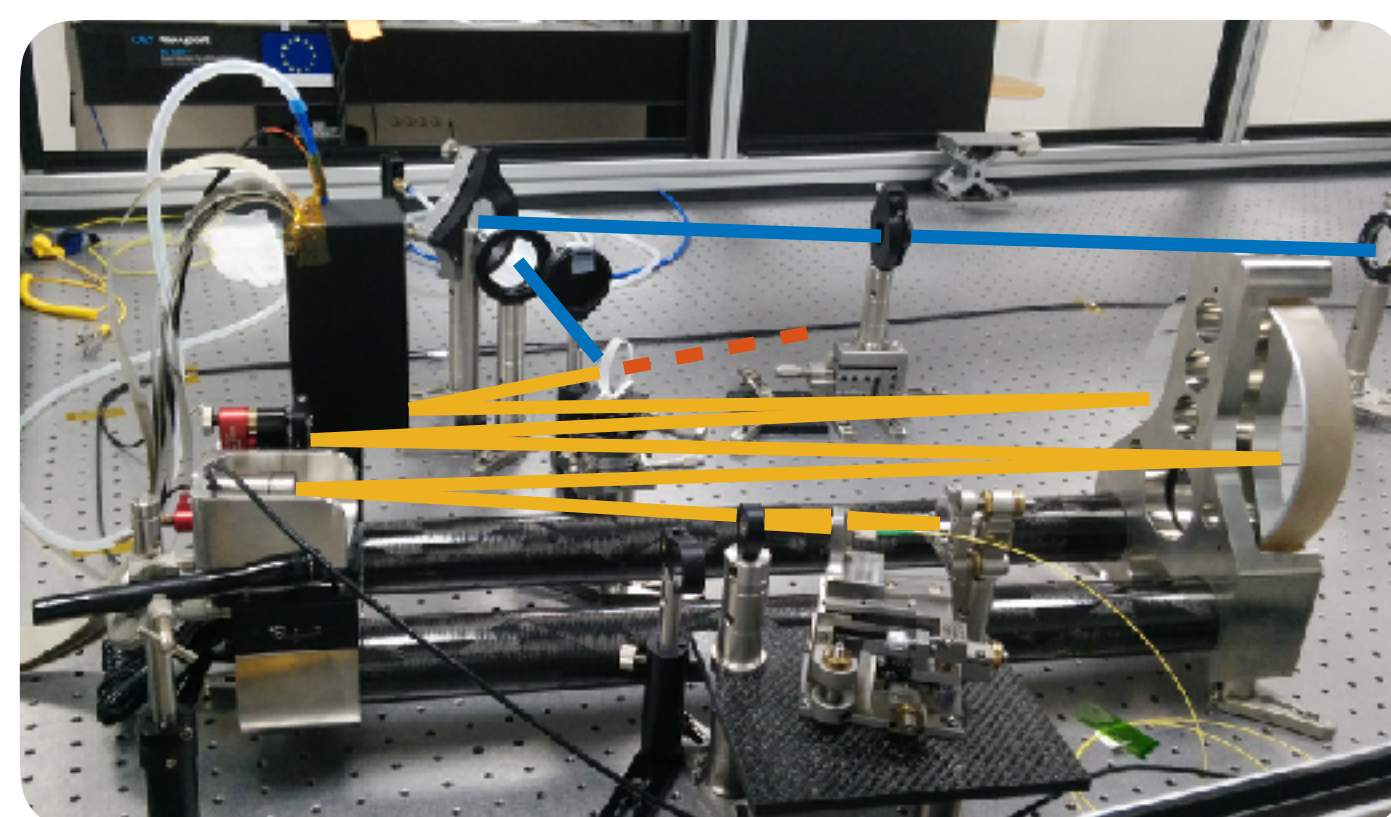
3D view of the SPEED bench. Blue rays stand for the visible path, red rays for infrared path and yellow rays for common path

- * **Common path** simulating a **segmented architecture telescope** (169 segments IrisAO deformable mirror on n°5),
- * **Visible path** dedicated to **cophasing aspects** (SCC-PS scheme with **FQPM** on n°9 and **modified Lyot stop** on n°11),
- * **Infrared path** dedicated to **high contrast imaging** (**two continuous deformable mirrors** for dark hole strategies on n°14 and 15 and a **PIAACMC coronagraph** on n°16 and 17).

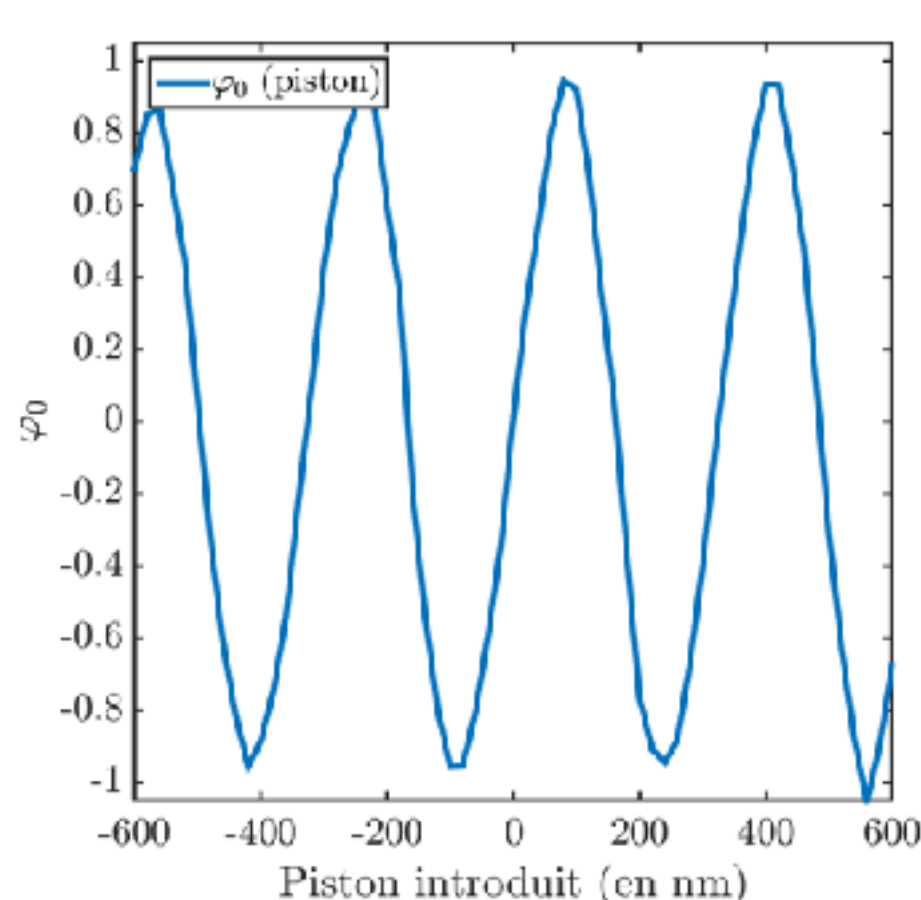
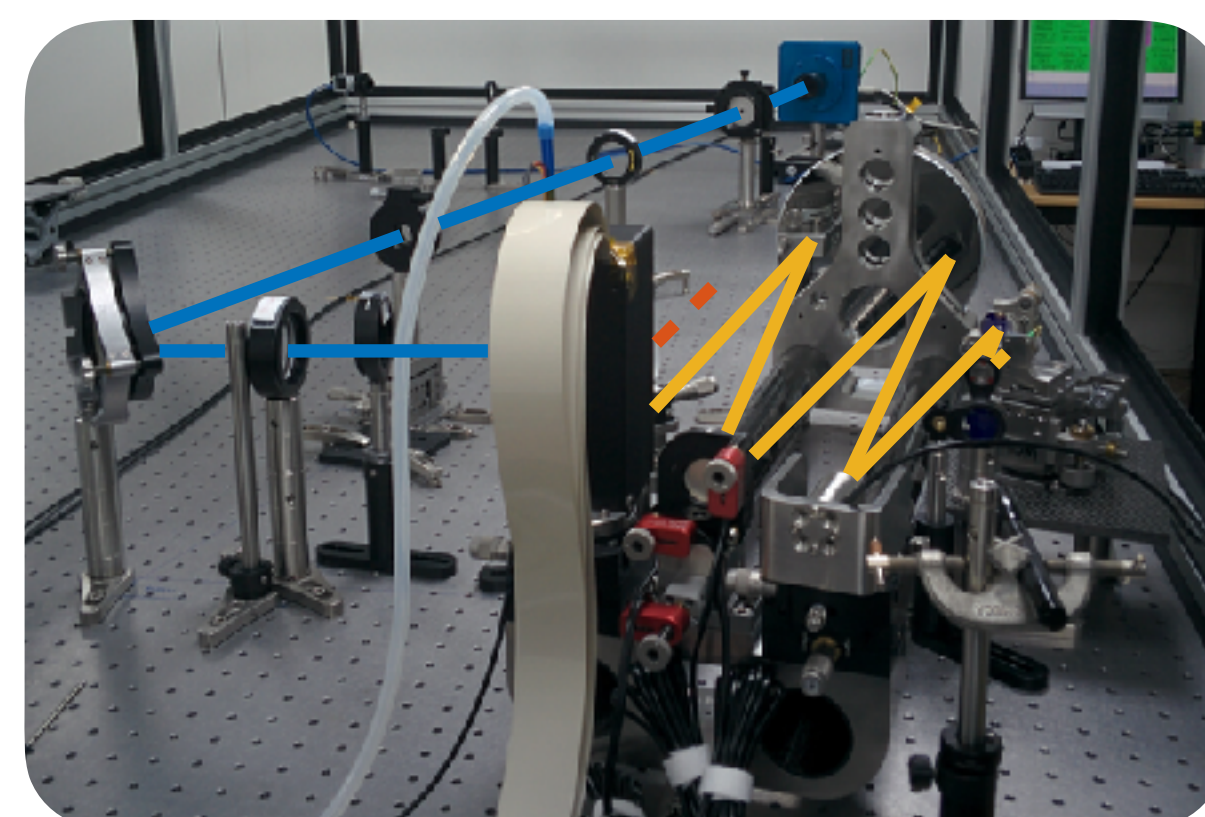
High throughput coronagraphy at close separation ($\sim \lambda/D$) with wavefront control and shaping for phase and amplitude correction under ELT-like conditions.

VISIBLE PATH INTEGRATION

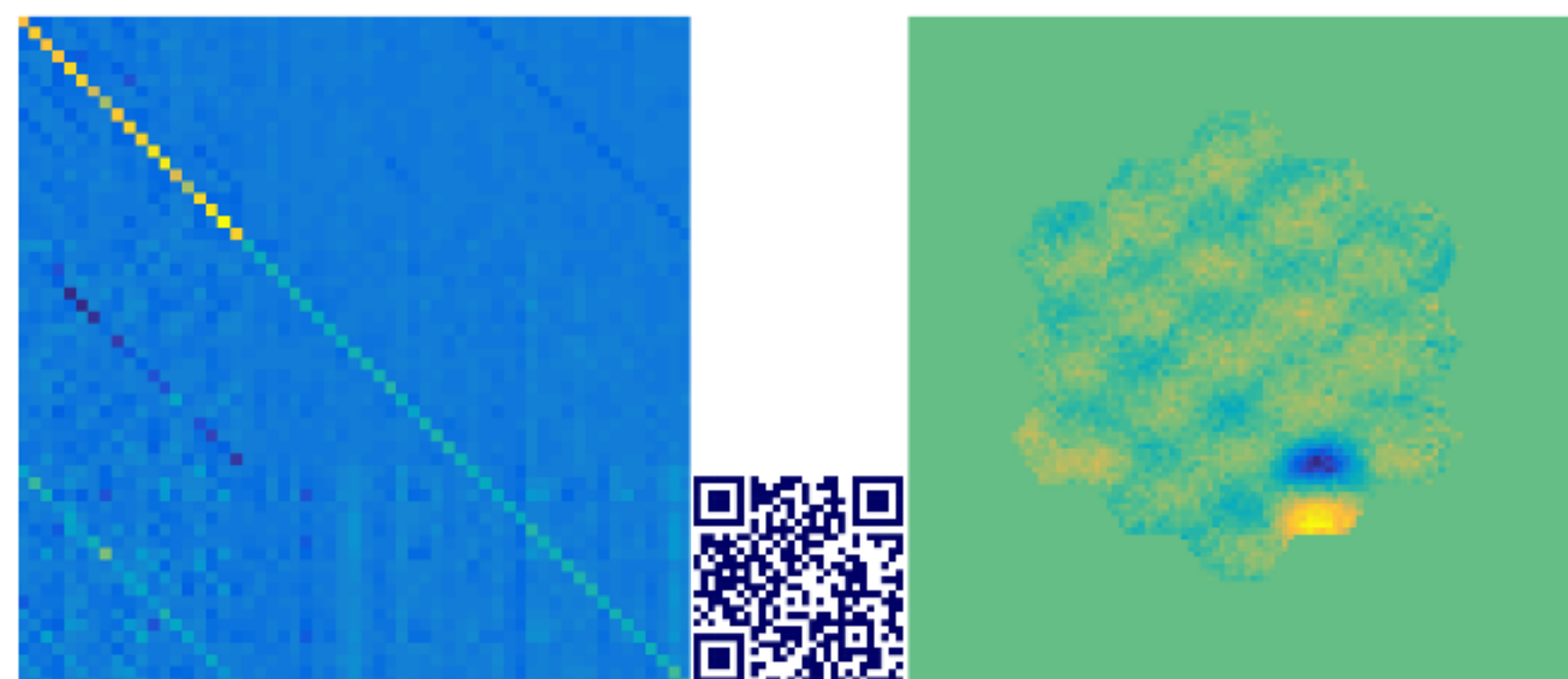
- * The **visible path** is now integrated on the **SPEED testbed**. And the **first characterizations** have been conducted,
- * Measurement of **off-axis PSF** and **FQPM coronagraphic image**,
- * **Piston and tip-tilt response** of the **central segment** of a 19 segments pupil,
- * **Building of the calibration matrix**.



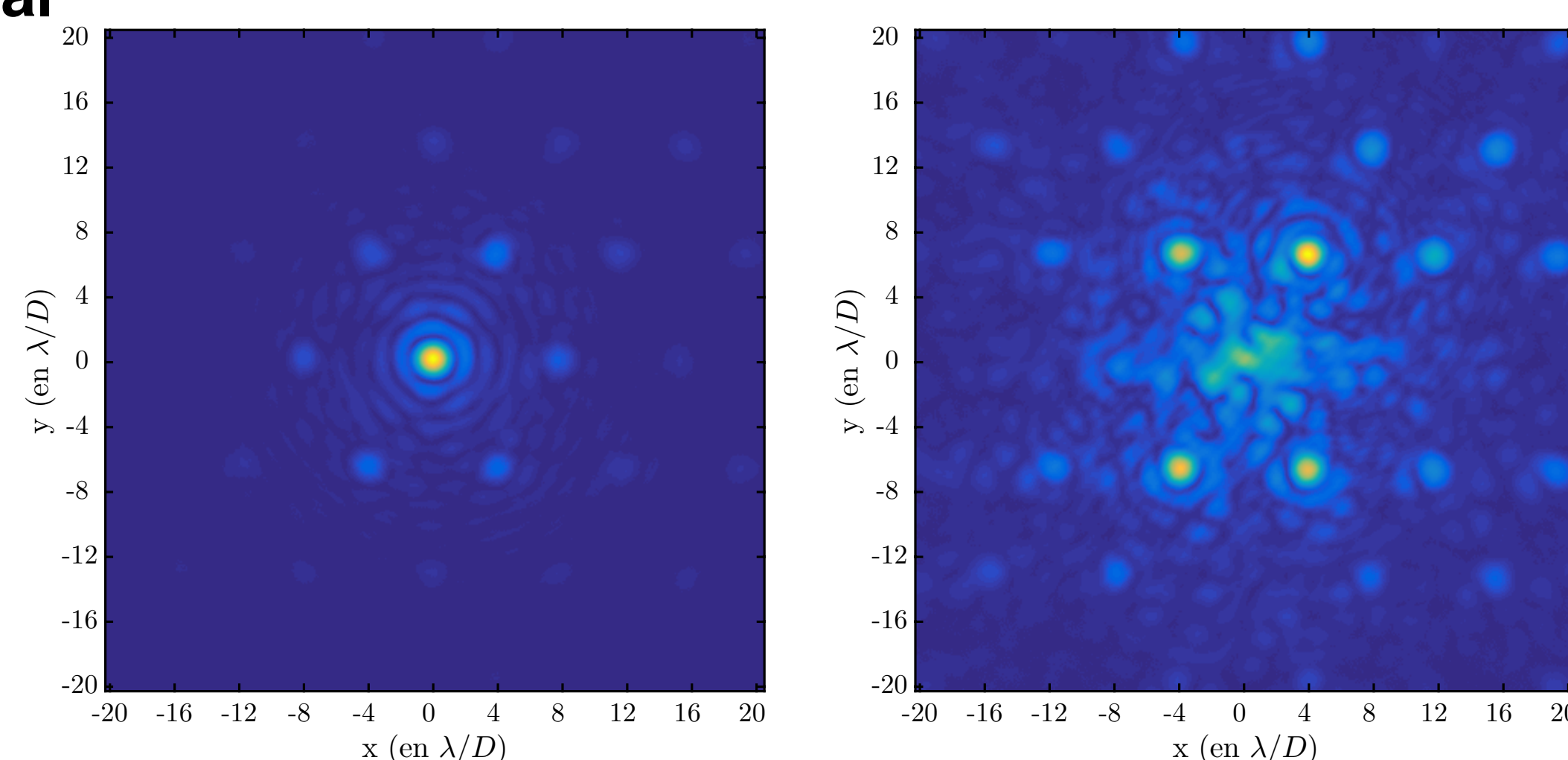
Common and visible path of the SPEED testbed.



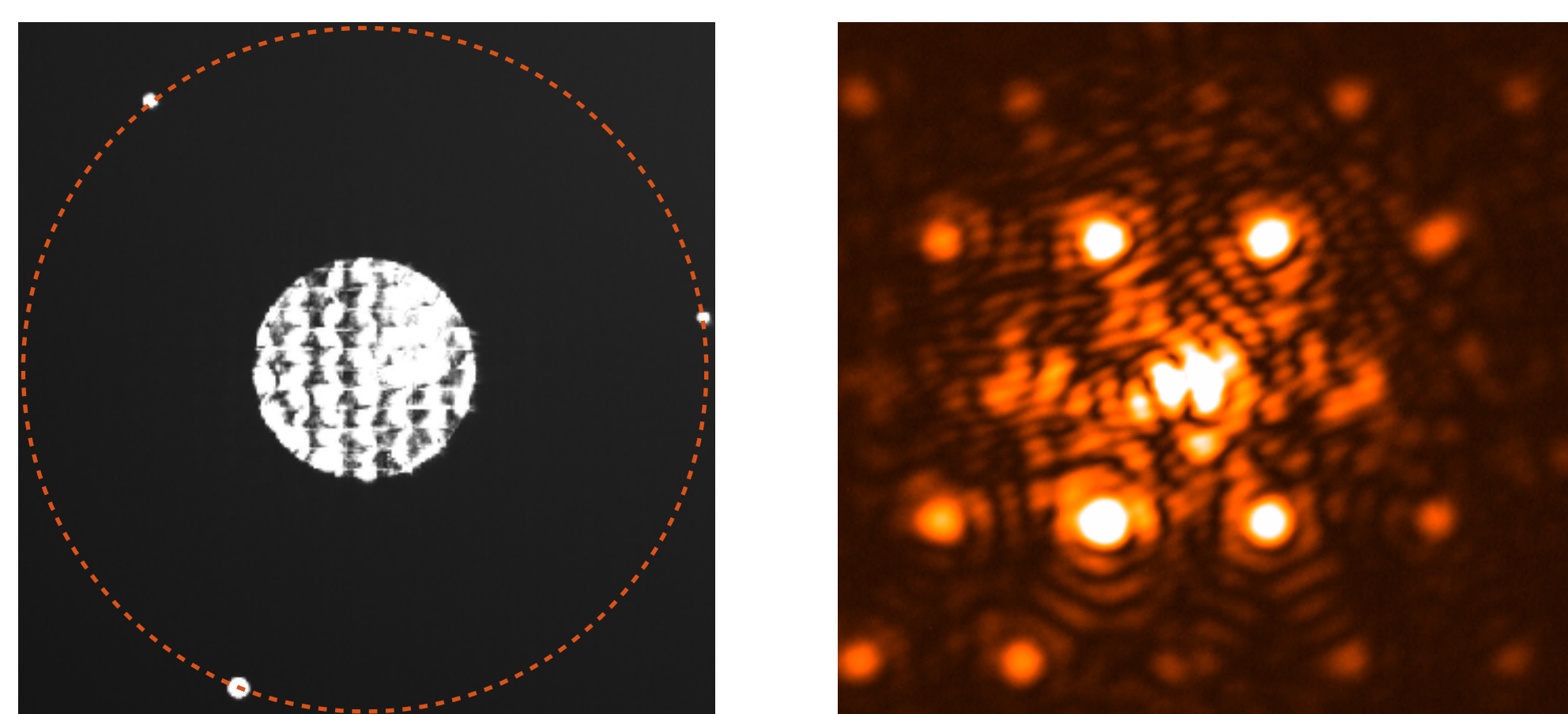
Piston response curve (left) along with the last iteration image (left)



Interaction matrix (left) and the SCC-PS image of the last iteration (right).



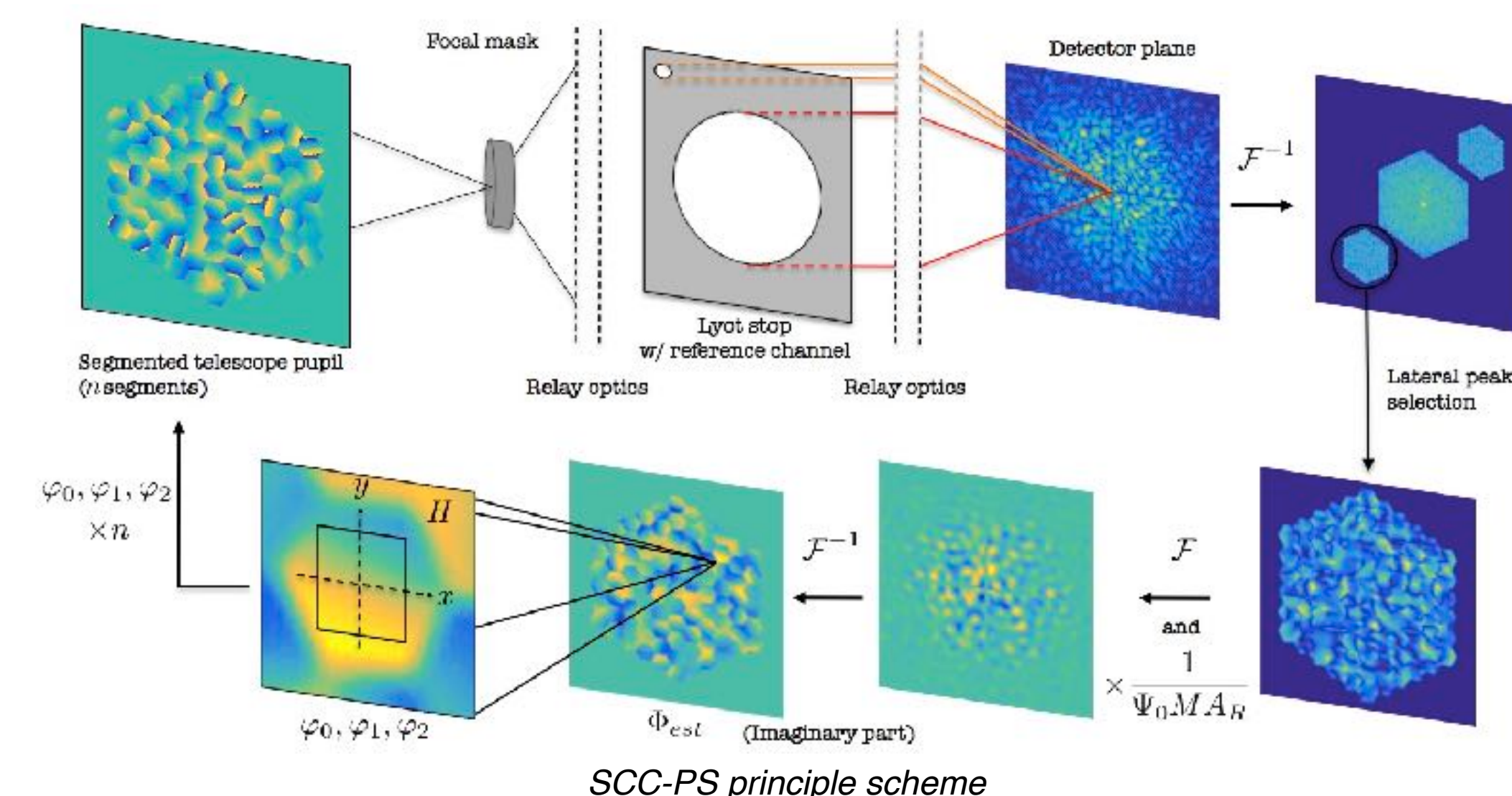
Off-axis PSF (left) and FQPM coronagraphic image (right) taken on the SPEED bench.



Pupil plan image with the three SCC-PS references (left) and fringed focal plan image (right).

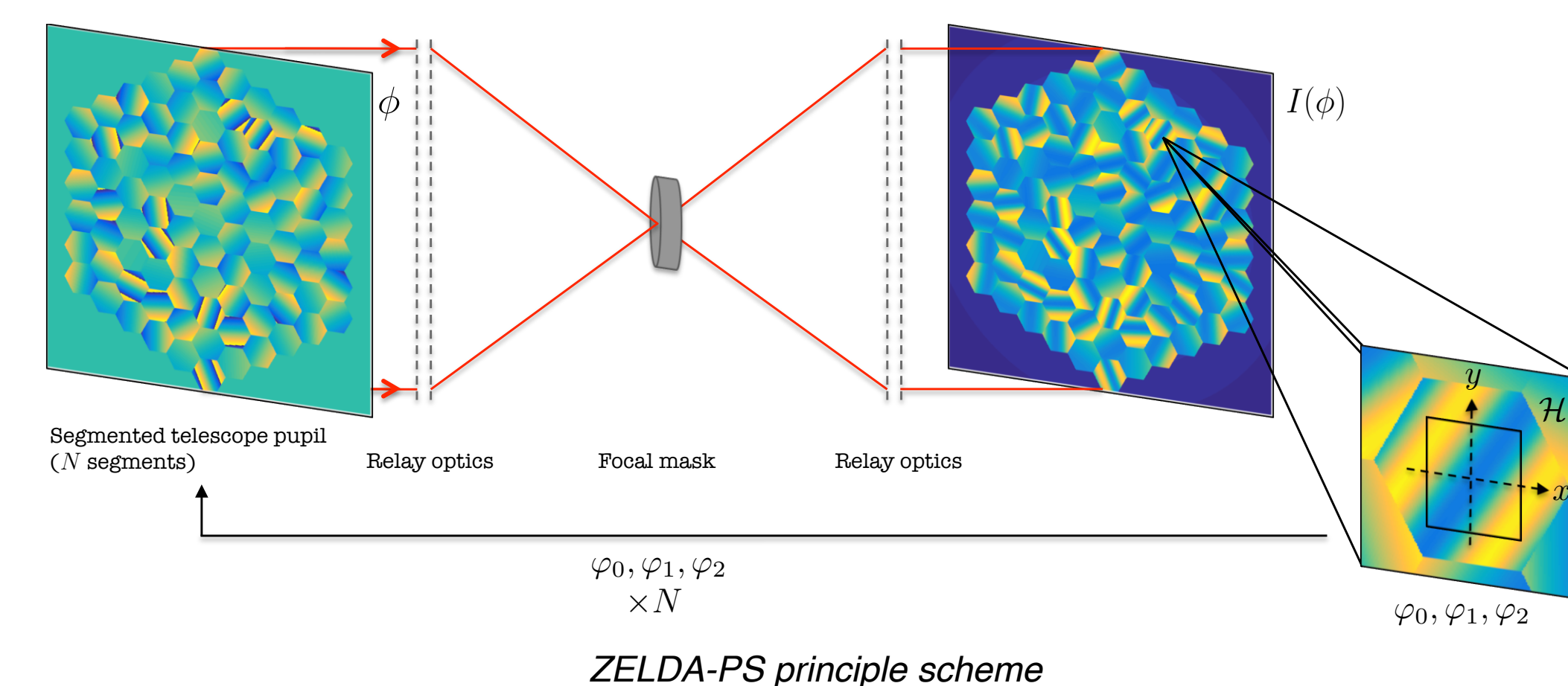
COPHASING TECHNIQUES

SCC-Phasing Sensor (2)



- * **Focal plan measurement** of the phase aberrations,
- * Based on a **modified coronagraphic setup**. **Phase information** is encoded in the **interference fringes** present in the focal plan.

ZELDA-Phasing Sensor (3)



- * **Pupil plan measurement** of the phase aberrations,
- * Based on the **Zernike phase mask ZELDA** where **phase** is directly retrieved in the pupil plan.

- * Development of **new concepts** of **focal phase** or/and **amplitude masks**,
- * Test of the SCC-PS algorithm in **numerical simulations** with different types of coronagraphs.

REFERENCES

- (1) Martinez *et al.*, "The Segmented Pupil Experiment for Exoplanet Detection : 3. advances and first light with segments cophasing," in [Society of Photo-Optical Instrumentation Engineers (SPIE) Conference Series], Society of Photo-Optical Instrumentation Engineers (SPIE) Conference Series 10703, 14 (June 2018).
- (2) Janin-Potiron *et al.*, "Self-coherent camera as a focal plane fine phasing sensor," A&A (2016).
- (3) Janin-Potiron *et al.*, "Fine cophasing of segmented aperture telescopes with ZELDA, a Zernike wavefront sensor in the diffraction-limited regime," A&A (2017).

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