
Exoplanets by Opto-infrared Polarimetry and Spectroscopy CHaracterizing EXoplanets

The CHEOPS Project: Characterizing Exoplanets by Opto-infrared Polarimetry and Spectroscopy

M. Feldt

Max Planck Institute for Astronomy

Padova Observatory

ETH Zurich

University of Amsterdam

Leiden Observatory

Astrophysical Institute Jena

State Observatory Tautenburg

Faculty of Sciences, Univ. of Lisbon

University of Padova

Naples Observatory

Outline

- What is CHEOPS?
- Who is doing CHEOPS?
- Techniques
- Programme
- The Instrument
- Outlook

What Is CHEOPS?

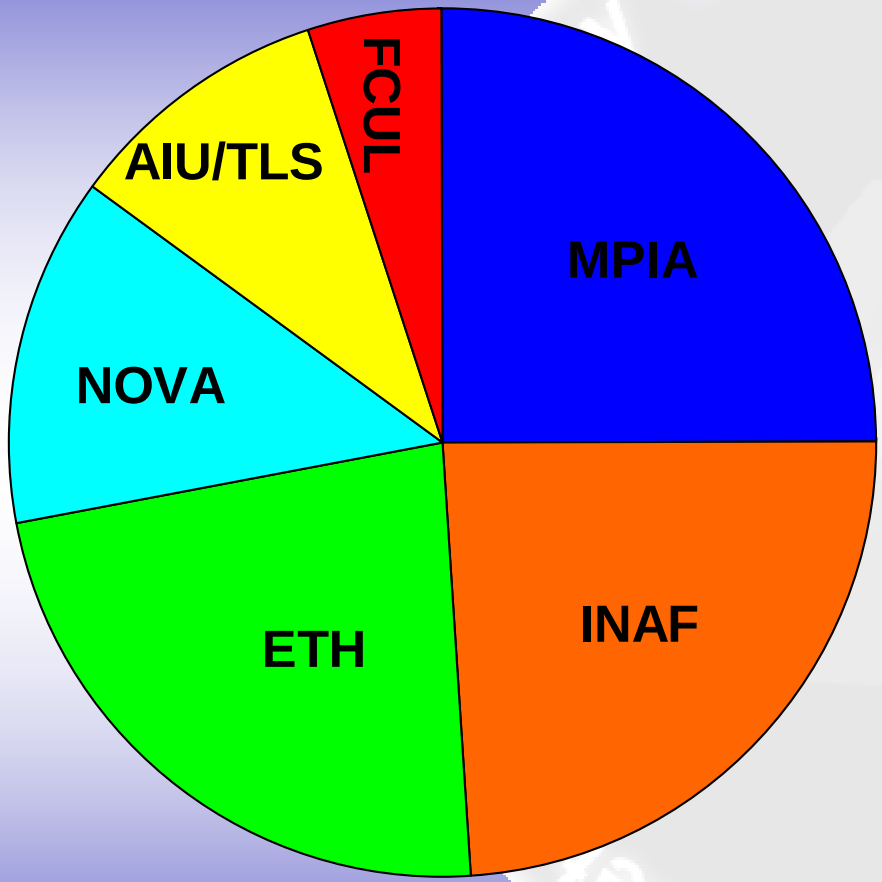
- Feasibility study “Direct detection of exoplanets“
- Conceptual design of a „Planet Finder“ as a 2nd-Generation VLT Instrument for ESO
- Technical requirements for a high-contrast / XAO instrument
- Demonstration experiments
- Conceptual design
- Planning of a science program for direct detection of:
  - Old, Jupiter-like planets in nearby (<15 pc) systems
  - young, still warm planets in up to 100 pc distance
  - studies in the immediate environment of bright (guide) stars
- Suggest operation model for a survey

Key Science

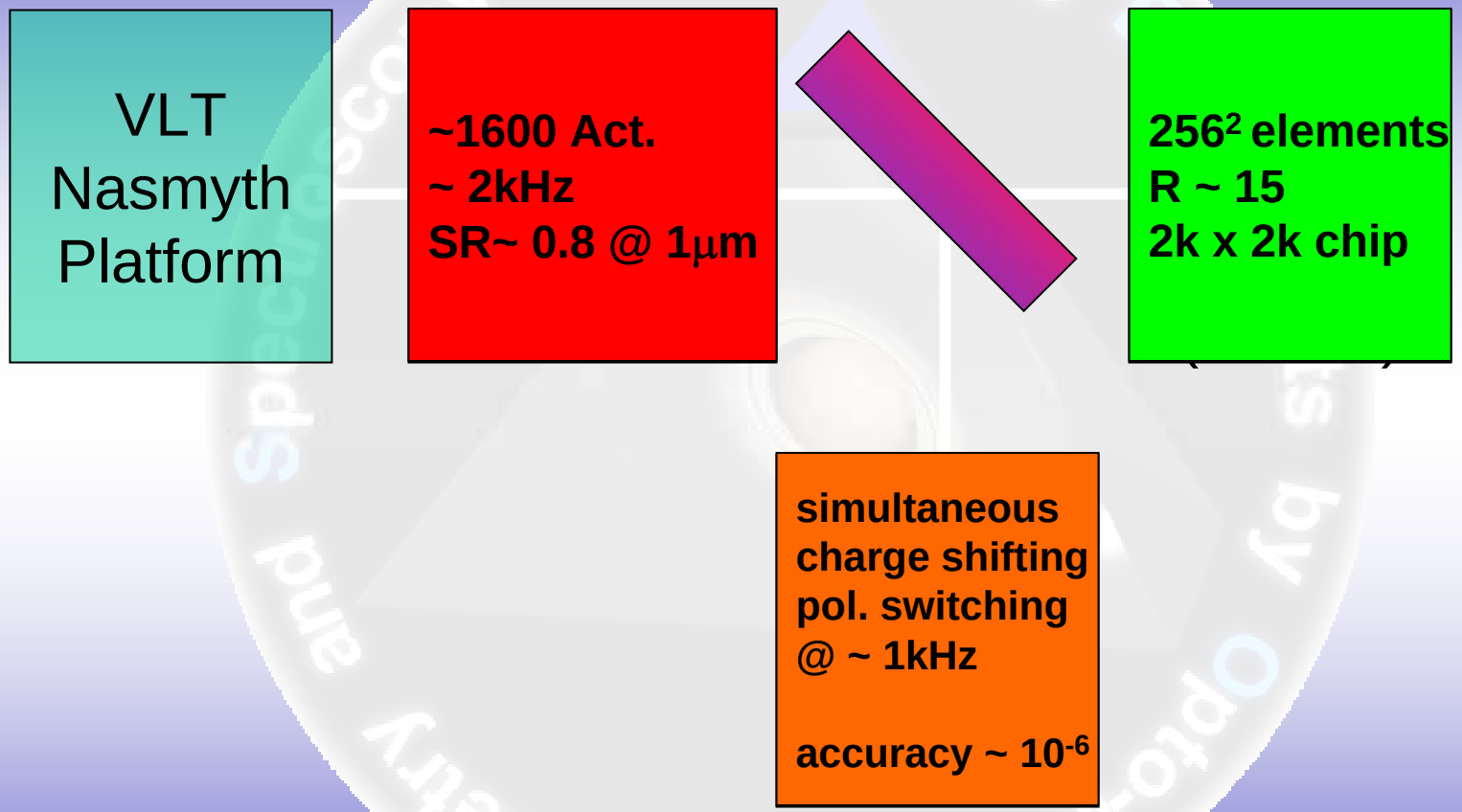
- Primary Goals:
  - Find mature EGPs, similar to the ones in our own solar system
  - Find young & warm planets in the nearest star forming regions

- Secondary goals...
  - Brown dwarfs
  - YSO disks & jets
  - Debris disks
  - Massive YSOs, ionized regions
  - AGB stars
  - PNae
  - SNae ...

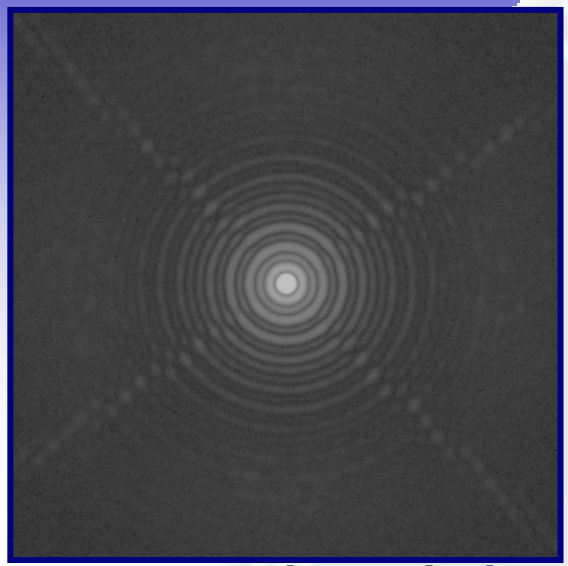
CHEOPS Consortium



Instrument Concept



IFS simulation



Integrated PSF (1s)

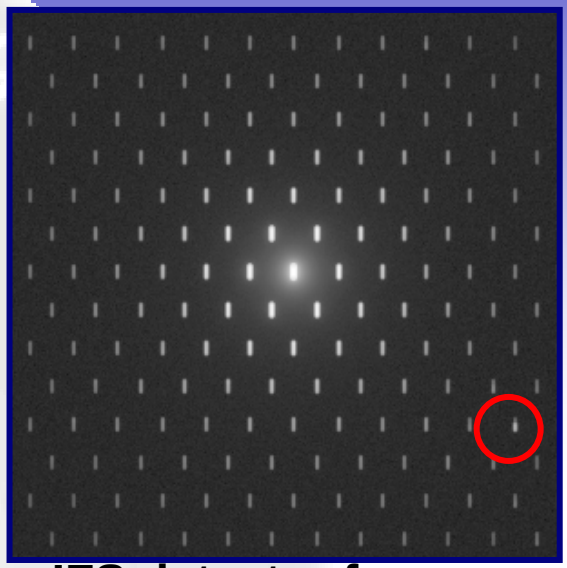
Planetary contrasts:

10^{-3}, 10^{-4}, 10^{-5}, 10^{-6}

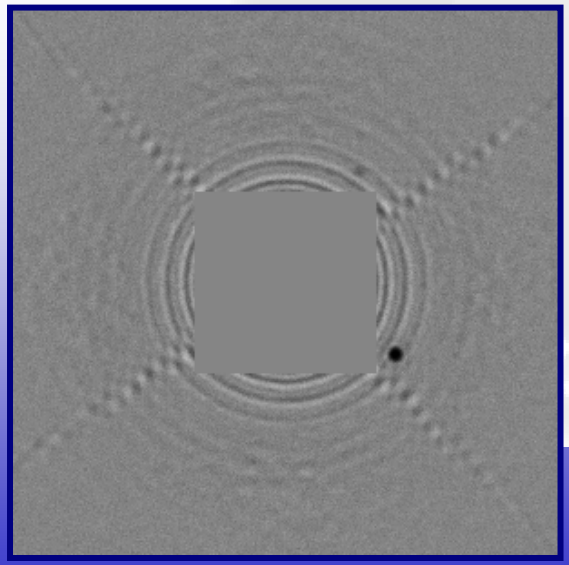
Detection SNRs:

45, 5, 0.9, 0.02

Integration time: 1s



IFS detector frame

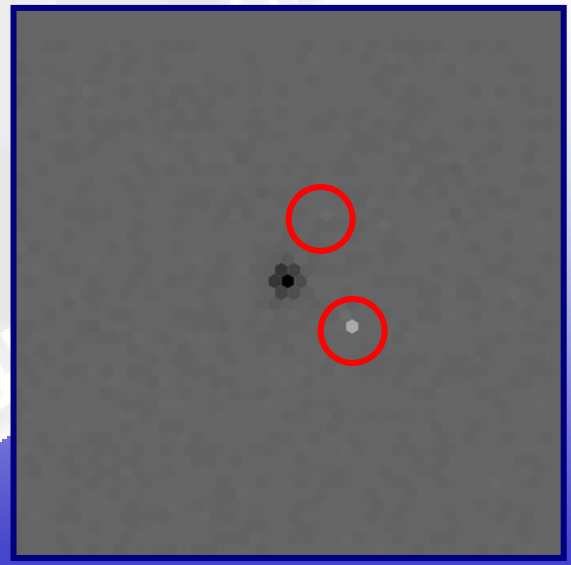


2-λ difference

Separation: 0.5´´

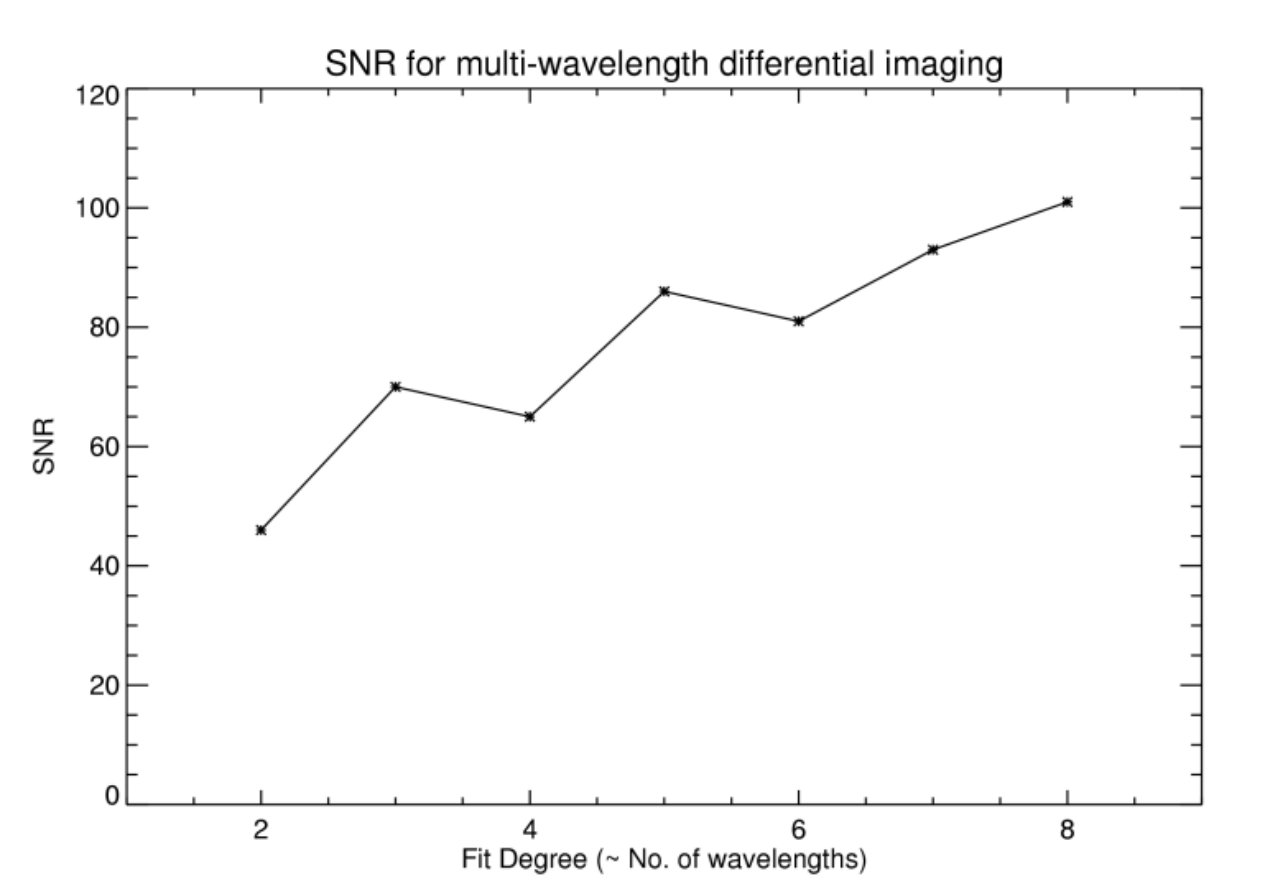
λ= 1.46 μm

SR=0.9

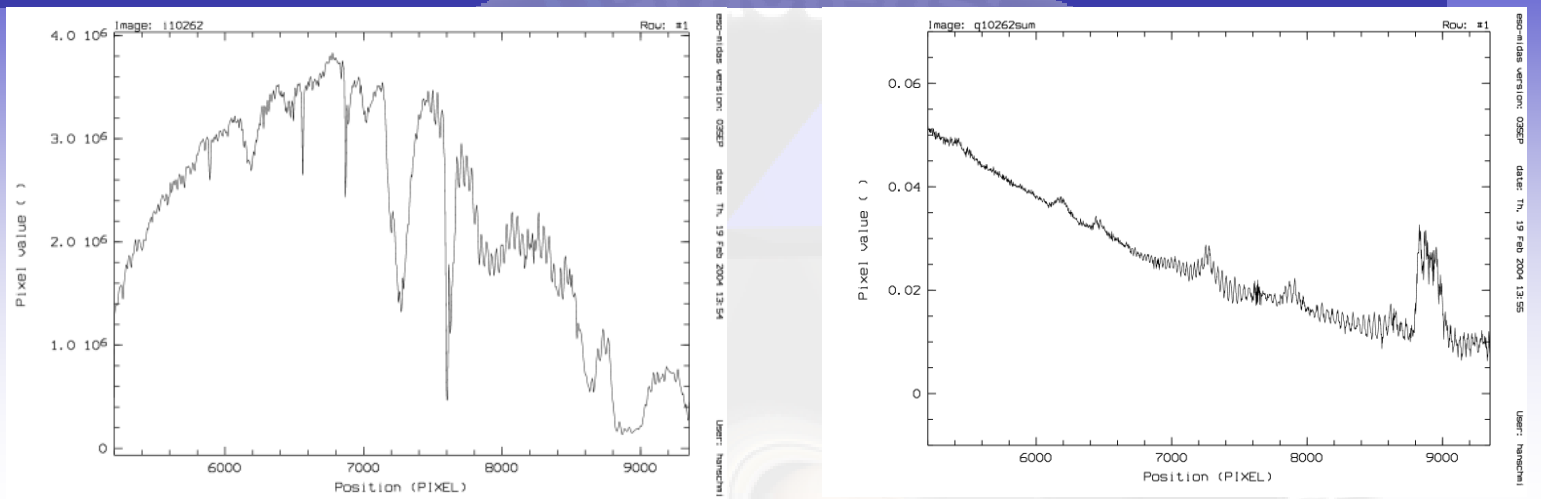


Reconstructed Image

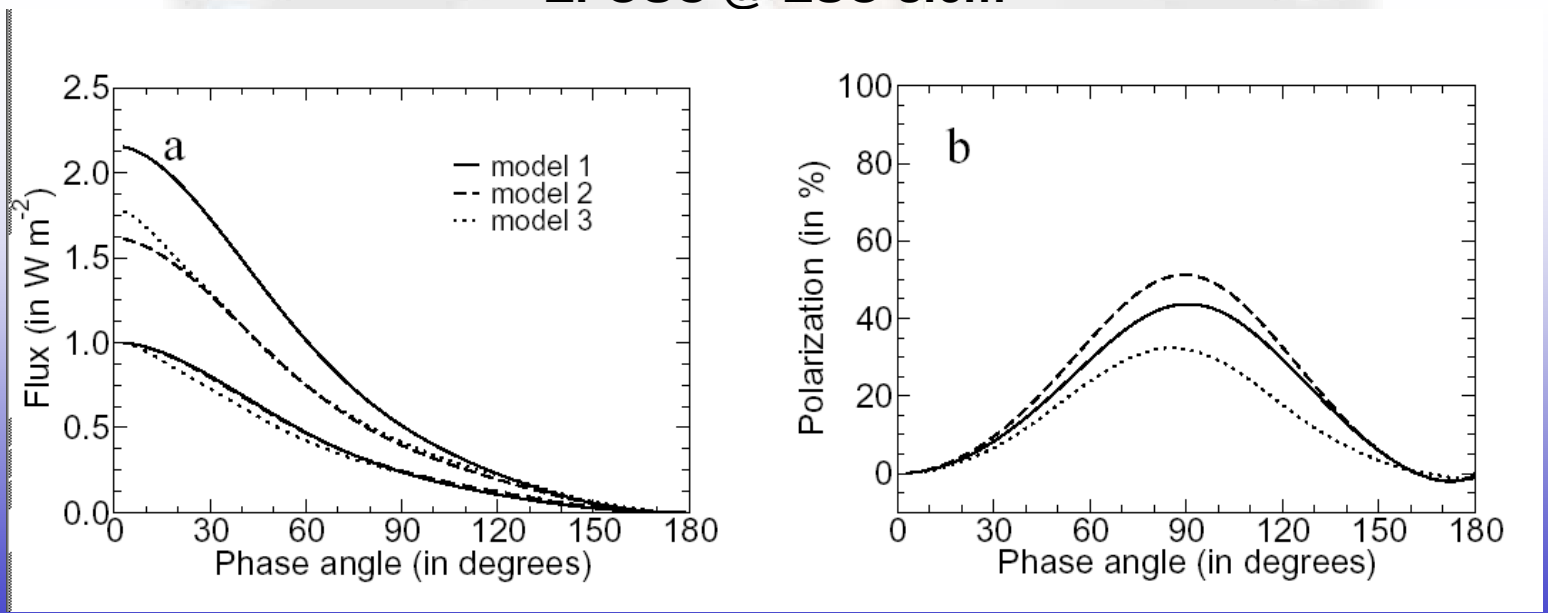
IFS – The benefit of many wavelengths



Polarimetry of solar system objects



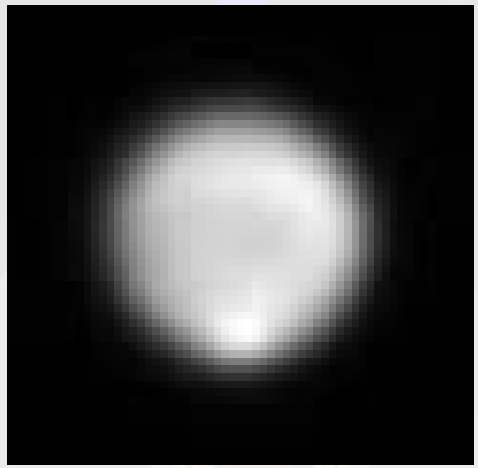
EFOSC @ ESO 3.6m

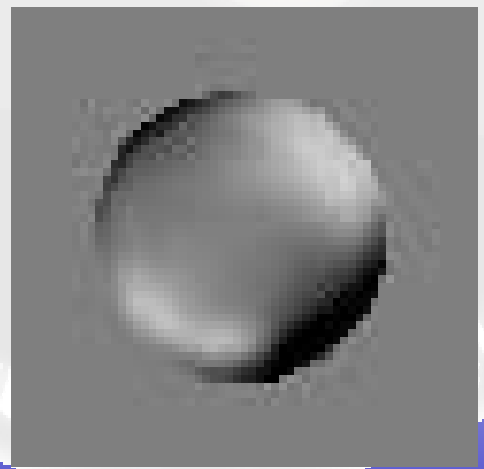


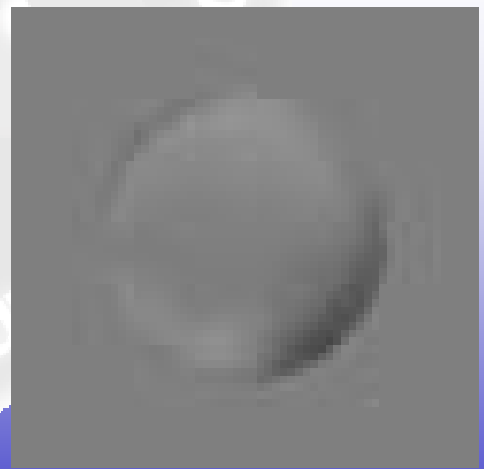
D. Stam, 2003, Frontiers in ExoPlanet Research, Paris

ZIMPOL - performance on Mars

Intensity I
600nm (80nm)

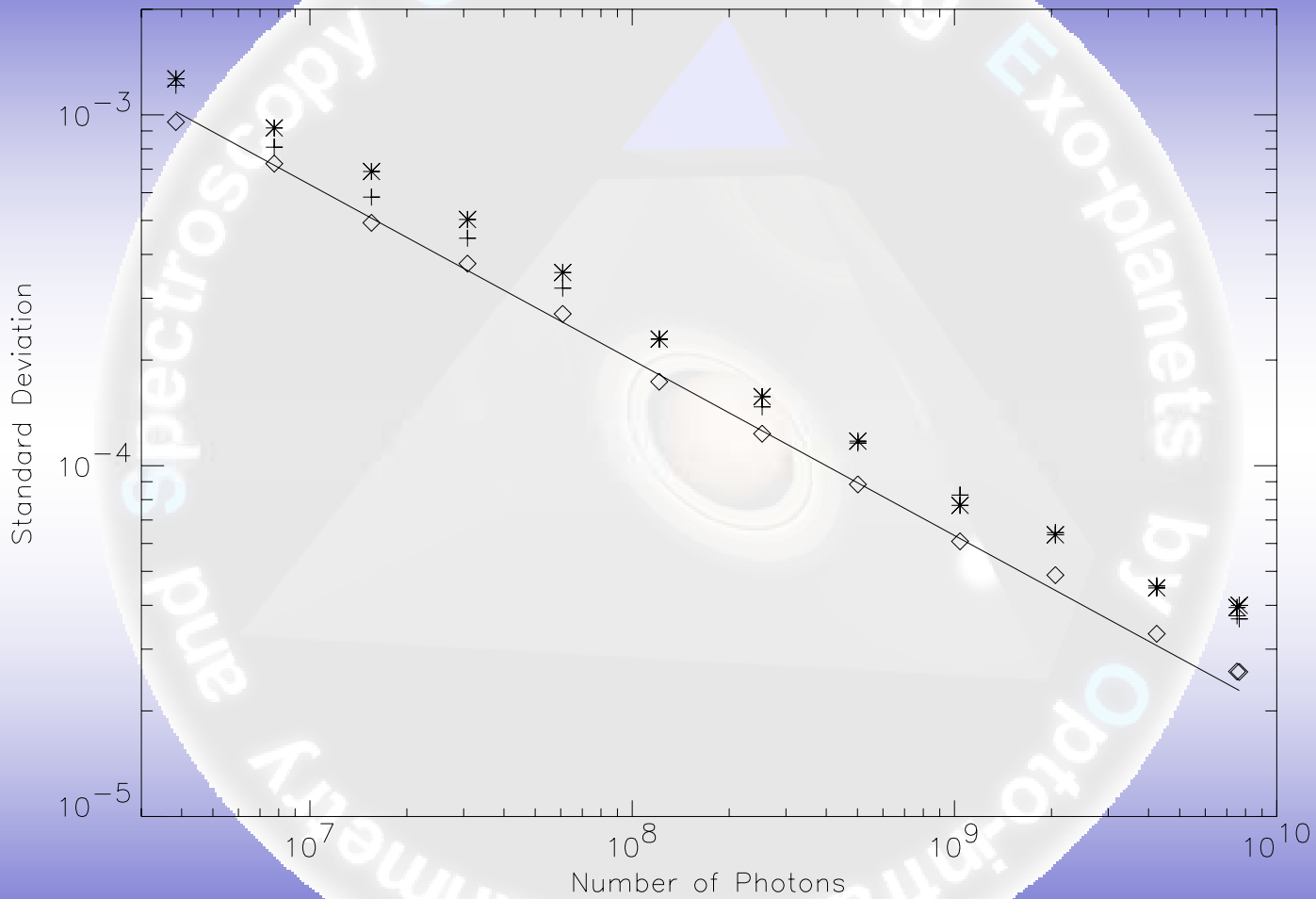






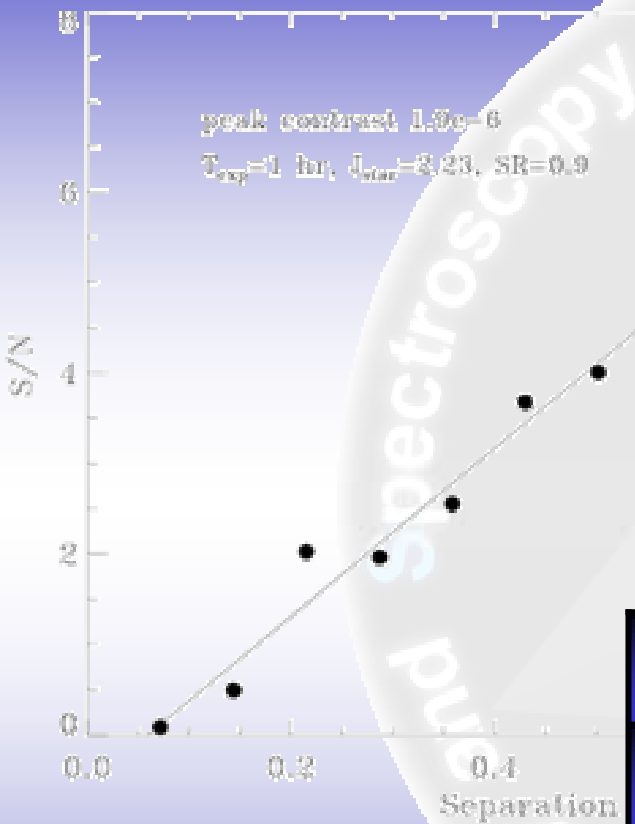
Stokes Q/I U/I V/I (cuts +/- 1%)

ZIMPOL - performance on Mars



Polarimetric noise level vs. number of photons

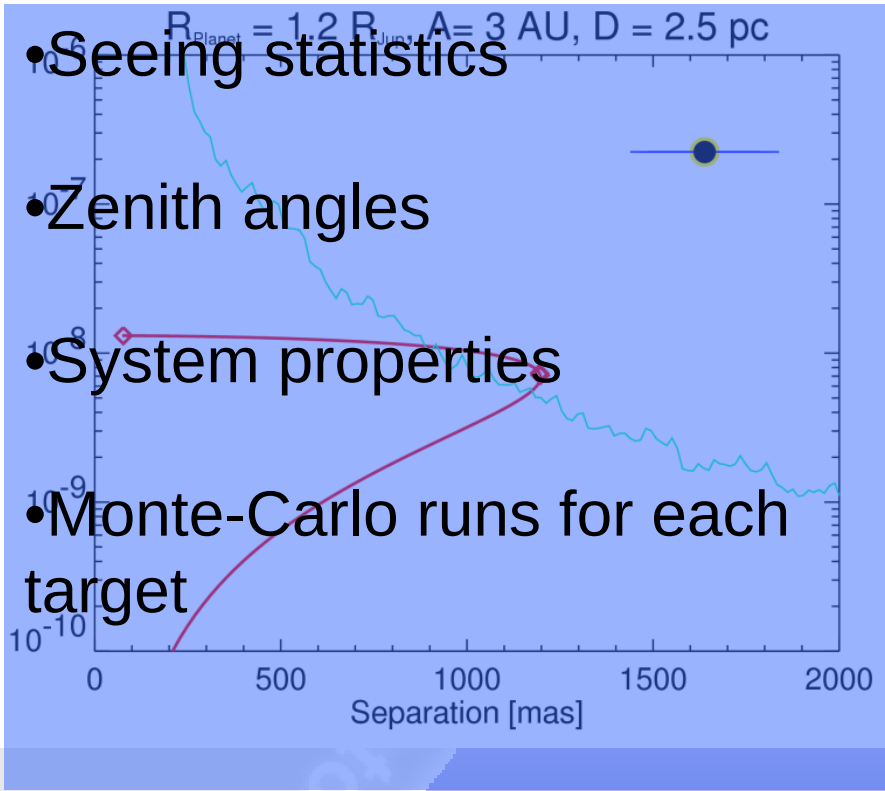
Detection Limits



Quantity	Required	Goal
Contrast @ 0.5´´	10^7	10^8
Spectral coverage	0.65-0.95μm 0.95-1.4μm	dito
FOV	0.3´´- 2.5´´	0.0´´- 5´´
Guide star brightness (I)	< 8 mag	< 10 mag

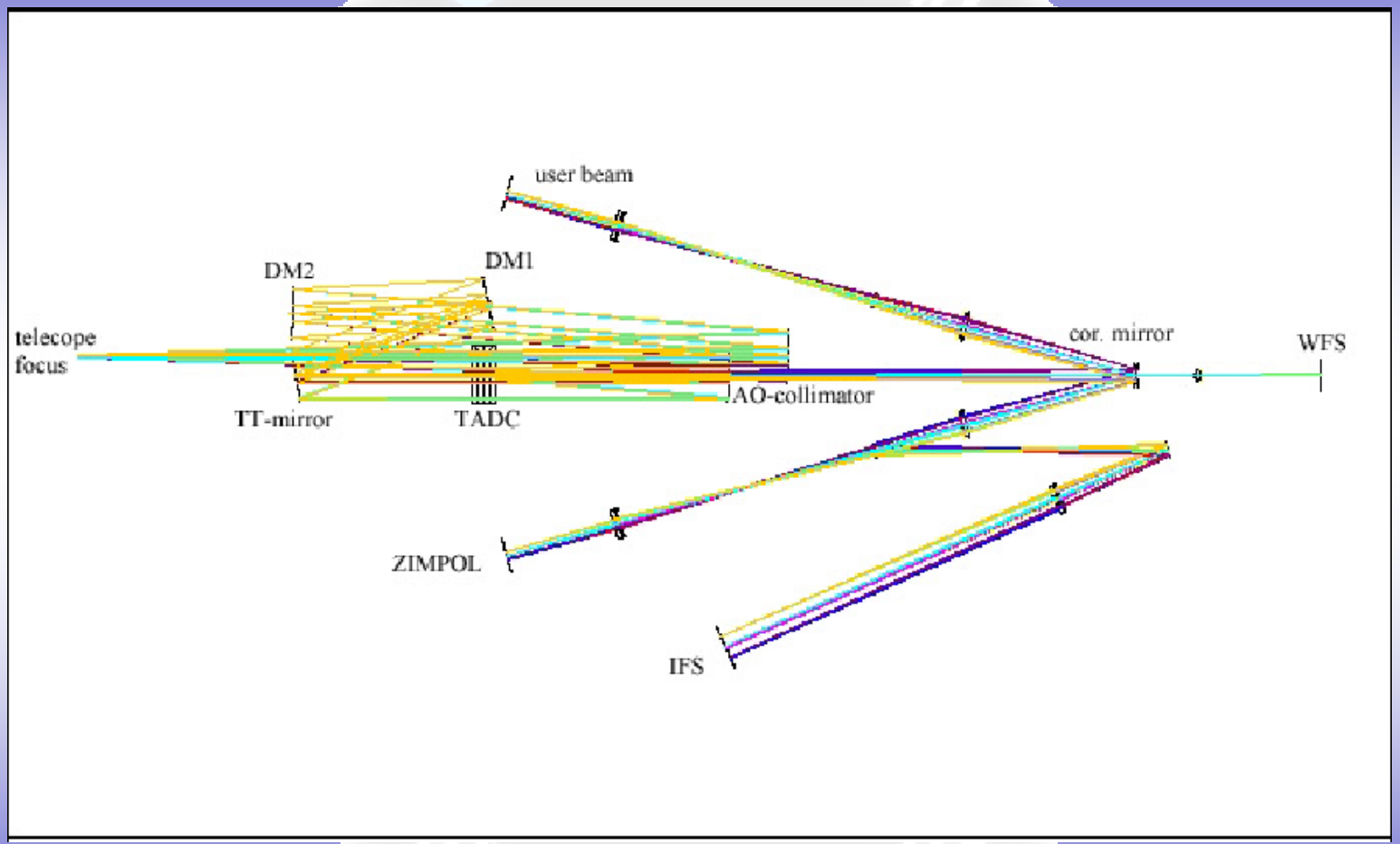
Planning the Programme

- Optimize detection rate
  - ``Visit´´ detection probability
  - ``Design´´ detection probability
- Featured object: α Cen, VDP 4%
- Preliminary programme detection rate estimates:



Programme duration	100 N	~ 5 yr
No. of targets:	110	550
Exp. det. (cold / old)	1	15 - 30
Exp. det. (warm /young)	N/A	N/A

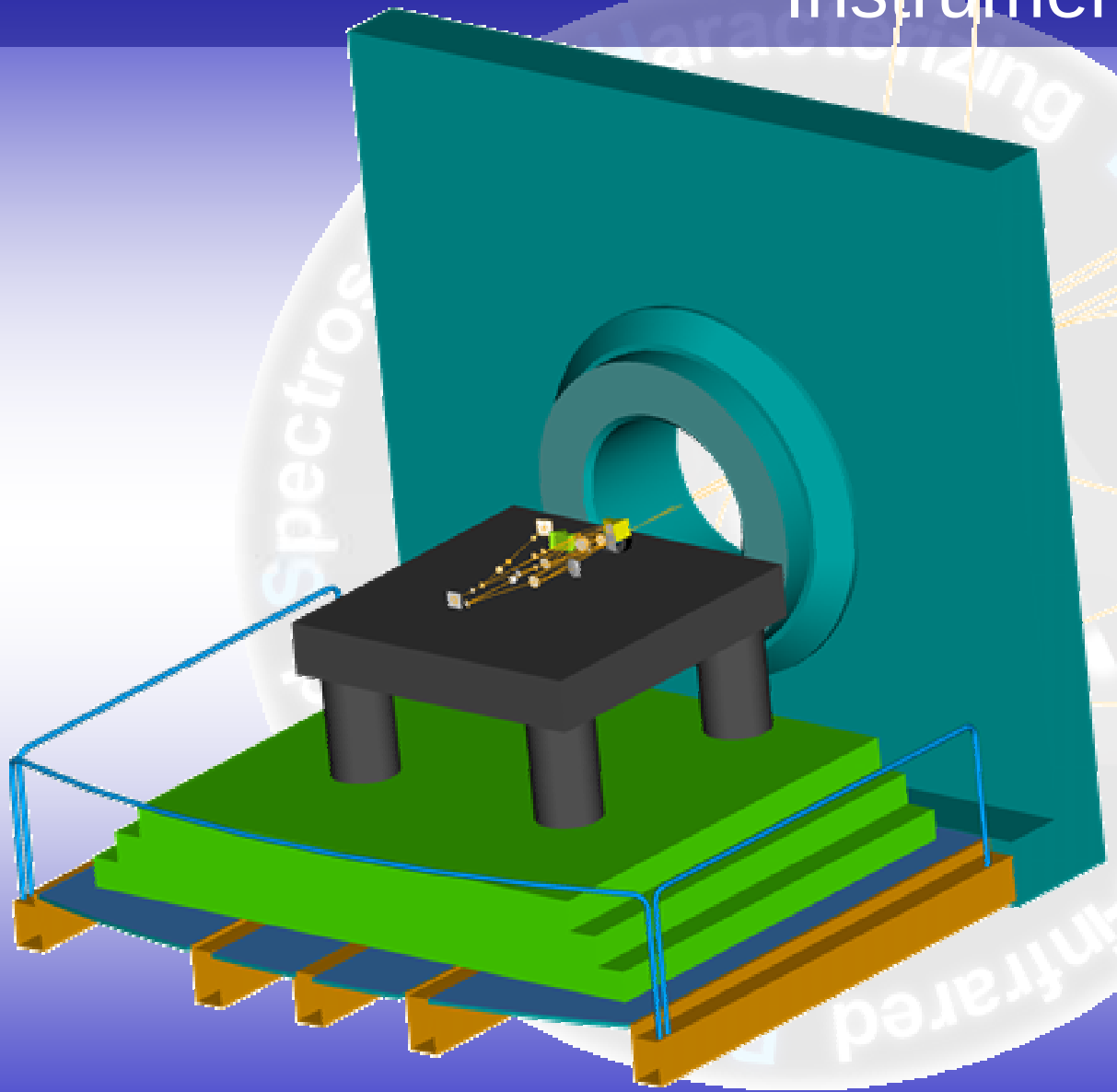
Instrument Status – Optical Design



Xinetics DM


42 x 42 Mirror
Polished and Gold Coated 42x42 Mirror
42x42 Array with Facesheet

Instrument Status



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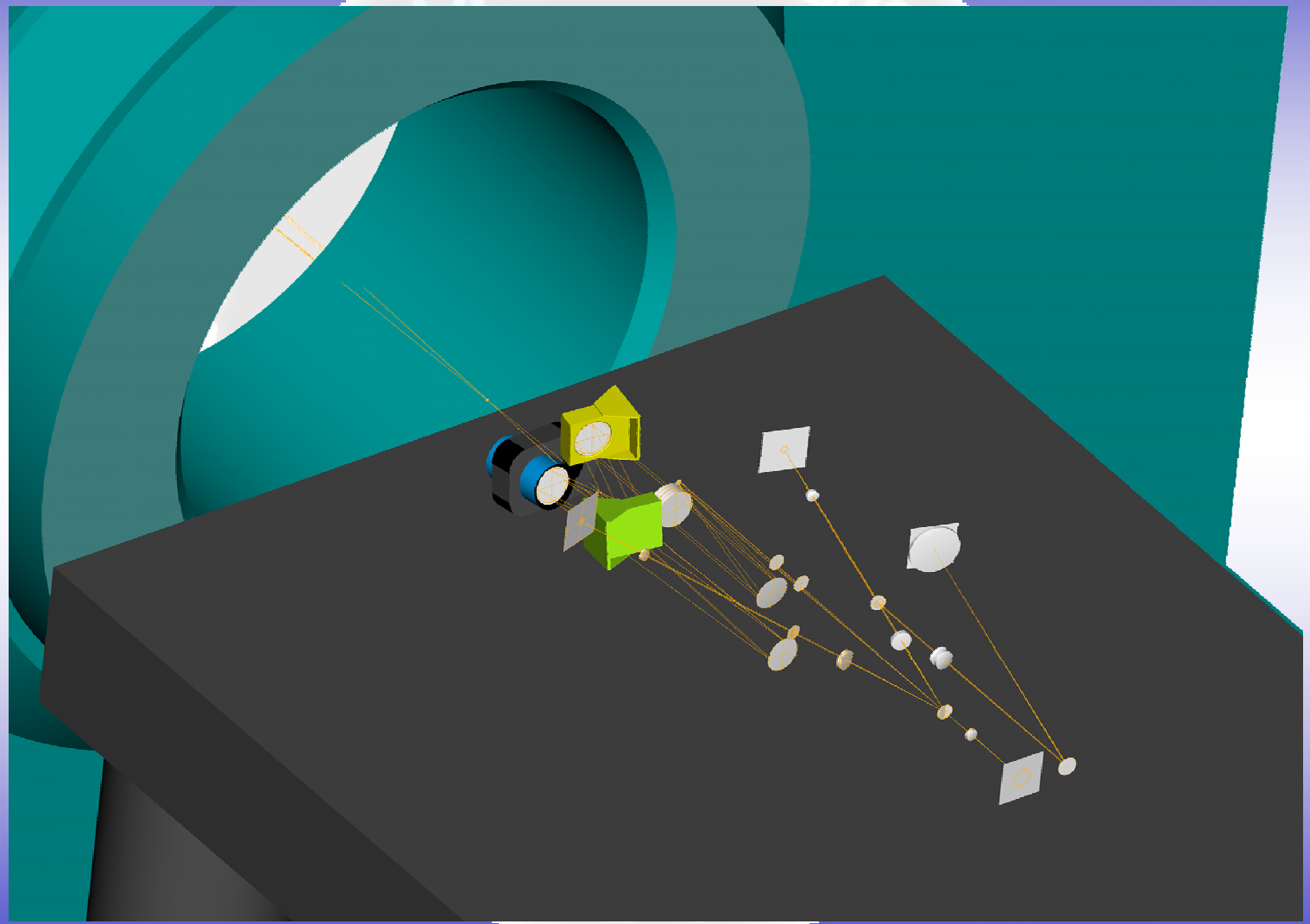

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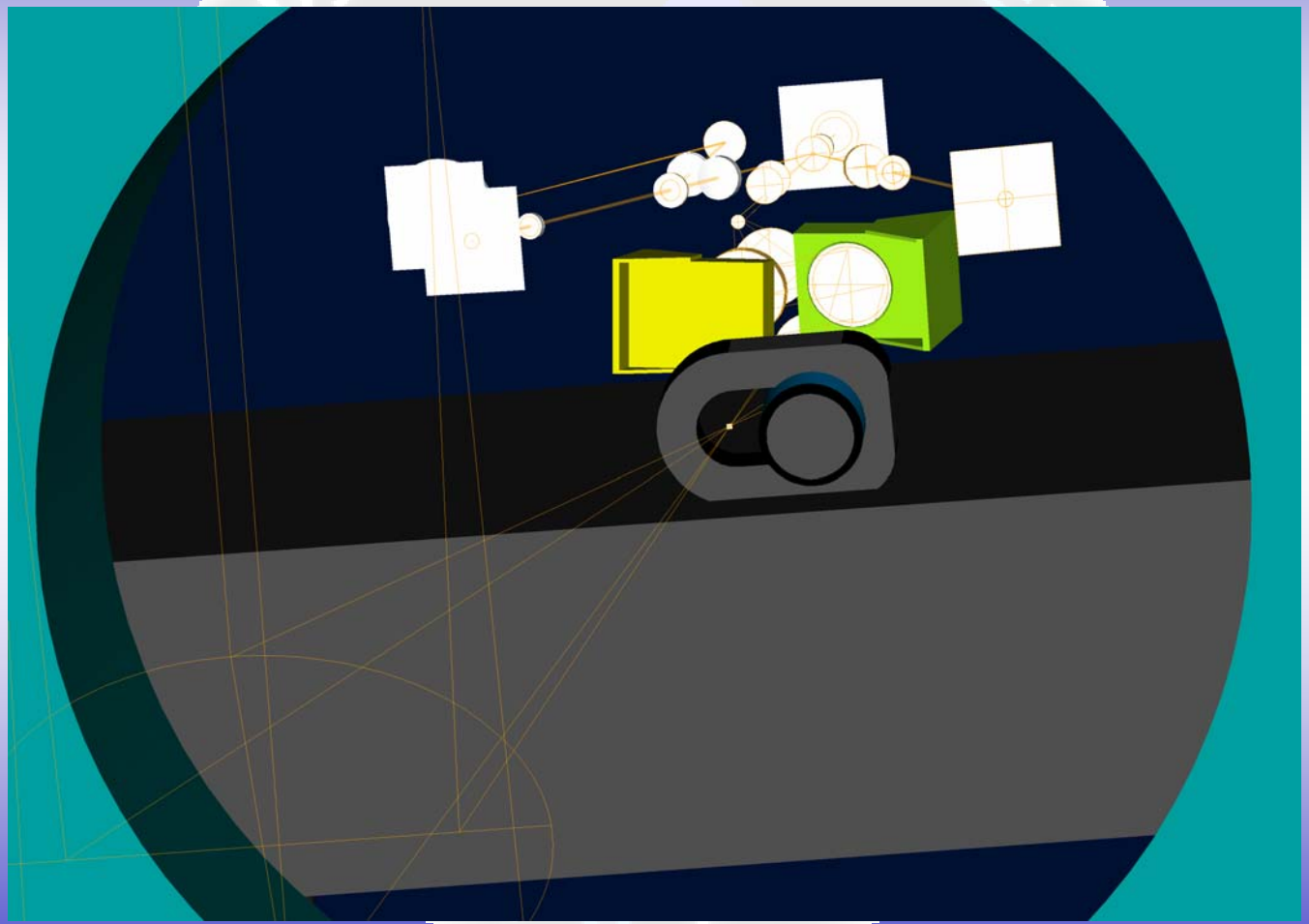

Continuation after phase A

- Review / Selection 2004/05
- Phase B (final design) 2005
- Phase C/D (construction/integration) 2006/7
- First light 2008