SPARC4
Simultaneous Polarimeter and Rapid Camera in Four Bands

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Technical team

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- ✓ **Keith Taylor**
- ✓ **Tania Dominici (LNA/MCT)**
- ✓ **René Laporte**
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Scientific support

- ✓ **Alex Carciofi (IAG/USP)**
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- ✓ **Gabriel Franco (UFMG)**
- ✓ **Joaquim E. Rezende Costa (INPE/MCT)**
- ✓ **Karleyne M. G. da Silva (INPE/MCT)**
- ✓ **Marcelo Assafin (Obs. Valongo/UFRJ)**
- ✓ **Tania Dominici (LNA/MCT)**

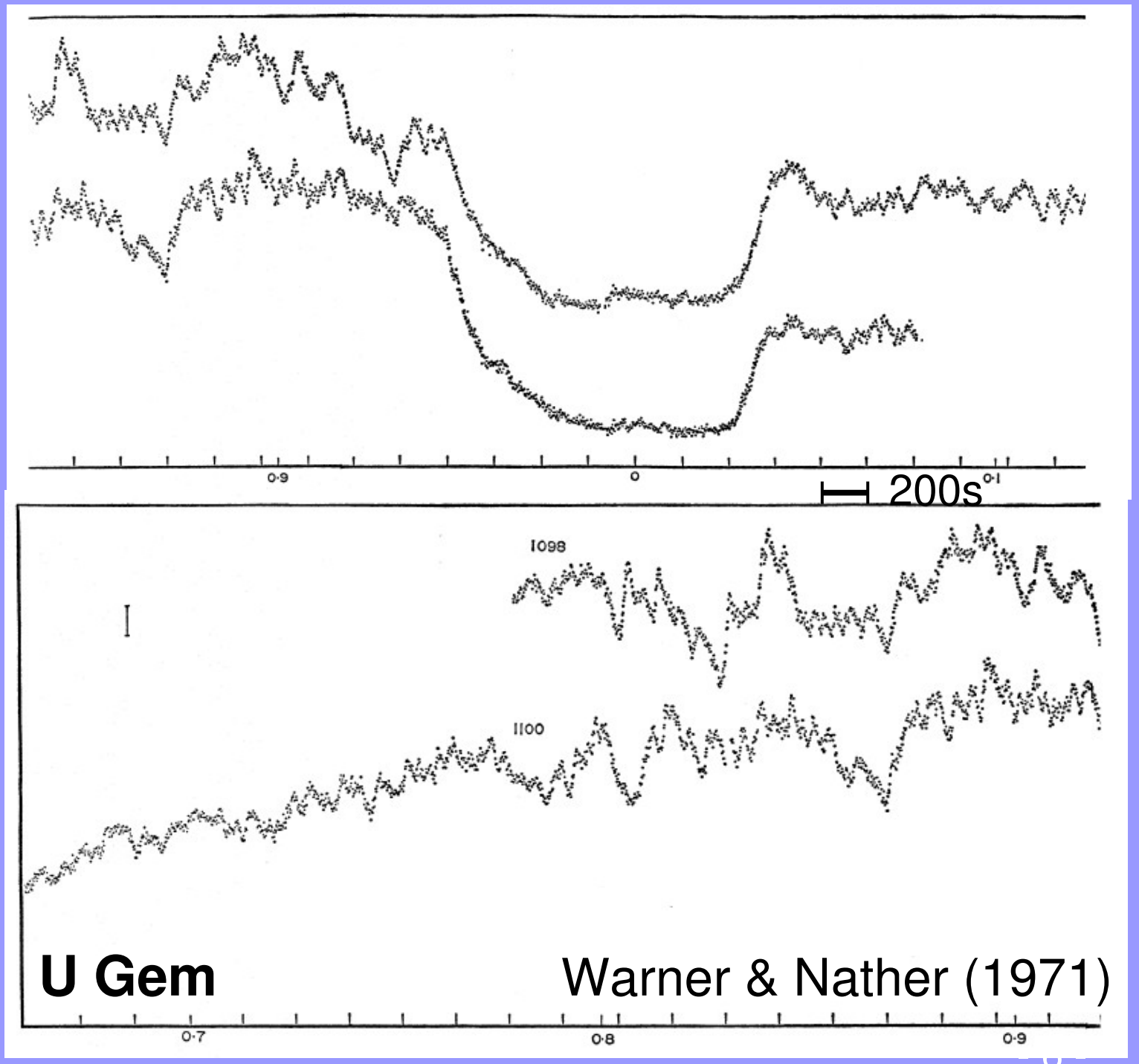
Concepts

- ✓ **To improve OPD instrumentation**
  - ➜ **obtain simultaneously four broad band images**
  - ➜ **temporal resolution ~ 1s**
  - ➜ **polarimeter**
- ✓ **To be useful to a broad range of scientific interests**

Science

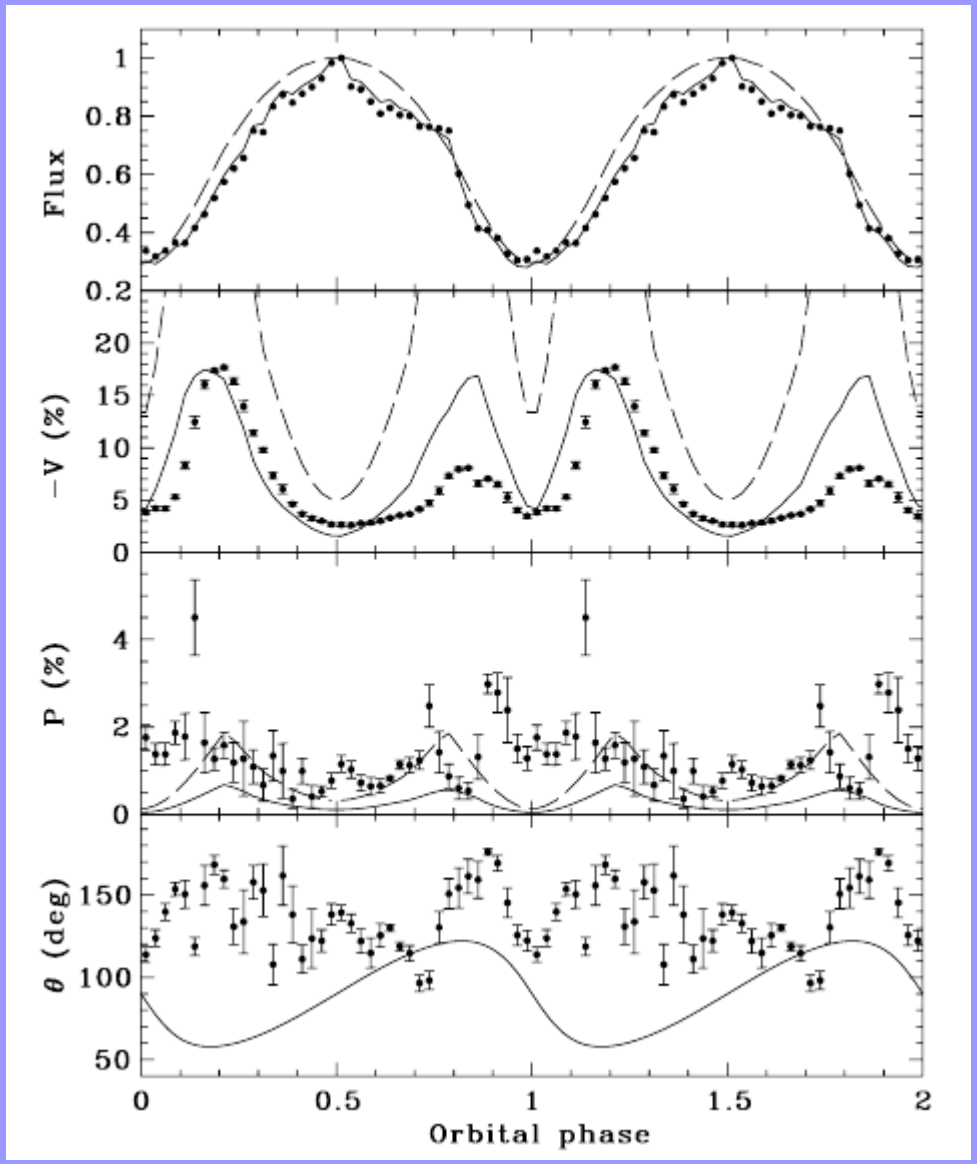
- ✓ **Interactive binaries**
- ✓ **Pulsating stars**
- ✓ **Circumstellar envelopes**
- ✓ **Star formation**
- ✓ **Blazars**
- ✓ **Solar system studies**
- ✓ **Exoplanets**
- ✓ **Gravitacional microlenses**

Flickering

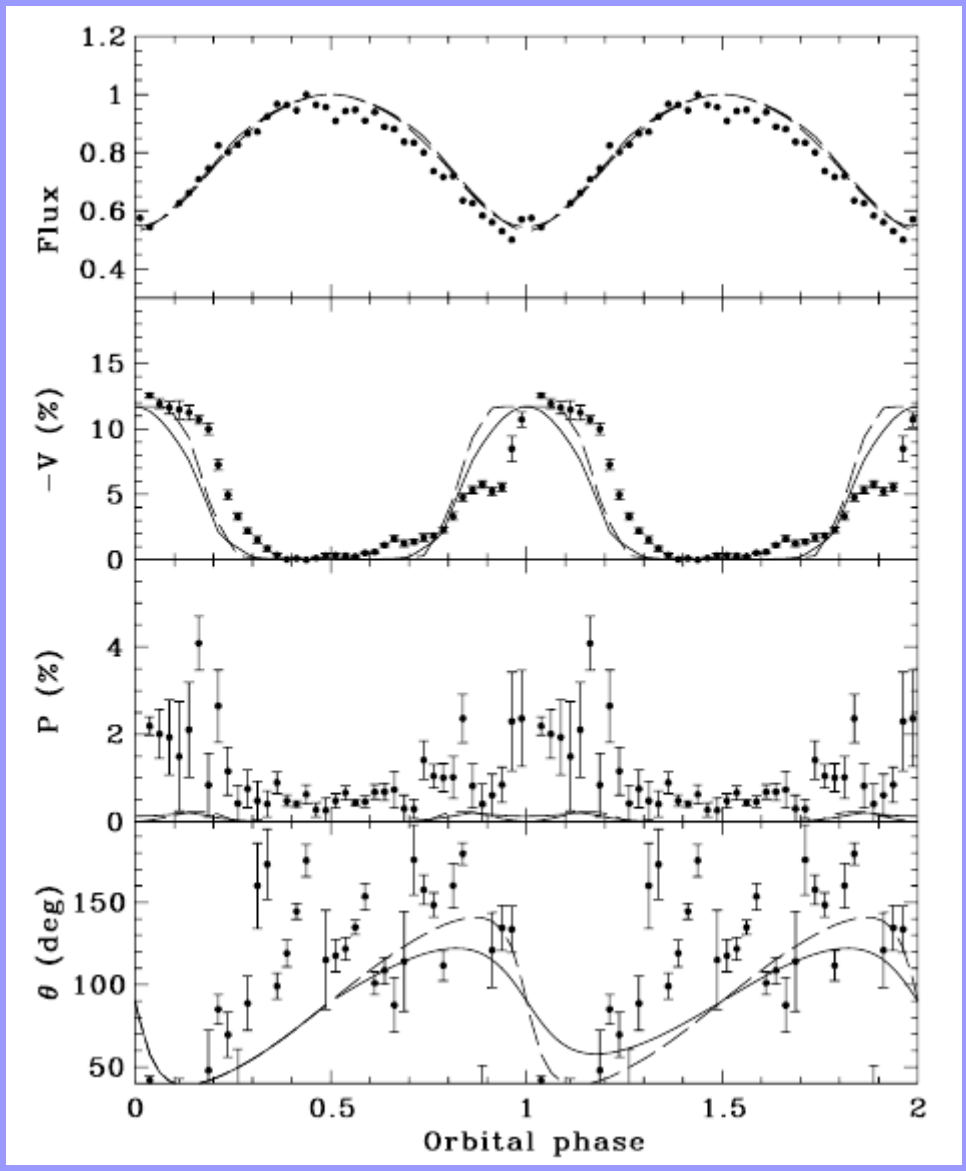


1RXS J231603.9-052713

Rodrigues et al. 2006

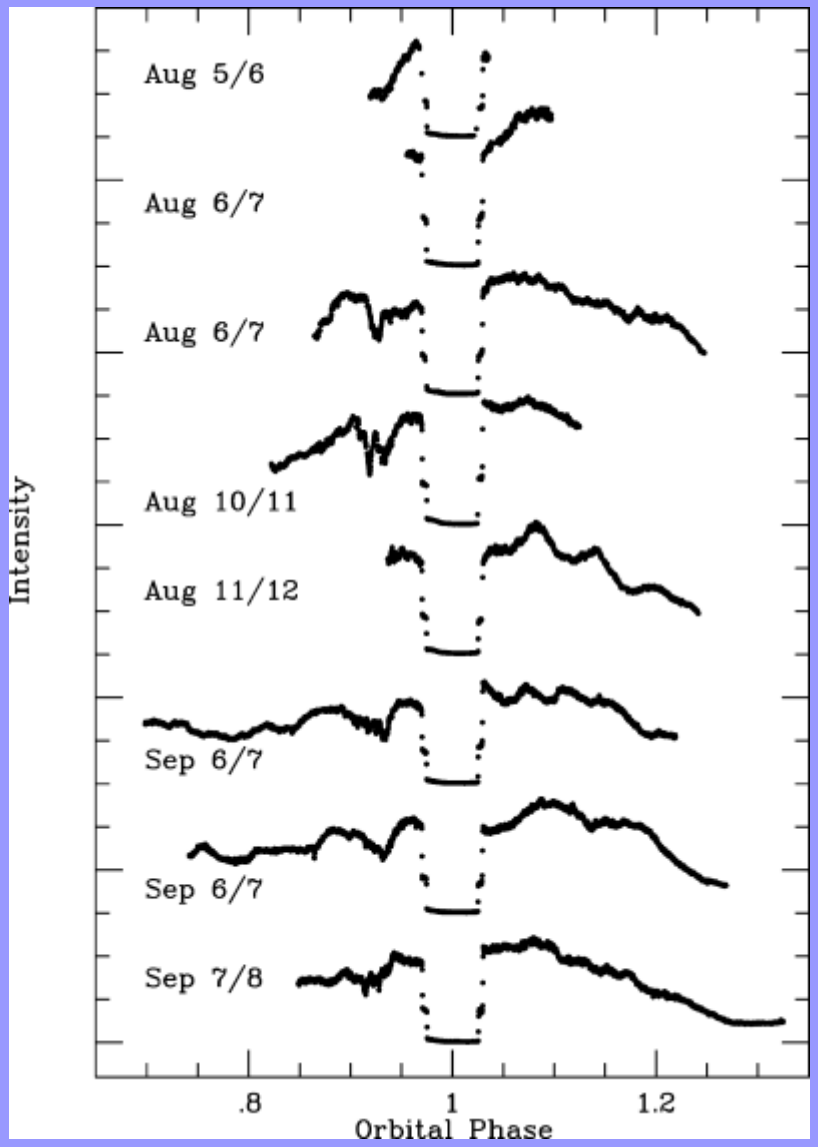


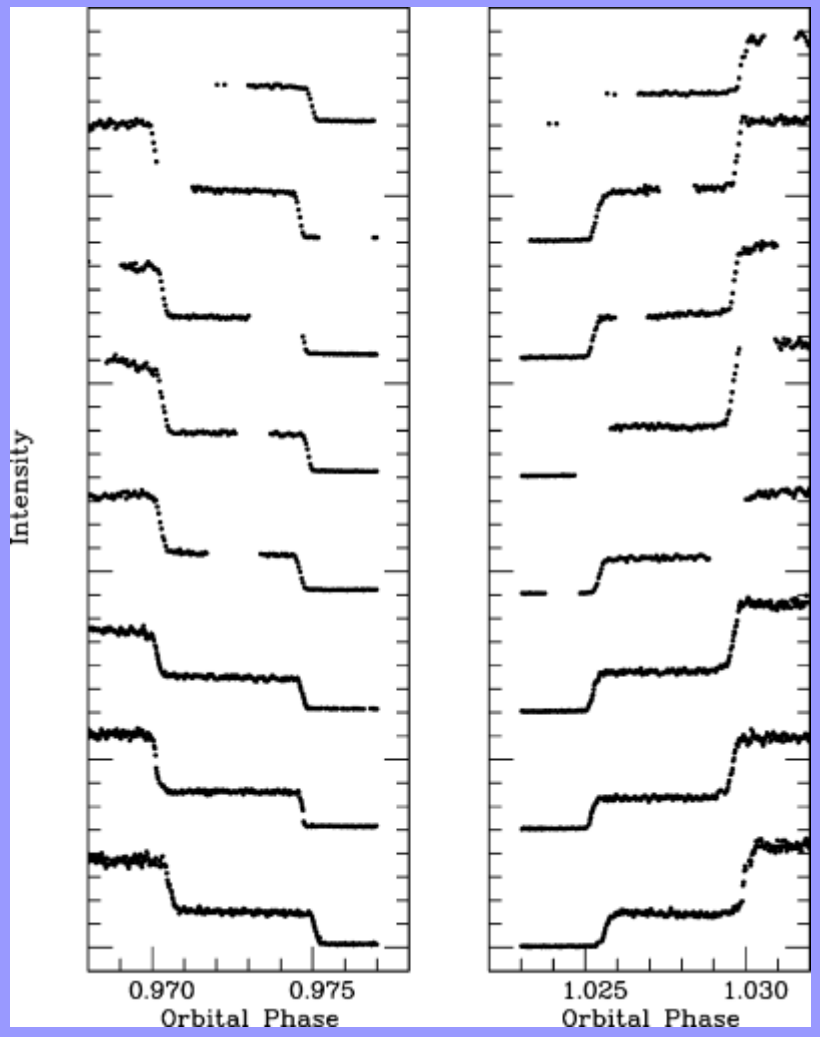
R Band



I Band

Eclipsing systems





O'Donoghue et al. 2006 - FL Cet

0.001 phase = 5.2 s

Circumstellar envelopes

✓ Grain chemical composition

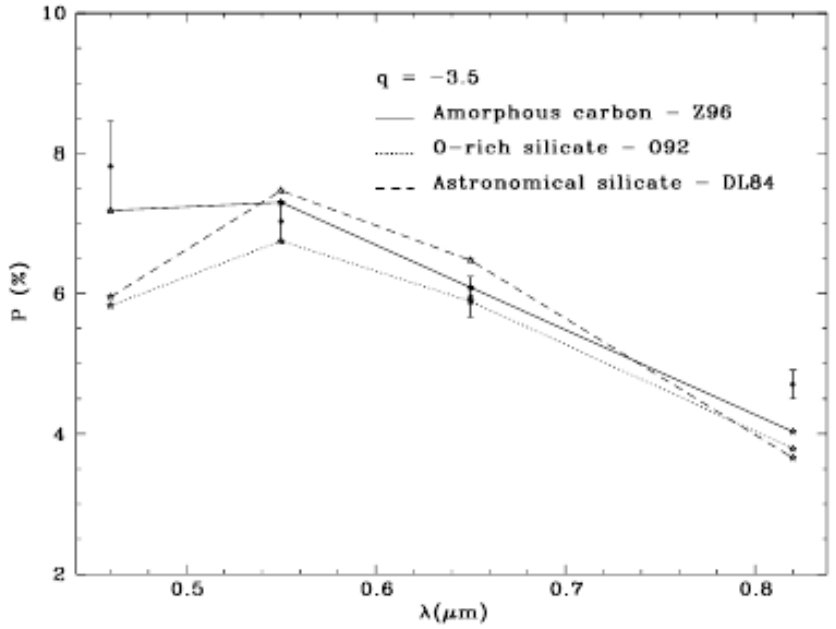


FIG. 3.—Models to the intrinsic polarization of Hen 3-1475 using different grain composition.

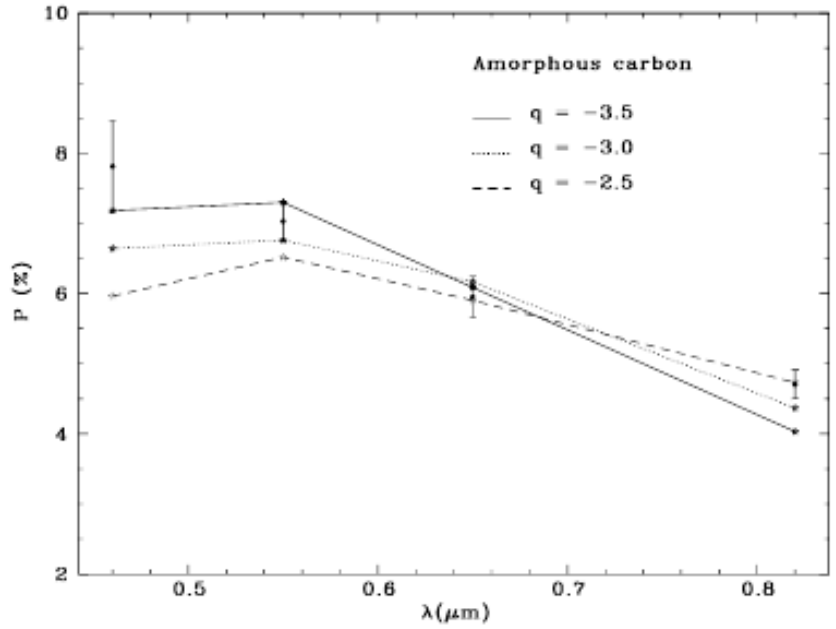
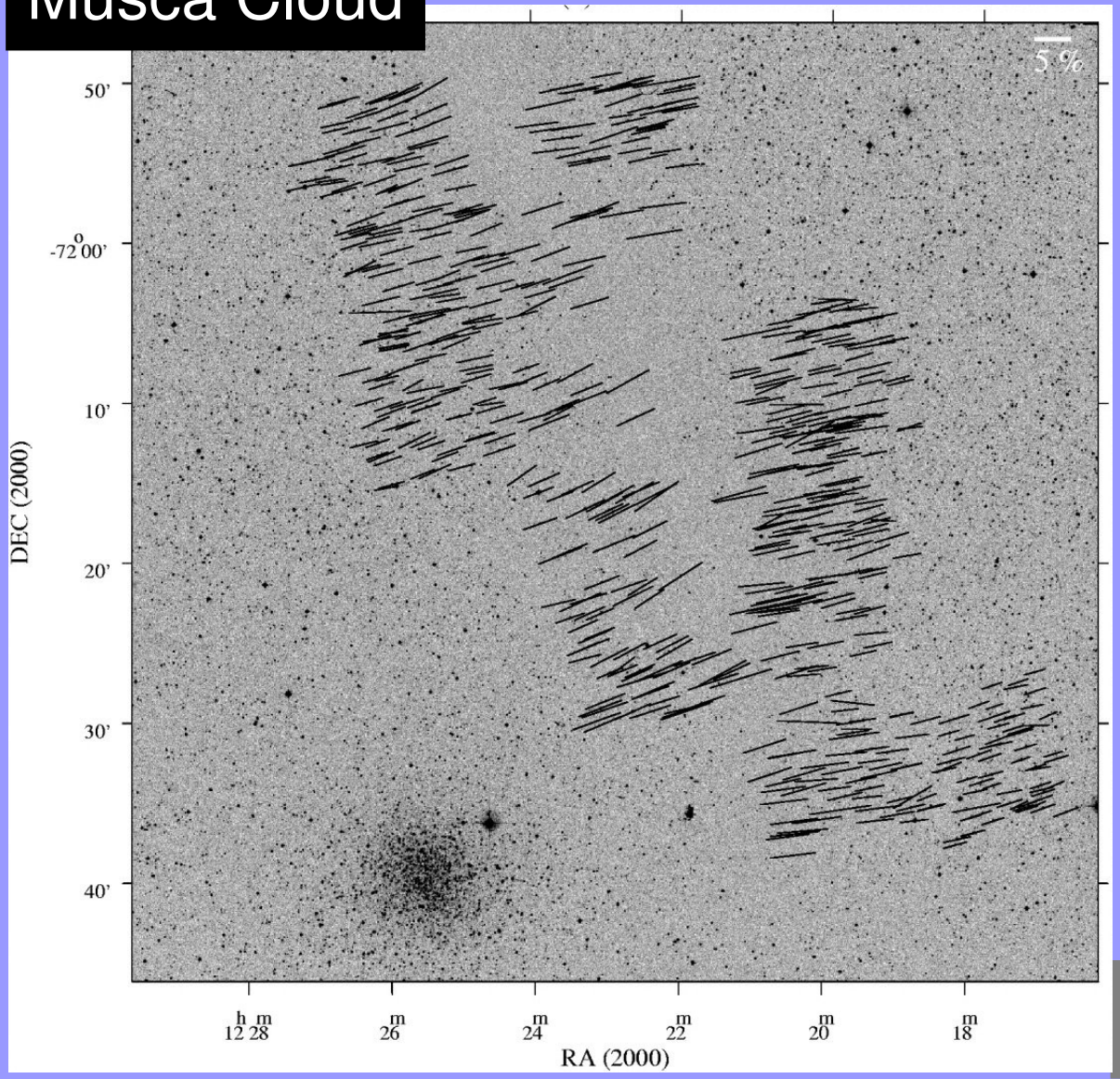


FIG. 4.—Same as Fig. 3, but varying the index of the power-law size distribution.

Rodrigues et al. (2003)

Star formation

Musca Cloud



- ✓ **Interstellar magnetic field: direction and dispersion**

Pereyra & Magalhães 2007

Star formation

Quiescence

Alves et al. 2008

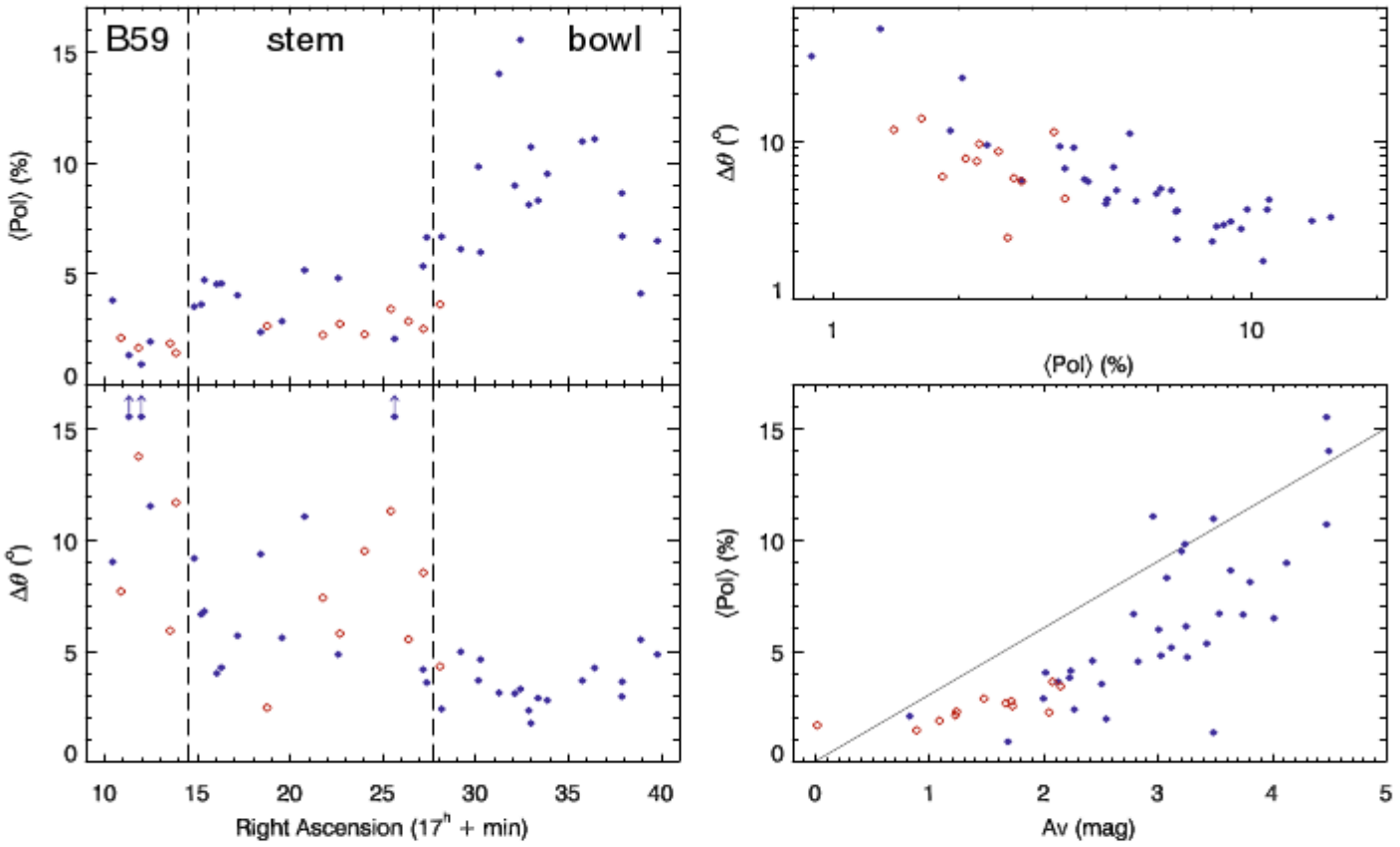
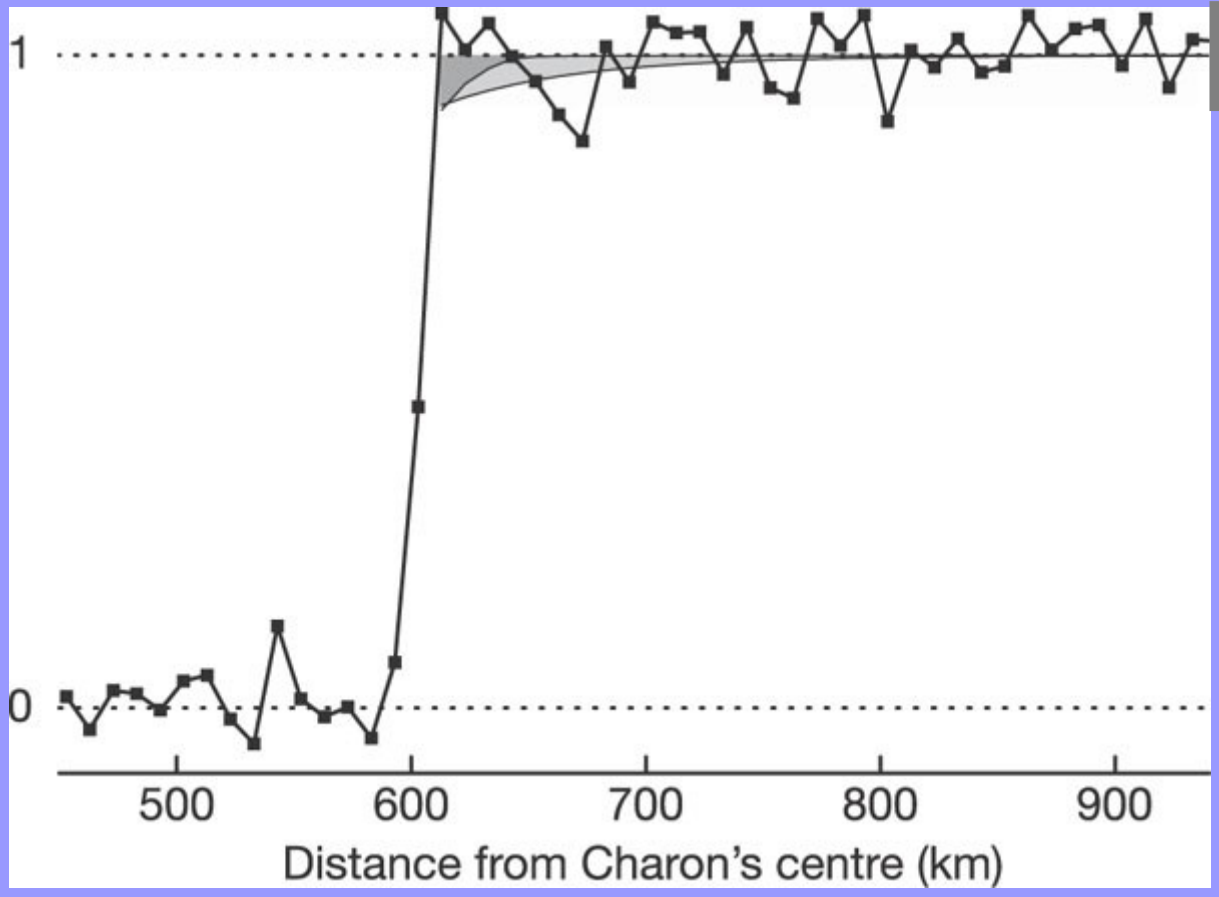


Fig. 2. *Left panels*: distribution of the mean polarization and of the polarization angle dispersion, $\Delta\theta$, as a function of the right ascension of the observed areas, respectively. The polarization angle dispersion is corrected by its mean error (i.e., $\Delta\theta^2 = \sigma^2_{\rm std} - \langle\sigma_\theta\rangle^2$). The vertical dashed-lines delimits the transition between regions with different polarimetric properties. Filled and open dots represent values for fields with and without associated dense cores, respectively. As shown by the *botton right panel*, the regions traced by the optical polarimetry have extinction of $A_{\rm V} \lesssim 2.2$ mag for fields without cores, while the ones associated with cores show $0.8 \lesssim A_{\rm V} \lesssim 4.5$ mag. *Top right panel*: correlation between dispersion in polarization angle and mean polarization. *Botton right panel*: mean polarization versus visual absorption derived from the 2MASS data for the observed stars with $P/\sigma_P \geq 10$. The solid line represents optimum alignment efficience ($P(\%) = 3 \times A_{\rm V}$).

Solar system studies

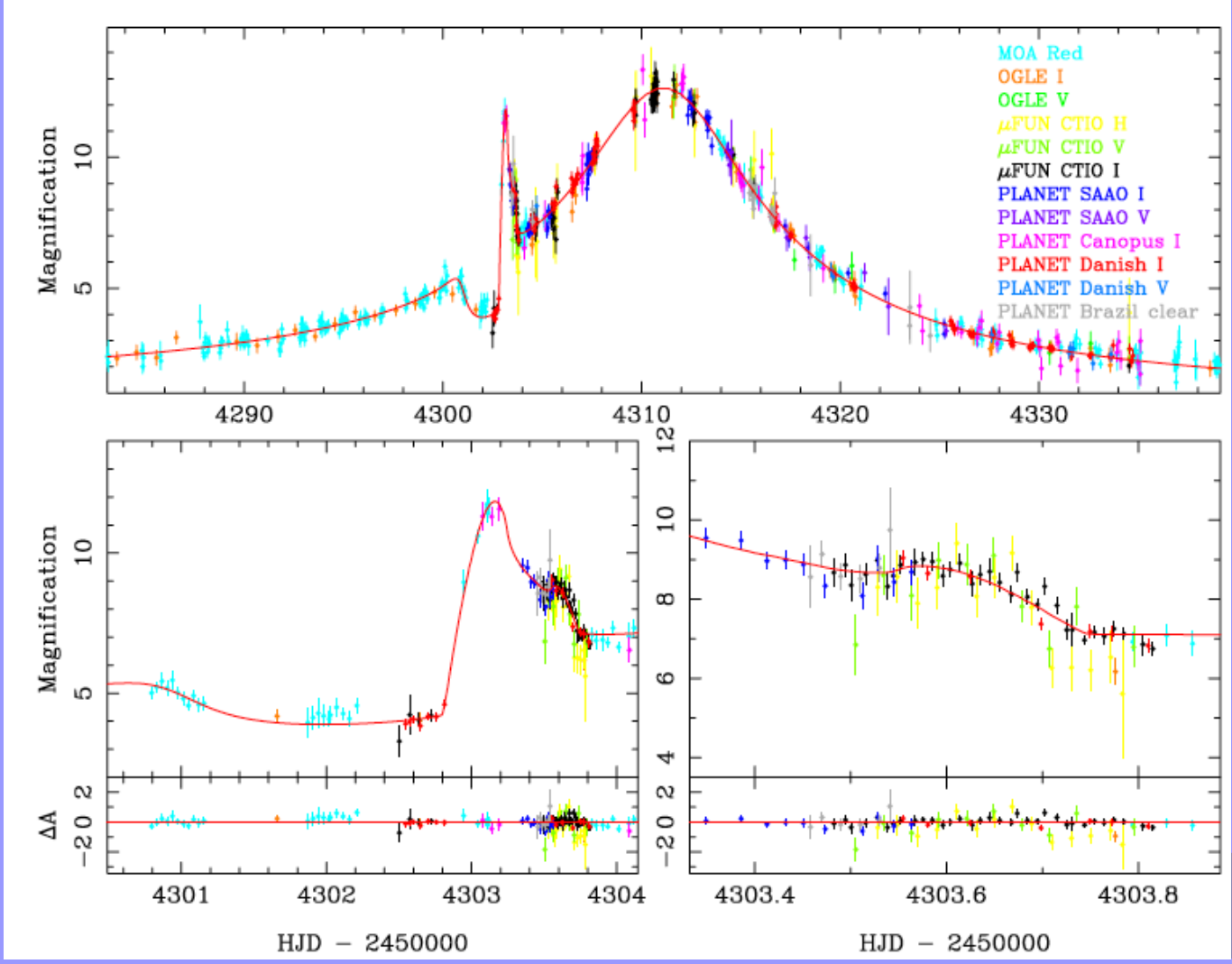
✓ **Stellar ocultation by Charon**

➜ **Detect atmospheres**



Sicardy et al. (2006)

Gravitational microlenses



Cold Neptune Planet

Sumi et al. (2010)

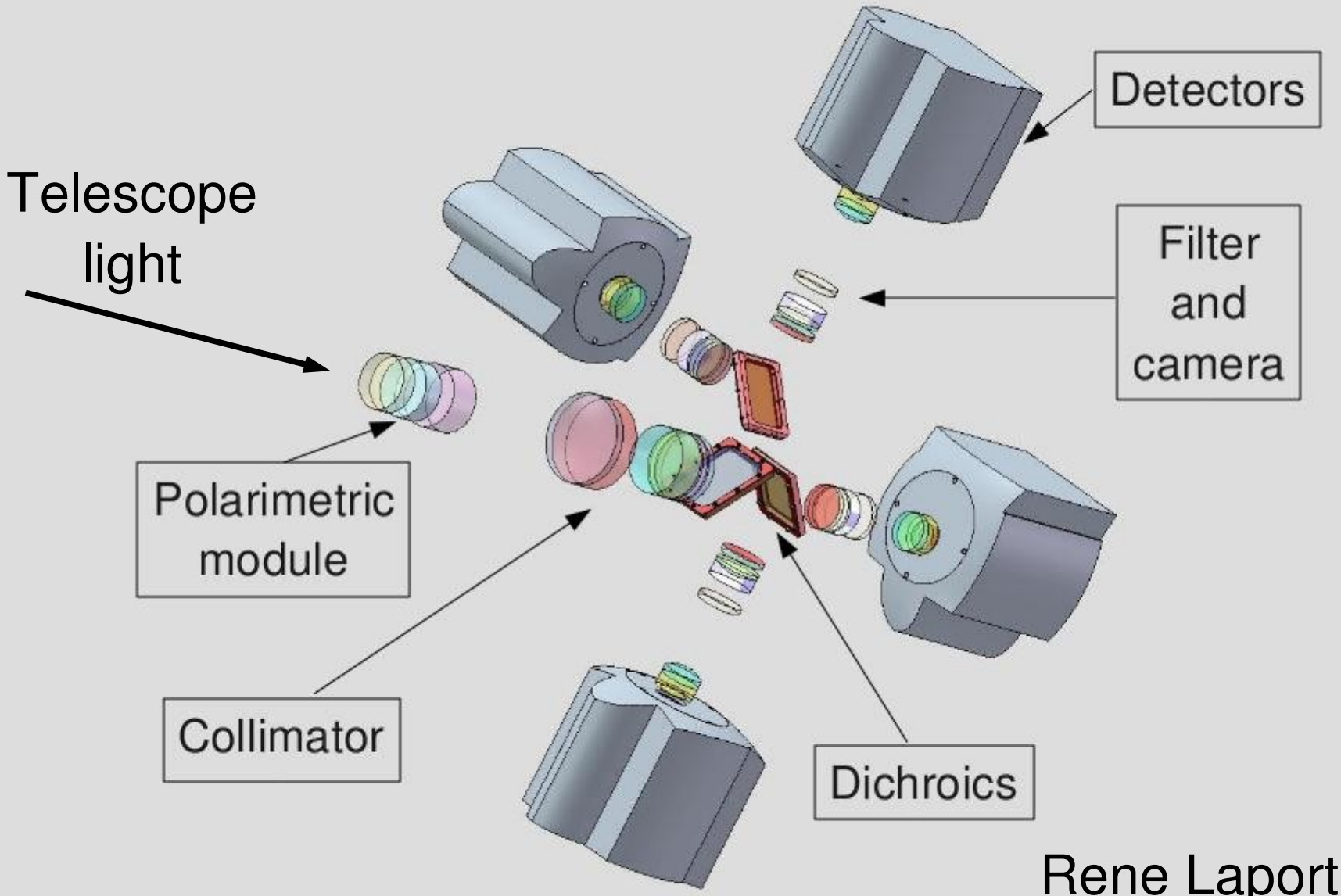
Requirements

- ✓ To cover the optical range with four broad bands
- ✓ Field of view: larger than 5 x 5 arcmin
- ✓ Good temporal resolution: better or equal 1s
- ✓ SNR: 0.02 mag in an integration of 1s of 14 mag object - EMCCDs?
- ✓ To have a photometry mode (no polarization)

Follow-up of LSST discoveries

- ✓ **... “15-second exposures in two photometric bands every three nights on average, with typical 5-sigma depth for point sources of r=24.5” ...**

Preliminar layout



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Similar instruments

✓ **TurPol (Piirola 1988)**

→ **UBVRI, dichroics, polarimeter, photomultipliers**

✓ **ULTRACAM (Dhillon et al. 2007)**

→ **3 bands, dichroics, 500 Hz, CCDs**

✓ **GROND (Greiner et al. 2008)**

→ **7 bands (IR + Vis), dichroics, CCDs**

✓ **HIPPO (Potter et al. 2008)**

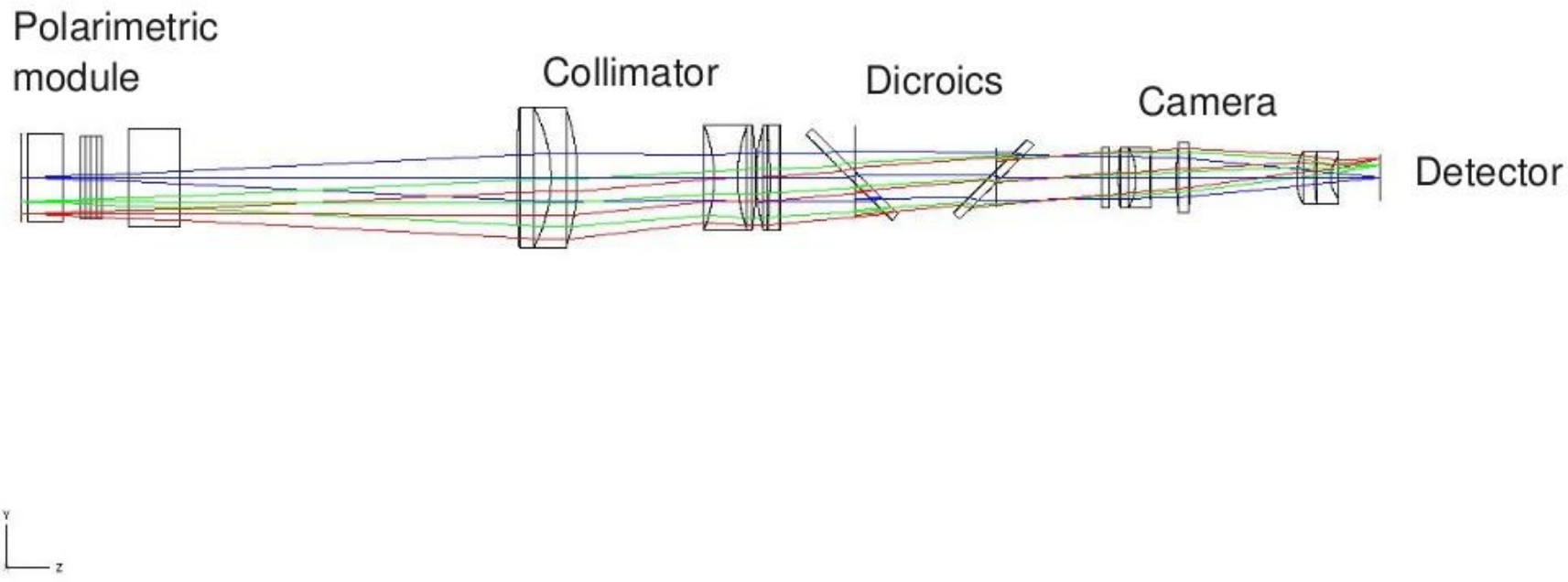
→ **2 bands, chopper, polarimeter, photomultipliers**

SPARC4 is competitive!

- ✓ **SPARC4 is a fast camera that combines the simultaneous measurement of polarization and/or photometry on four bands with bidimensional detectors**

Some work...

Preliminar optical design



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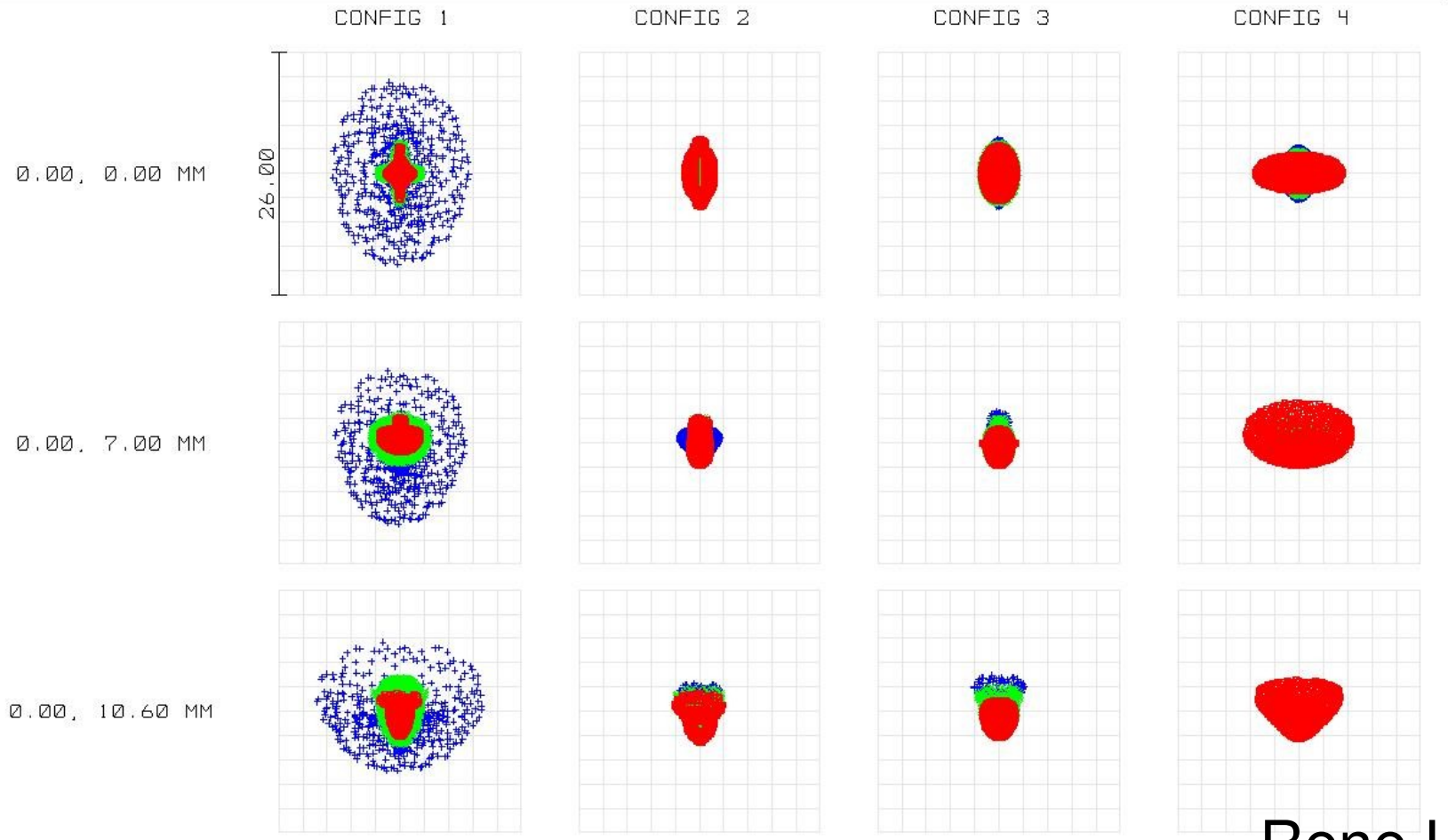
Spot diagram



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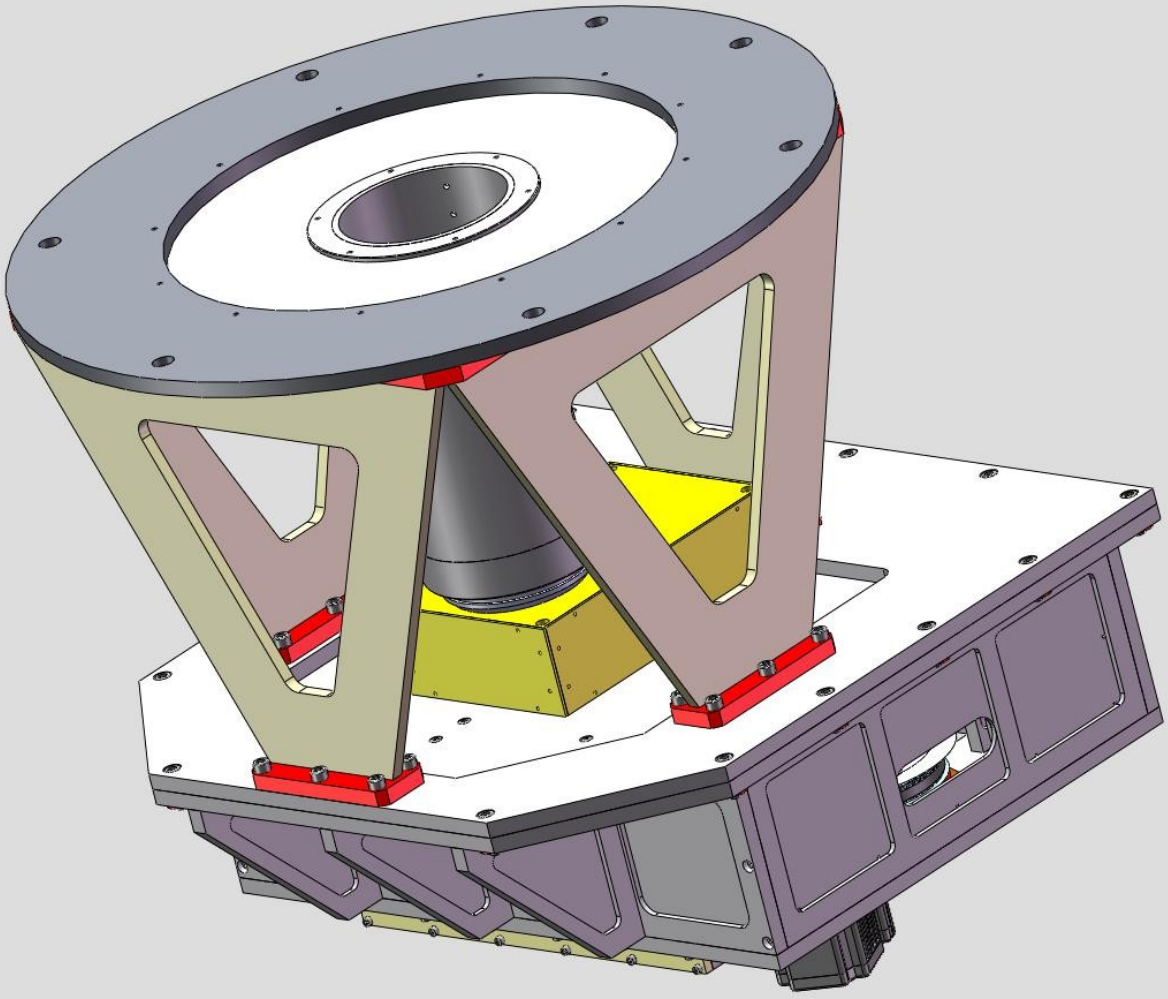
Mechanical design



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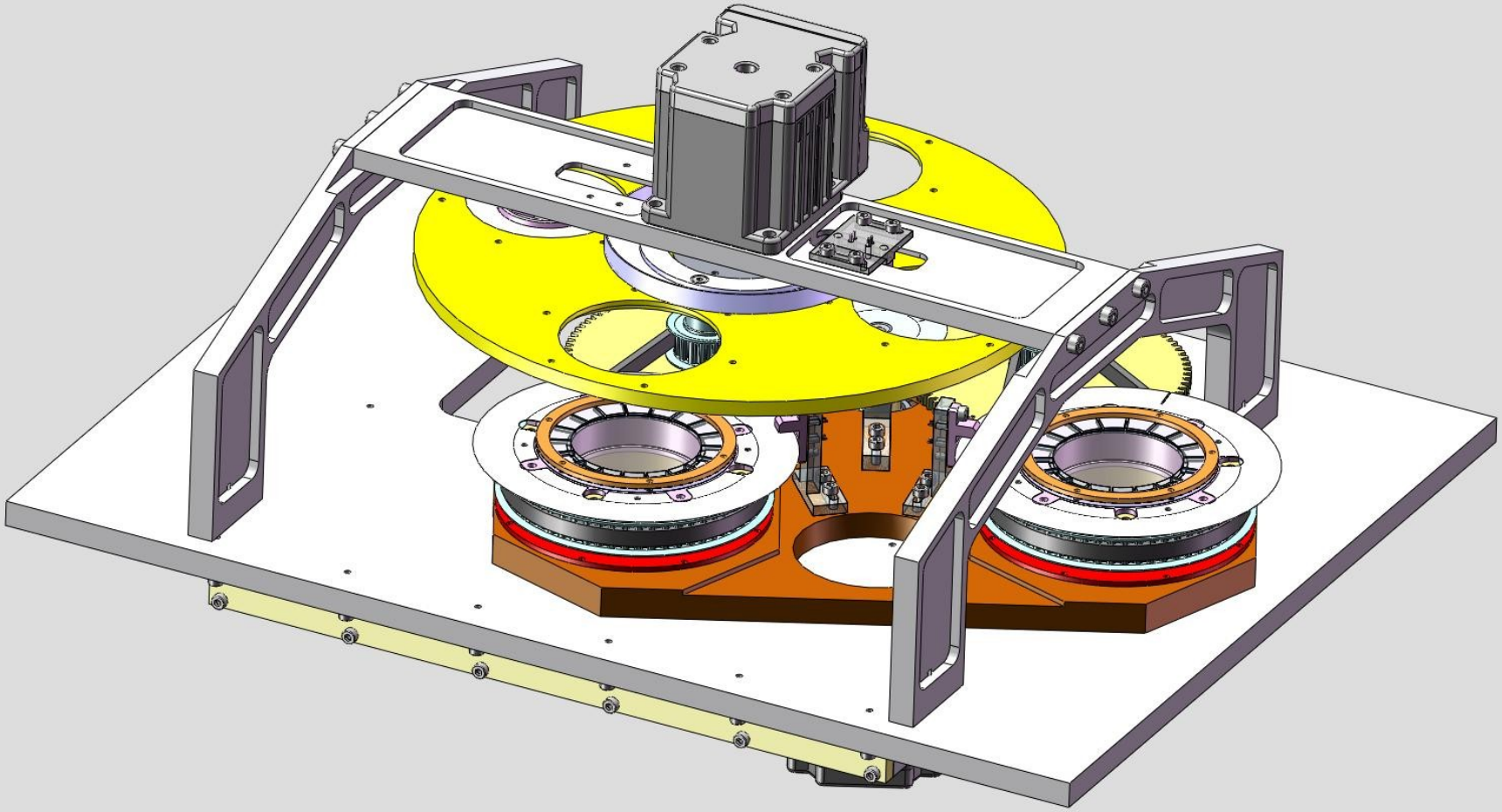
Mechanical design



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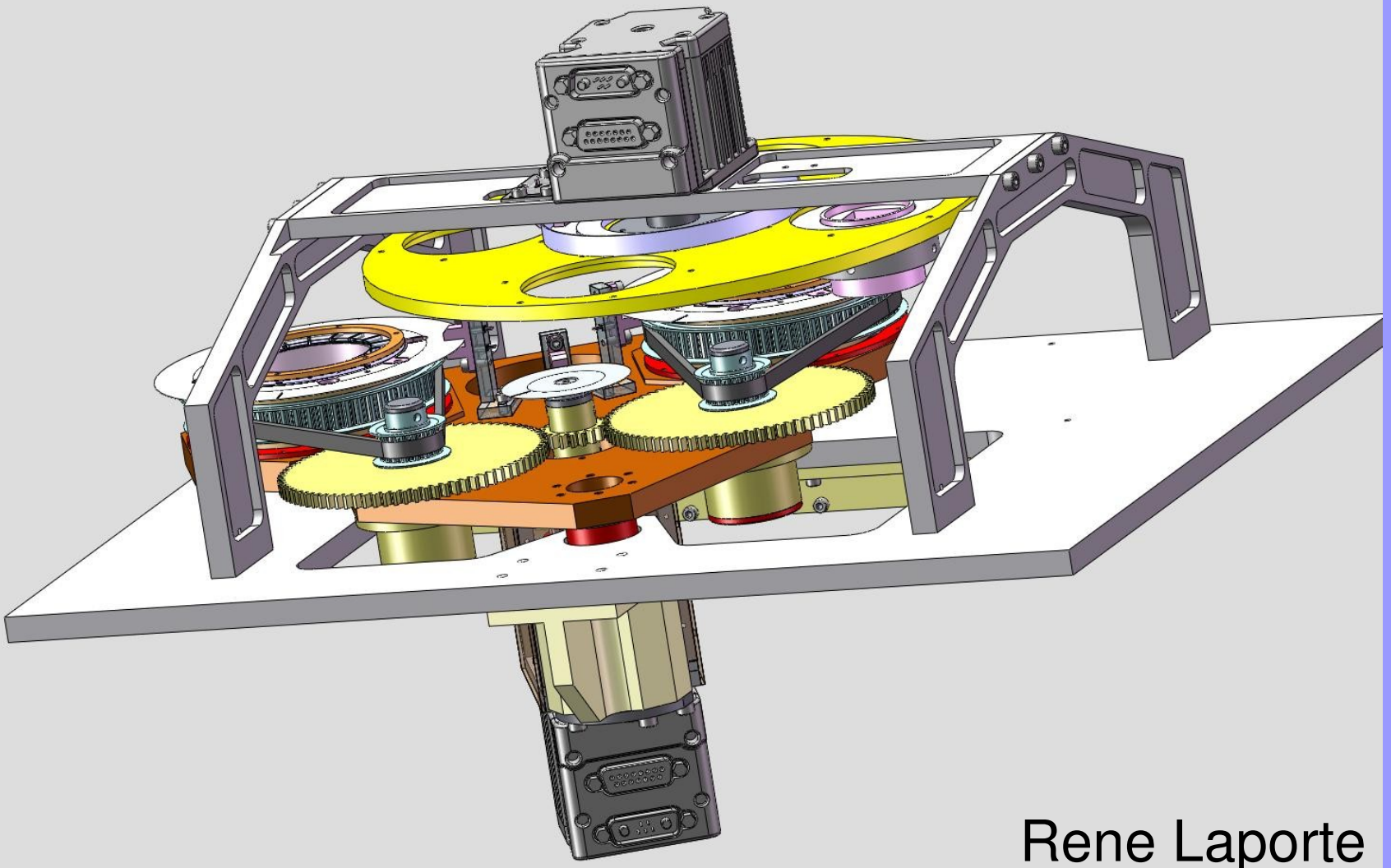
Mechanical design



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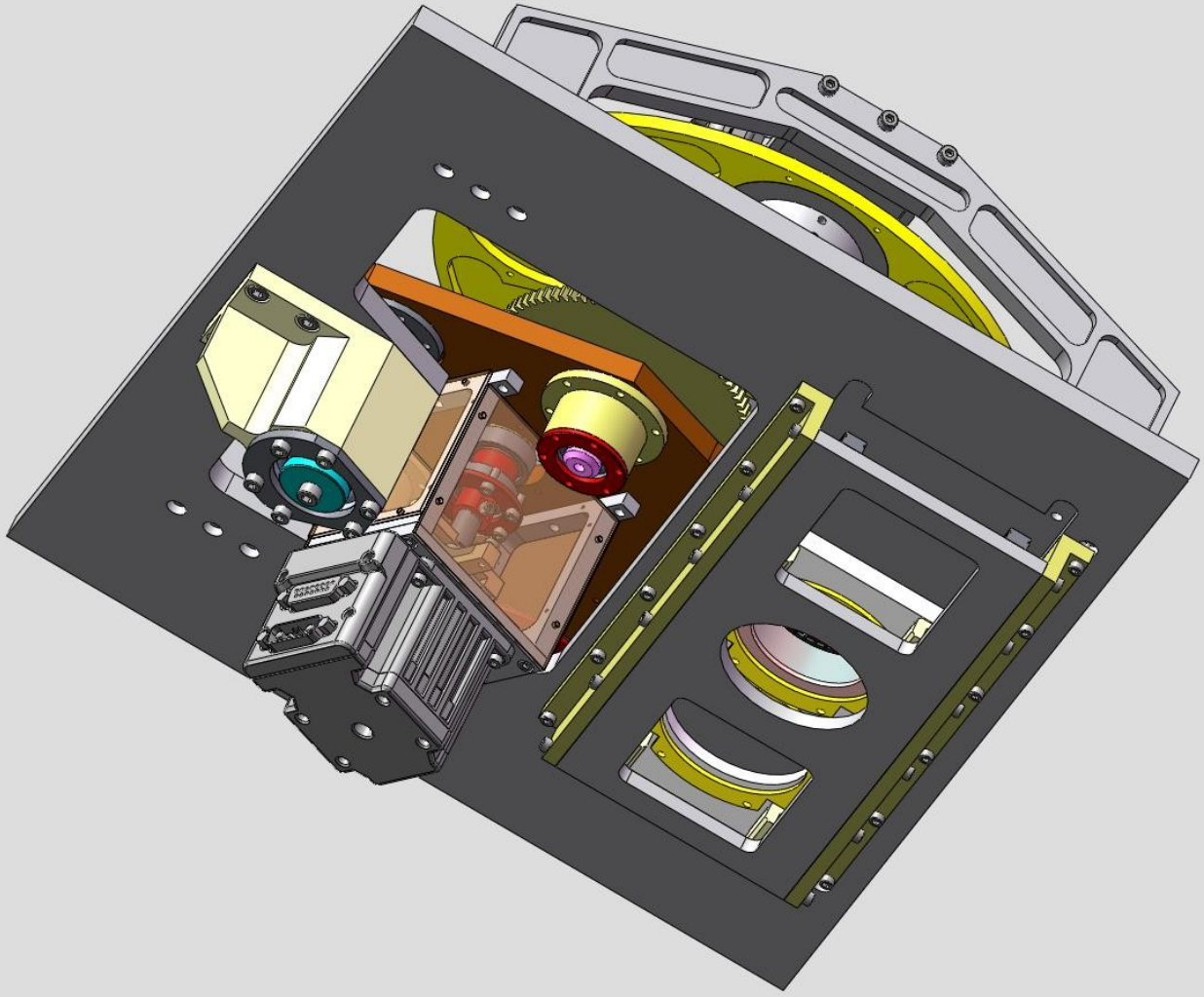
Mechanical design



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Fapesp proposal

✓ **Conceptual design phase**

➜ **studies...**

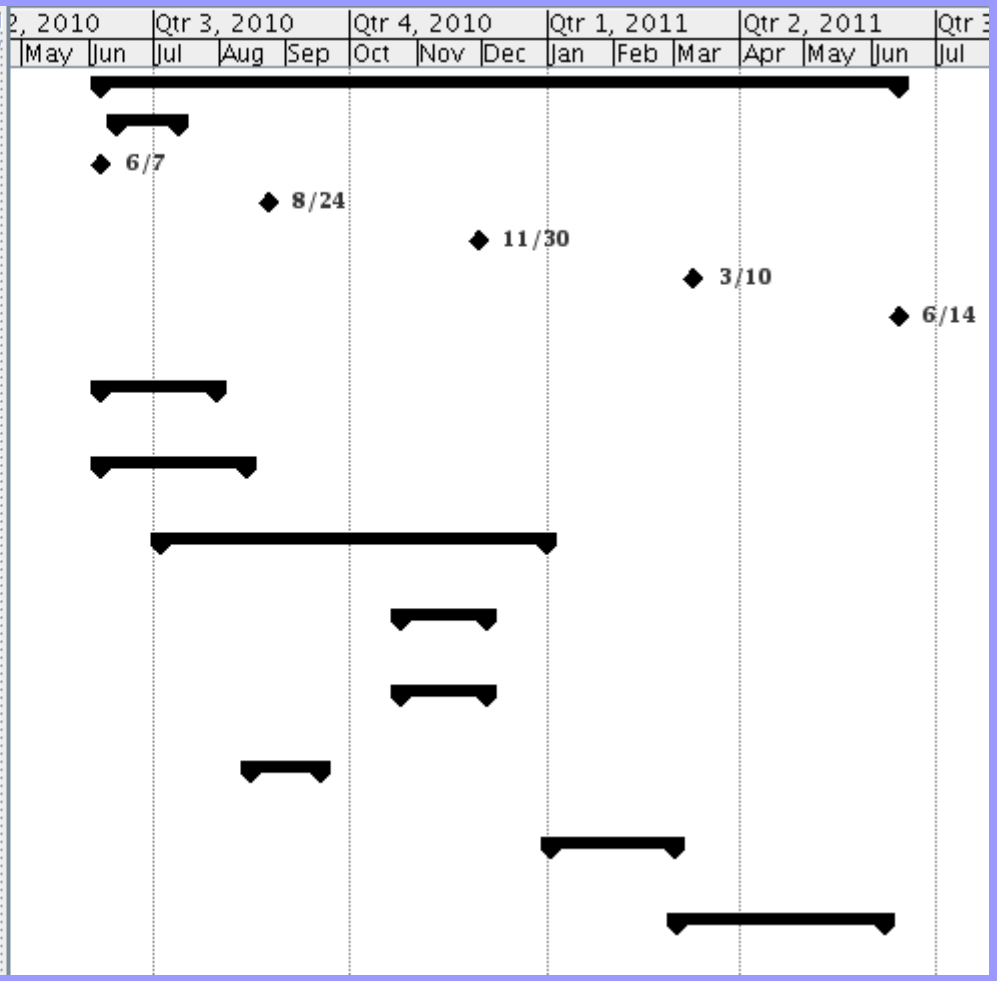
✓ **Infrastructure**

➜ **a basic lab to test instruments**

Proposal submitted in February

Schedule

	Name	Duration
1	⊟Milestone	266 days
2	⊞Science requirements	22 days
5	Secure FAPESP funding for Concept Design Phase	0 days
6	Internal Review (Detector & Optics)	0 days
7	Internal Review (Electro-mechanics)	0 days
8	CoDR	0 days
9	Funding of Final Design and Procurement	0 days
11	⊞Detector Design Study	40 days
19	⊞Optical Design	50 days
28	⊞Opto-mechanical design	130 days
39	⊞Electronics control	30 days
44	⊞Software control	30 days
49	⊞Data Reduction pipe-line	25 days
53	⊞Concept Design Review	42 days
58	⊞CoDR response and preparations for next phase	70 days



Next step

✓ **Define the final list of requirements**

➜ **Workshop/meeting among interested people**

Are you interested?

- ✓ **http://www.das.inpe.br/sparc4**

- ✓ **Contact:**
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