A multi-channel system for the E-ELT

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The E-ELT

primary mirror (D) / AP	:	39 000 mm /	37 000 mm
Nasmyth focal length (F)	:	646 793 mm	focal ratio D:F = 1:17.481

Instrument/Detector definition

detector	:	CCD 4k×4k, 15μm/pix & HAWAII 4k×4k, 15μm/pix

The focal reducer; collimator

field	:	2′ × 2′	1′ × 1′
reduction factor	:	300×	400×
aperture (diam. D)	:	130/123.3 mm	97.5/92.5 mm
focal length	:	2156 mm	1617 mm
# of channels	:	max 3	max 9
Lens diam. (max)	:	575 mm	300 mm

The focal reducer; camera

focal length (F; camera only)	:	350 mm	525 mm
focal length (total)	:	105 000 mm	210 000 mm
reduction factor	:	6.16×	3.08×
D:F	:	1:2.8	1:5.67
detector field radius	:	86.9/43.4 mm; □ 61.44×61.44 mm^2	

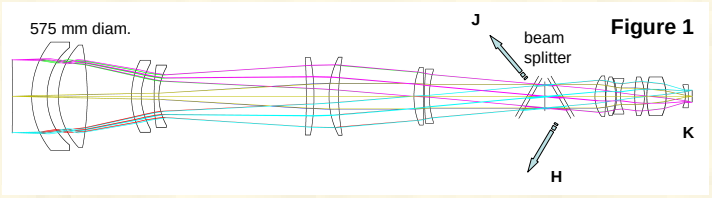

Figure 1

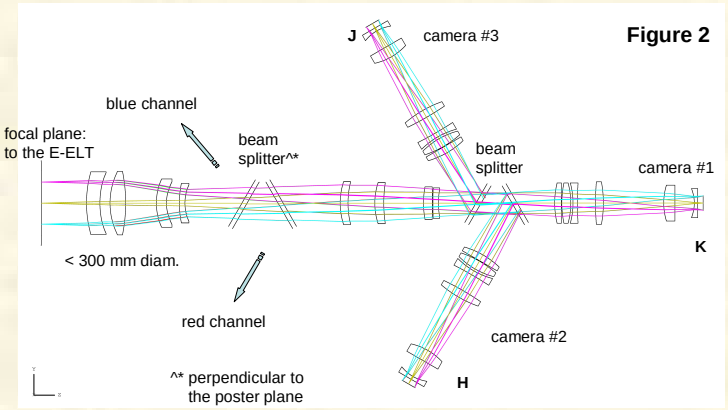

Figure 2

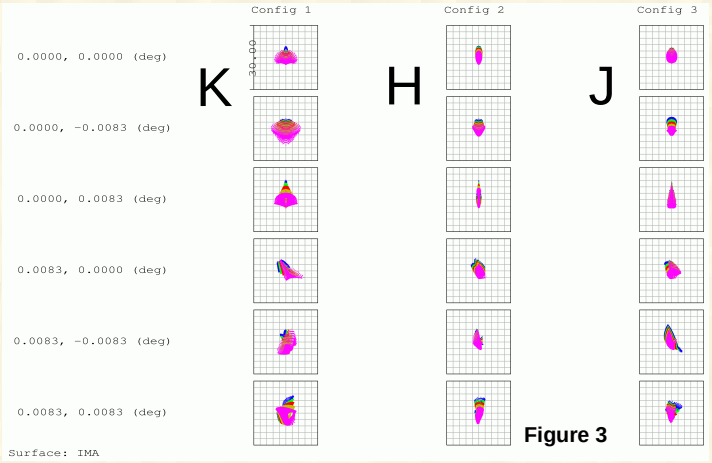

Figure 3

Motivation

Simultaneous imaging from the optical to the NIR bands is desirable for any kind of variability studies (e.g., variable stars, asteroids), time critical observations of transients (e.g., GRBs, Novae, Exoplanet transits), and even stationary sources (e.g., Lyman dropped out galaxies, QSOs). In addition, there is a financial aspect (the observing time used) as well as a technical point (how many instruments mounted) that speaks in favor of a multi-channel imager from the optical to the NIR bands.

What is shown here

We present the results of an optical design study of a multi-channel imager for the 39-m E-ELT, covering the wavelength range from 1100 nm to 2300 nm (3-channel solution) and 400 nm to 2300 nm (8-channel solution), respectively.

The basic concept: a JHK imager

The basic parameters of the optical system are given in the table, its basic design for a JHK imager with a usable field of view of 2'x2' is shown in **Fig. 1.** It is based on previous contributions by one of us (U.L.) for CAFOS, MOSCA, & PMAS on Calar Alto, Spain, and profited from the lessons we have learned during the development of GROND for La Silla, Chile (PI: J.G.; see references).

The 8-channel solution and a spectrograph

Figure 2 shows the expansion of the optical solution to an 8-channel camera by including two beam splitters in the collimator, allowing for a simultaneous imaging in g'r'i'z'YJHK (in principle, a 9th channel would be available, too). The usable field of view here is 1'x1'. Alternatively, by adding grisms, the system could be transformed into an E-ELT/X-Shooter system.

Image Quality

Figure 3 shows a spot diagram of the presented system for the JHK bands. The box size is 30 x 30 µm^2 (2x2 pixels), corresponding to 0.06 x 0.06 arcsec^2 (3-channel solution) and 0.03 x 0.03 arcsec^2 (8-channel solution), respectively. Shown are various spot positions starting from the image center (0,0) to the edge of the field. The configurations #1 to #3 correspond to the three camera systems shown in Fig. 2.

References: Greiner, J. et al. 2008, PASP 120, 405; Laux, U.; Astrooptik; Verlag Sterne & Weltraum 1999; CAFOS: http://www.caha.es/alises/cafos/cafos.html; GROND: http://www.mpe.mpg.de/~jcg/GROND/; MOSCA: http://www.caha.es/aguirre/mosca/mosca.html; PMAS: http://www.aip.de/pmas/OptI_pmas.html