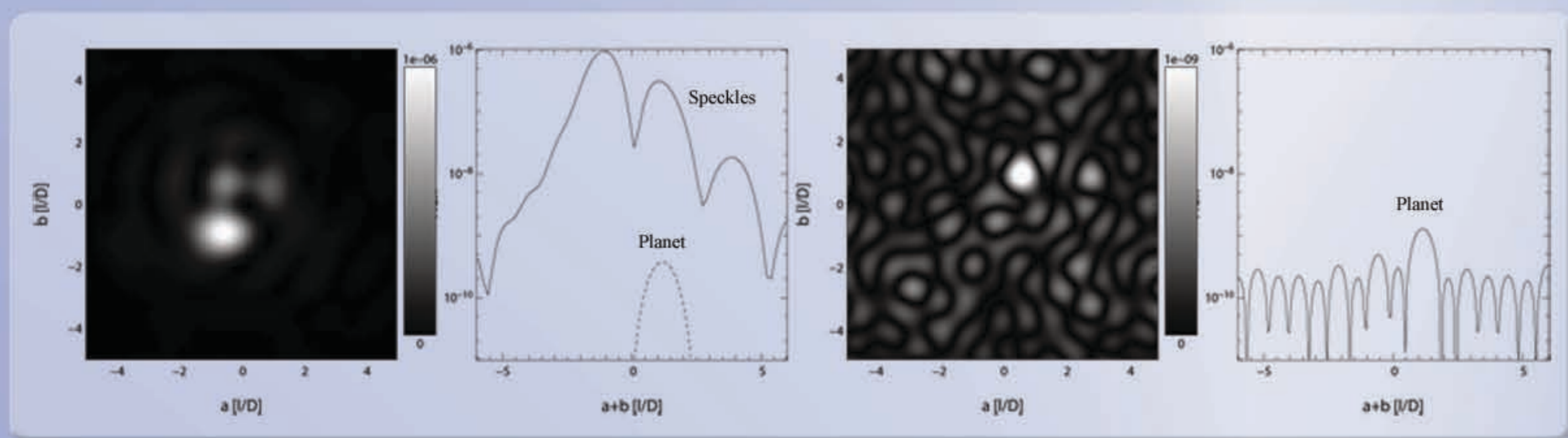
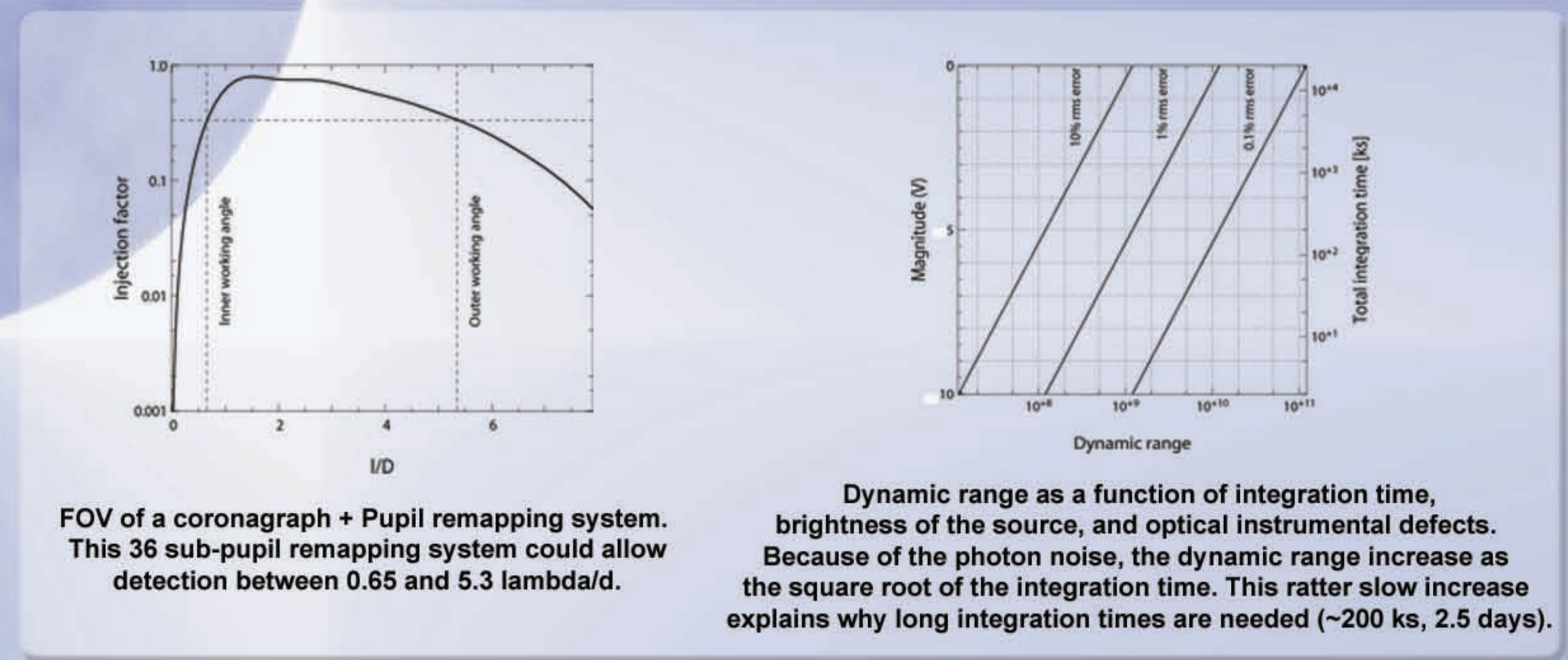
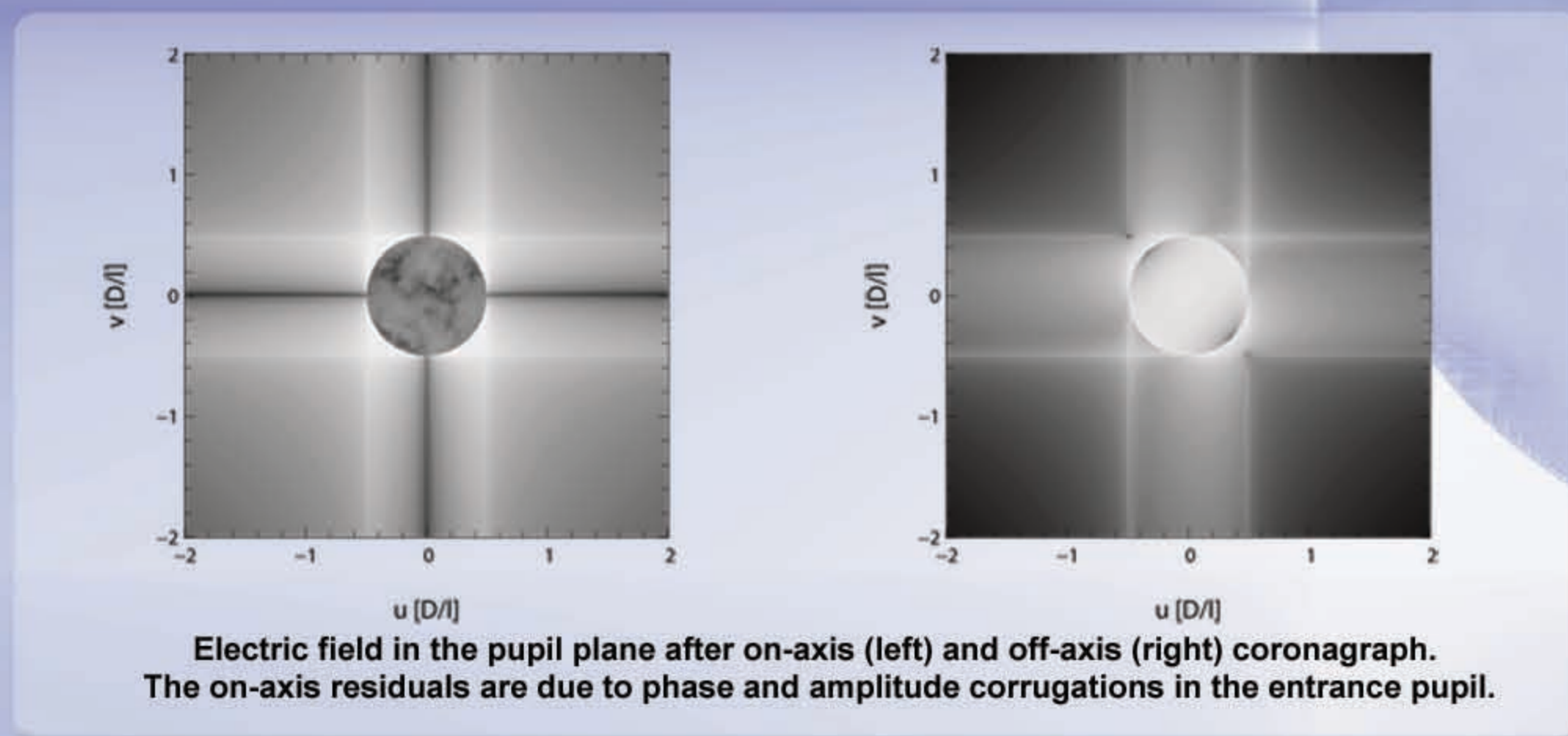
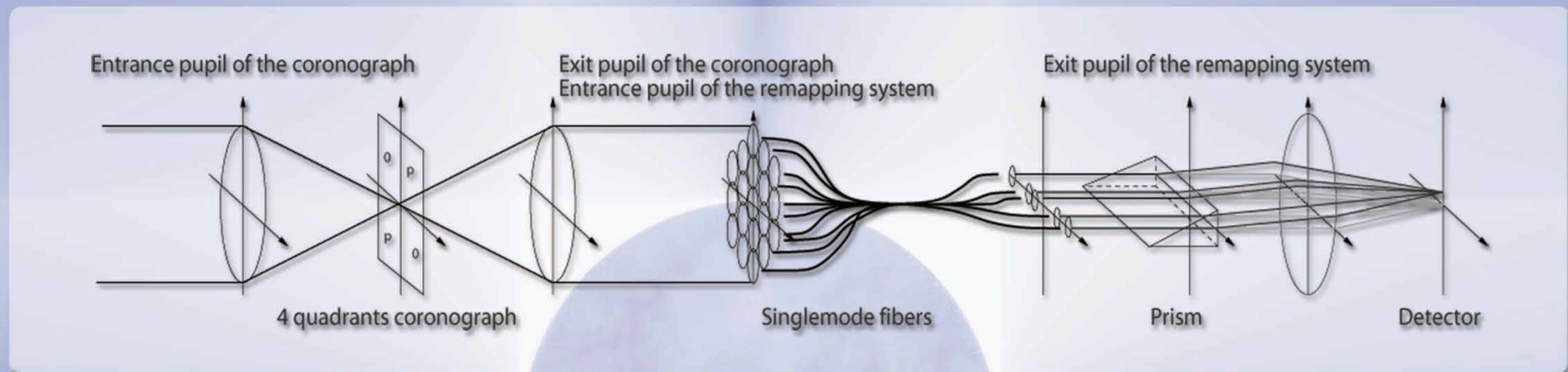


SELF-CALIBRATION OF CORONAGRAPHIC OTF : A SINGLE-MODE REMAPPING SYSTEM

S.LACOUR¹, G. PERRIN², P. TUTHILL¹, T. KOTANI², E. THIEBAUT³
¹ SYDNEY UNIVERSITY ² OBSERVATOIRE DE PARIS ³ OBSERVATOIRE DE LYON

We propose here an instrumental setup allowing self calibration of the optical transfer function (OTF). The goal is to enable the instrument to detect extrasolar planets at very small angular distance from their parent star, between 0.7 to 5 λ/d . The concept is based on the fact that, in this zone, the detection is limited by the optical defects instead of the photon noise. To do so, a 4 quadrant coronagraph (Rouan et al. 2004) is complemented by a pupil remapping system, as described in Perrin et al. (2006). Since it allows self-calibration of the OTF, the remapping system disentangles instrumental perturbation from astrophysical information. Finally, to allow detection of the hypothetical biomarkers, the exit pupil is dispersed through a prism, before being focused on the detector.



THE TWO LEFTS PANELS REPRESENT THE SIMULATED PSF OF A STAR CENTRED ON A CORONAGRAPHIC SYSTEM. WE SIMULATED OPTICAL DEFECTS EQUALS TO 1% RMS OF THE COMPLEX TRANSMISSION IN THE PUPIL (AMPLITUDE AND PHASE). ON THE TWO RIGHT PANELS IS PRESENTED THE SAME IMAGE AFTER SELF-CALIBRATION AND SUBTRACTION OF THE PSF OF THE STAR. THE SIMULATION SETUP CONSISTS OF A 1.5 METERS SPACE TELESCOPE, OBSERVING A MAGNITUDE 5 STAR SITUATED AT 15 PC. THE EXTRASOLAR PLANET HAS A 1 AU ORBIT AND REFLECTS THE LIGHT OF THE PARENT STAR WITH A CONTRAST RATIO OF 1E-9. THE TOTAL INTEGRATION TIME IS 200 KS, AND THE OTF IS SELF-CALIBRATED ACCORDING TO LACOUR ET AL. (2007).

ADVANTAGES OF THIS SYSTEM ARE TWOFOLD :

FIRST, IT ALLOWS SELF-CALIBRATION OF ANY TIME-DEPENDENT OTF :
 SPECKLE NOISE DOES NOT EXIST ANYMORE;
 PHOTON NOISE LIMITS THE DYNAMIC RANGE.

SECONDS, IT GIVES INTENSITY MAP AT THE DIFFRACTION LIMIT OF THE TELESCOPE. THE INNER WORKING ANGLE IS DEFINED BY THE REJECTION OF THE CORONAGRAPH, THE OUTER WORKING ANGLE BY THE FIELD OF VIEW OF THE SINGLE-MODE FIBERS.

References :
 Lacour S., Thiébaud, E., & Perrin, G. 2007, MNRAS, 374, 832
 Perrin G., Lacour S., Woillez J., & Thiébaud E. 2006, MNRAS, 373, 747
 Rouan D., Riaud P., Boccaletti A., Clénet Y., & Labeyrie, A. 2000 PASP, 112, 1479