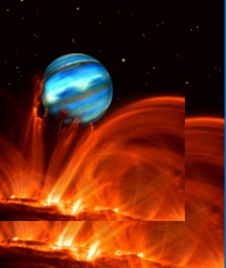
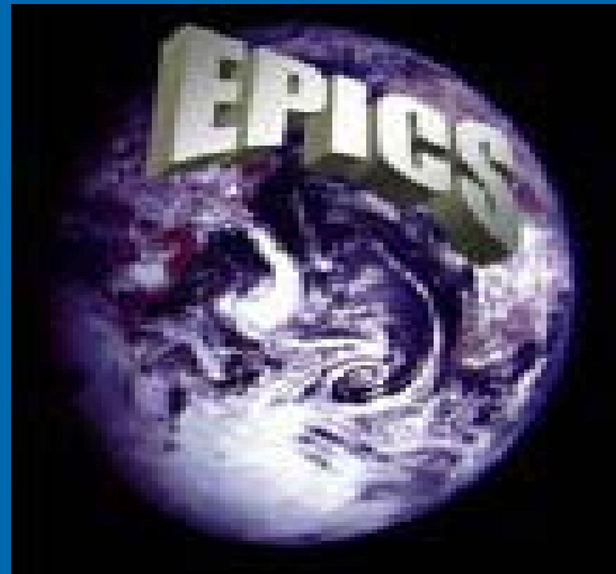




EPICS: imaging exo-planets with E-ELT

Raffaele Gratton, Markus Kasper & Cristophe Verinaud

Science Motivation

The EPICS instrument shall be optimized, and trade-offs made, based on the following prominent science cases:

1. Young self-luminous gas giants in star forming regions or young associations. *Determine frequency and mass distribution of giant planets*

2. Detection and characterization of mature gas giants at orbital distances between ~5 and 15 AU in the solar neighbourhood (< ~20 pc)

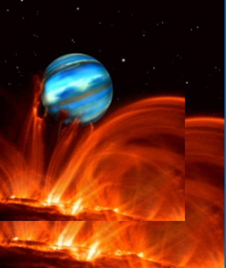
3. Imaging and characterization of warm or young Jupiters that have been previously discovered by radial velocity searches or direct imaging with smaller telescopes. *Understand giant planets' atmospheric composition and structure*

4. Detection and 1st order characterization of warm Neptunes and massive rocky planets and super-Earths around very nearby stars (≤ 10pc) with the ultimate goal of detecting such planets located in the HZ (for M-dwarfs and very close systems < 4 pc)

Top Level Requirements

6a Contrast Requirements Y-H band (10h telescope time, reference seeing conditions, 5s detection):

Brightness ratio at Distance [mas]	30	100	300	Limiting stellar magnitude I band
Science Case 1	10^{-6}	10^{-6}	10^{-6}	9 (goal 10)
Science Case 2		$2\ 10^{-9}$ (goal 10^{-9})	10^{-9} (goal $4\ 10^{-10}$)	7 (goal 8)
Science Case 3	10^{-8}	10^{-9}	10^{-8}	7 (goal 8)
Science Case 4	$2\ 10^{-9}$ (goal 10^{-9})	10^{-9} (goal $4\ 10^{-10}$)	$5\ 10^{-10}$ (goal $2\ 10^{-10}$)	5 (goal 6)

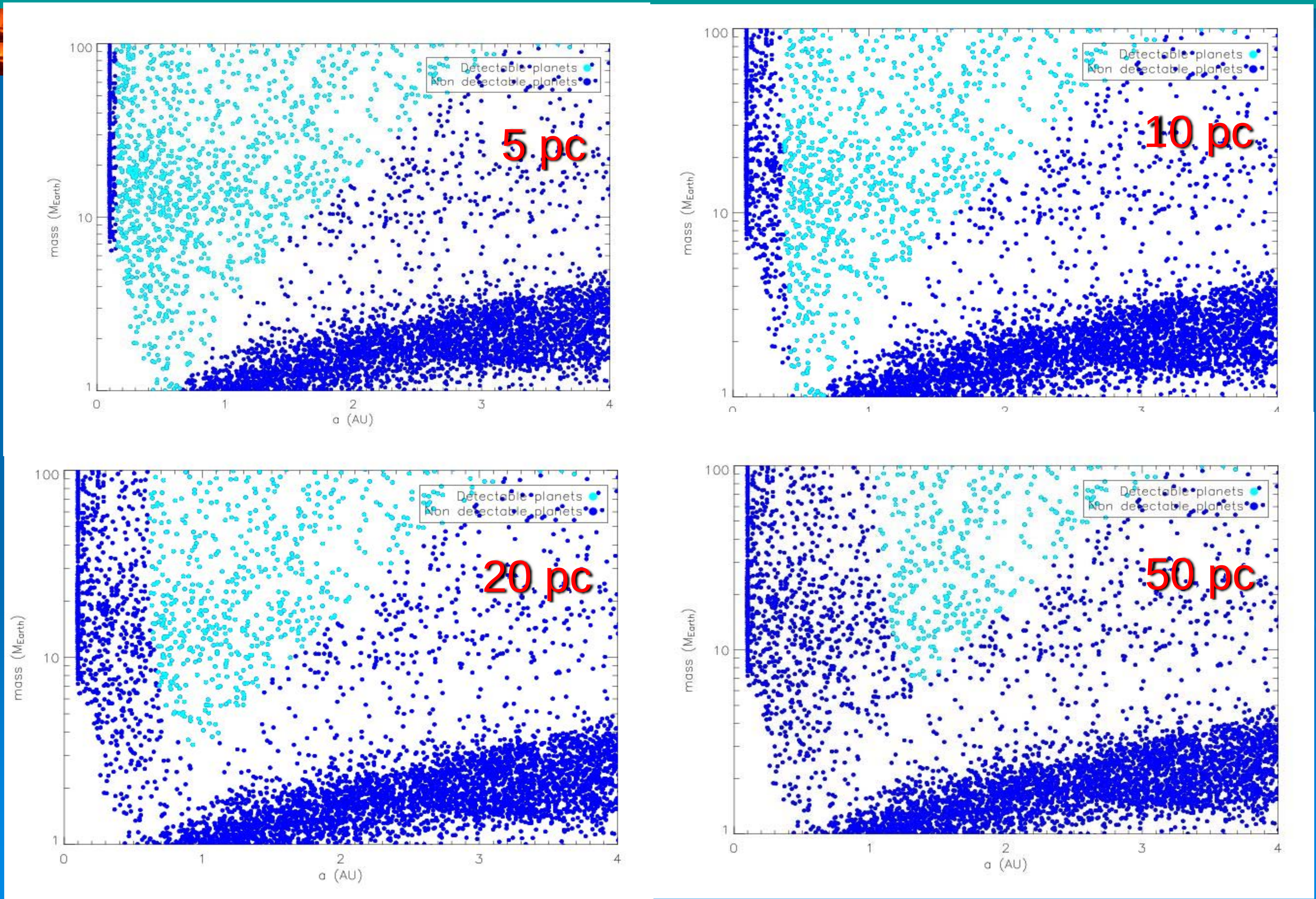


Top Level Requirements

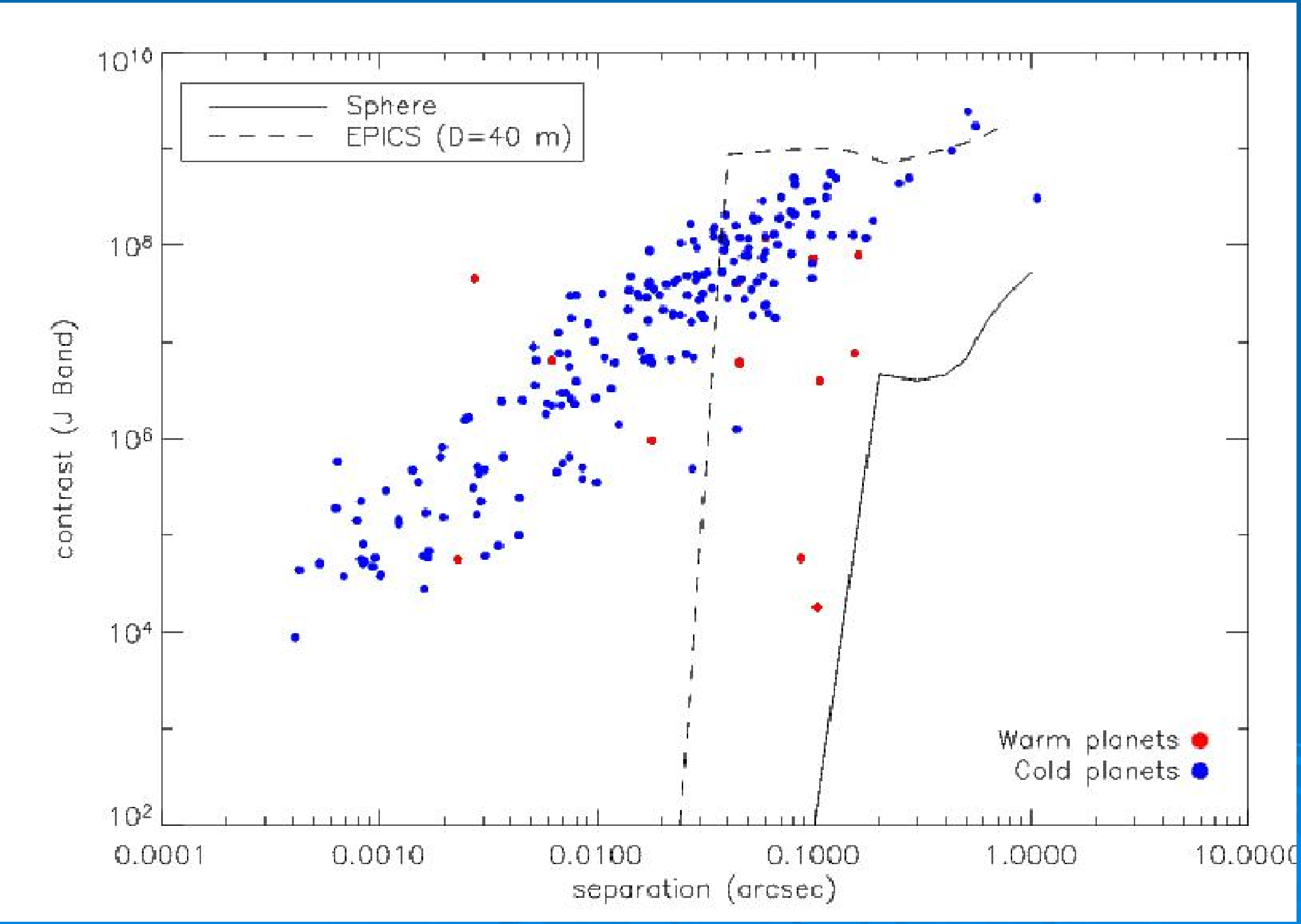
6b Contrast Requirements I-z band (10h telescope time, reference seeing conditions, 5s detection, for differential signal contrast (I1(planet)-I2(planet))/(I1(star)+I2(star)) where I1 and I2 are fluxes in two spectral bands (on/off CH4 absorption) or I(parallel) and I(perpendicular) for polarimetry:

Brightness ratio at Distance [mas]	30	100	300	Limiting stellar magnitude I band
Science Case 2		$2\ 10^{-9}$ (goal 10^{-9})	10^{-9} (goal $4\ 10^{-10}$)	7 (goal 8)
Science Case 4	$2\ 10^{-9}$ (goal 10^{-9})	10^{-9} (goal $4\ 10^{-10}$)	$5\ 10^{-10}$ (goal $2\ 10^{-10}$)	5 (goal 6)

Detection of rocky planets



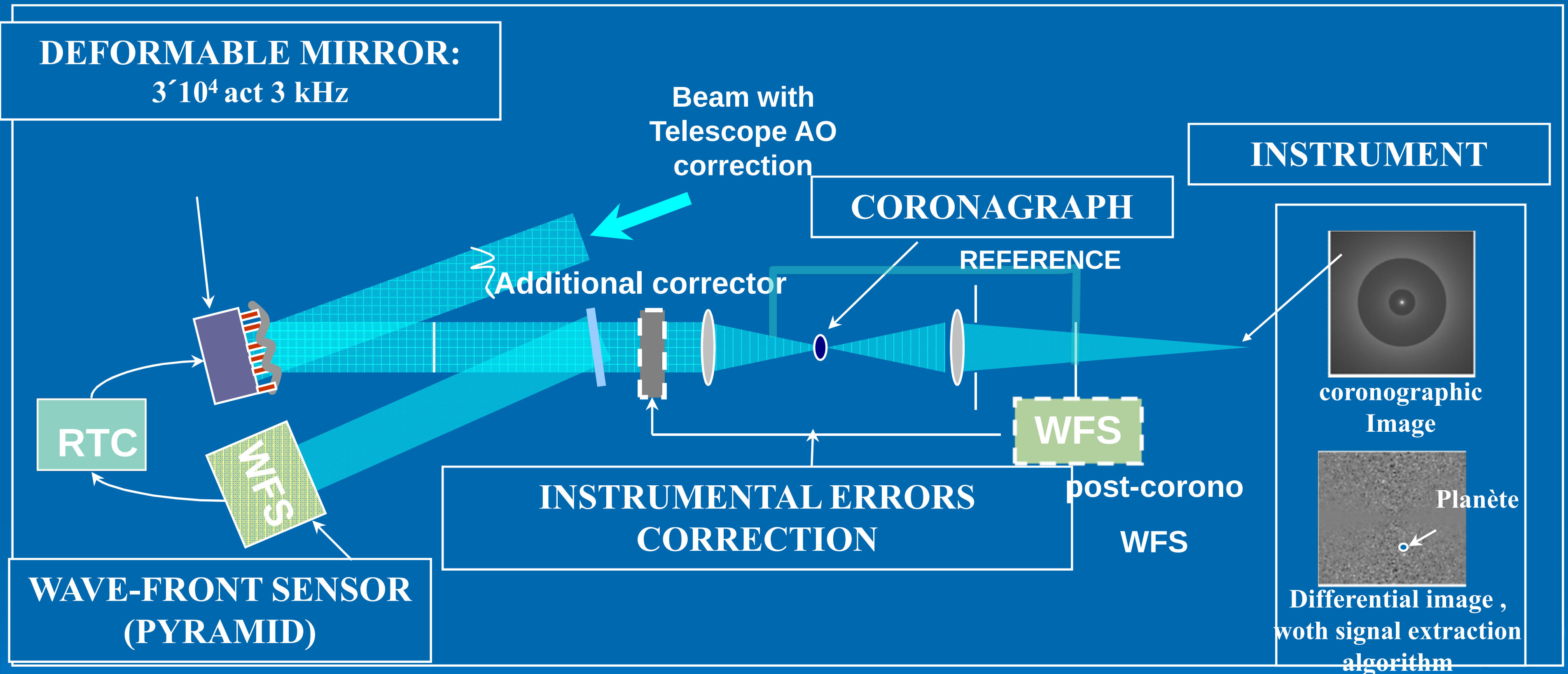
Giant planets from RV surveys



EPICS Consortium

ESO (PI institute, M. Kasper):	Management, coro, HOT facility, science
LAOG (Co-PI institute, C. Verinaud):	Management, simulations, XAO+FPWS, system design
LAM:	Coro, DZ
LESIA:	Coro, SCC
LUAN:	Coro
Padova observatory:	IFS, science
Oxford University:	IFS
ASTRON, UvA, UU:	ZIMPOL
ETH Zurich:	ZIMPOL
ONERA:	wavefront control consulting
MPIA:	IFS DRH

EPICS concept



-Integral Field Spectrograph

-Differential Polarimeter

-Self-Coherent Camera

Laboratory demonstration of accurate and efficient nanometer-level wavefront control for extreme adaptive optics

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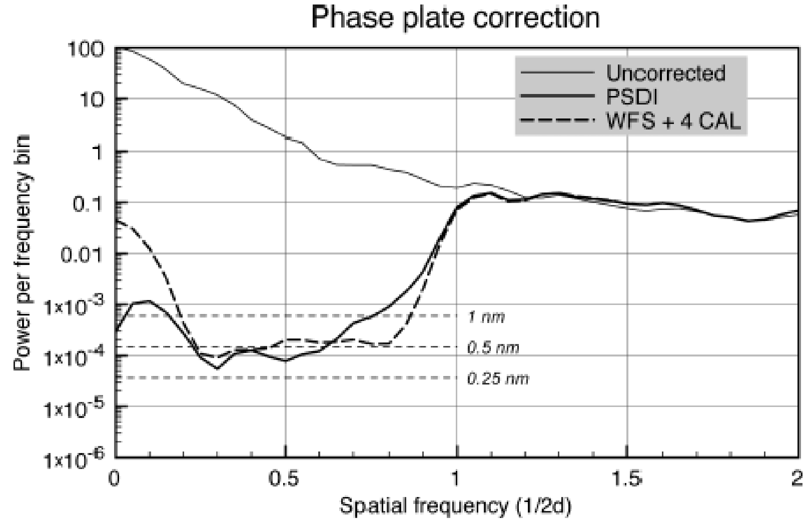

Fig. 7. Radial averages of the spatial PSD of residual error in the case of correcting an atmosphere-like phase plate after calibration of references. The WFS–FTR references were updated using the residual phase measurements provided by the PSDI. This substantially improves the depth of the dark hole, and most of it is corrected to the 0.5 nm rms level, equivalent to the PSDI correction.