

In Situ Calibration Units

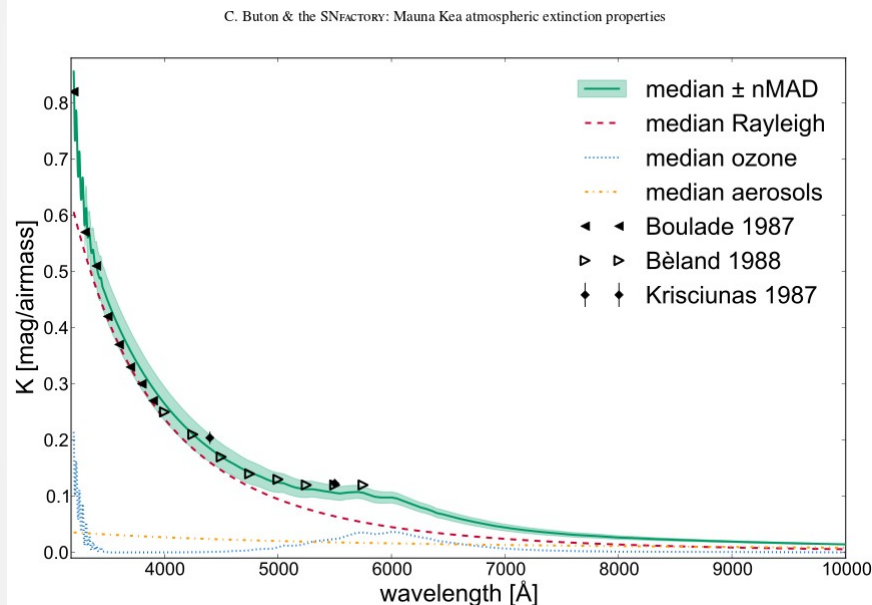


Daniel Küsters, Humboldt Universität zu Berlin
Zeuthen 17.09.2015

Split Calibration

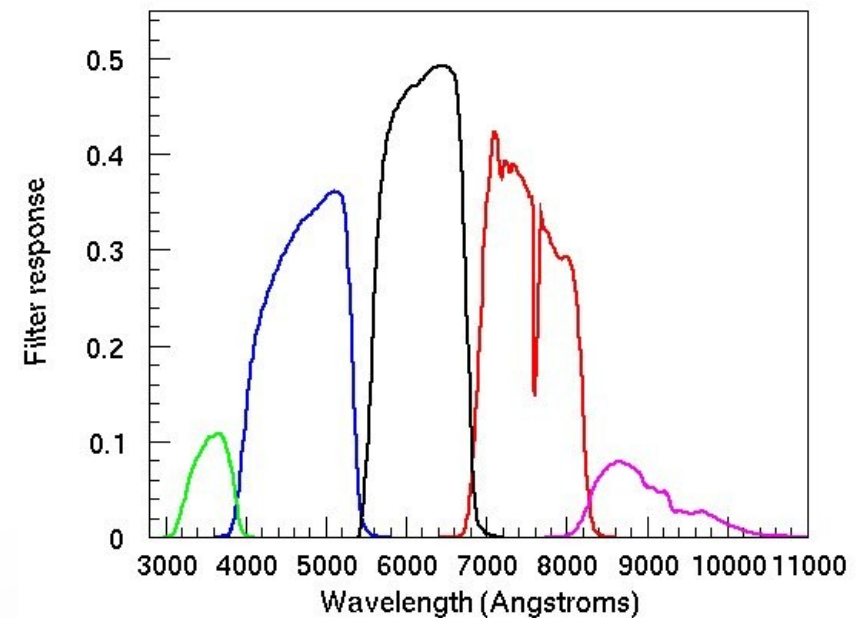
$$S_i(\lambda, \hat{z}_i, t) = S_i^*(\lambda, t) \times C(\lambda, t) \times T_{\text{atm}}(\lambda, \hat{z}_i, t)$$

Atmosphere



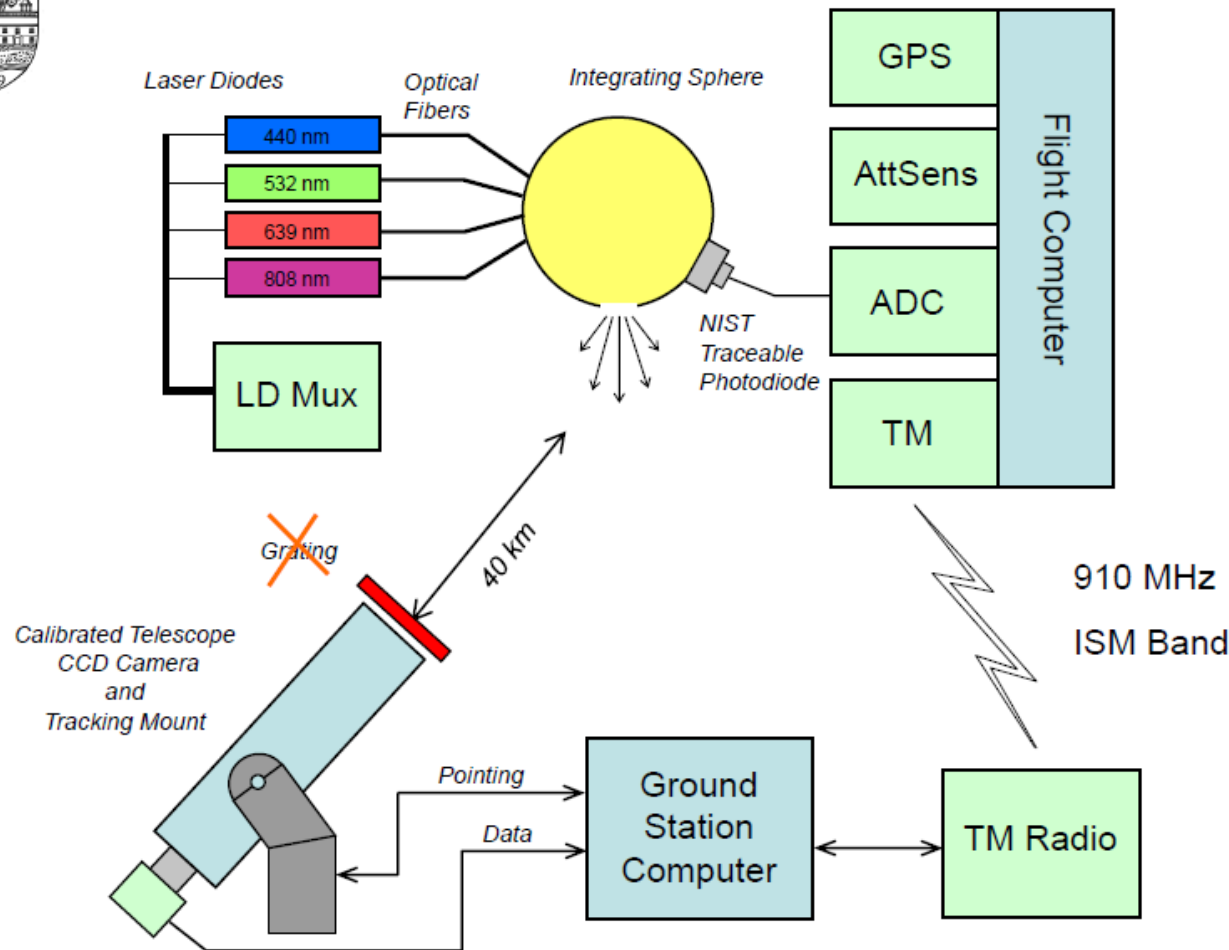
C. Buton A&A 549, A8 (2013)

Telescope and Detector



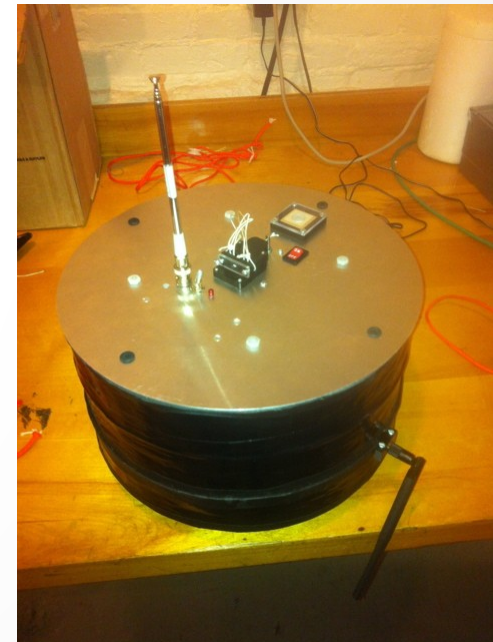
https://www.sdss3.org/images/camera_filters.jpg

Altair Balloon Borne Source Precision Calibration Project



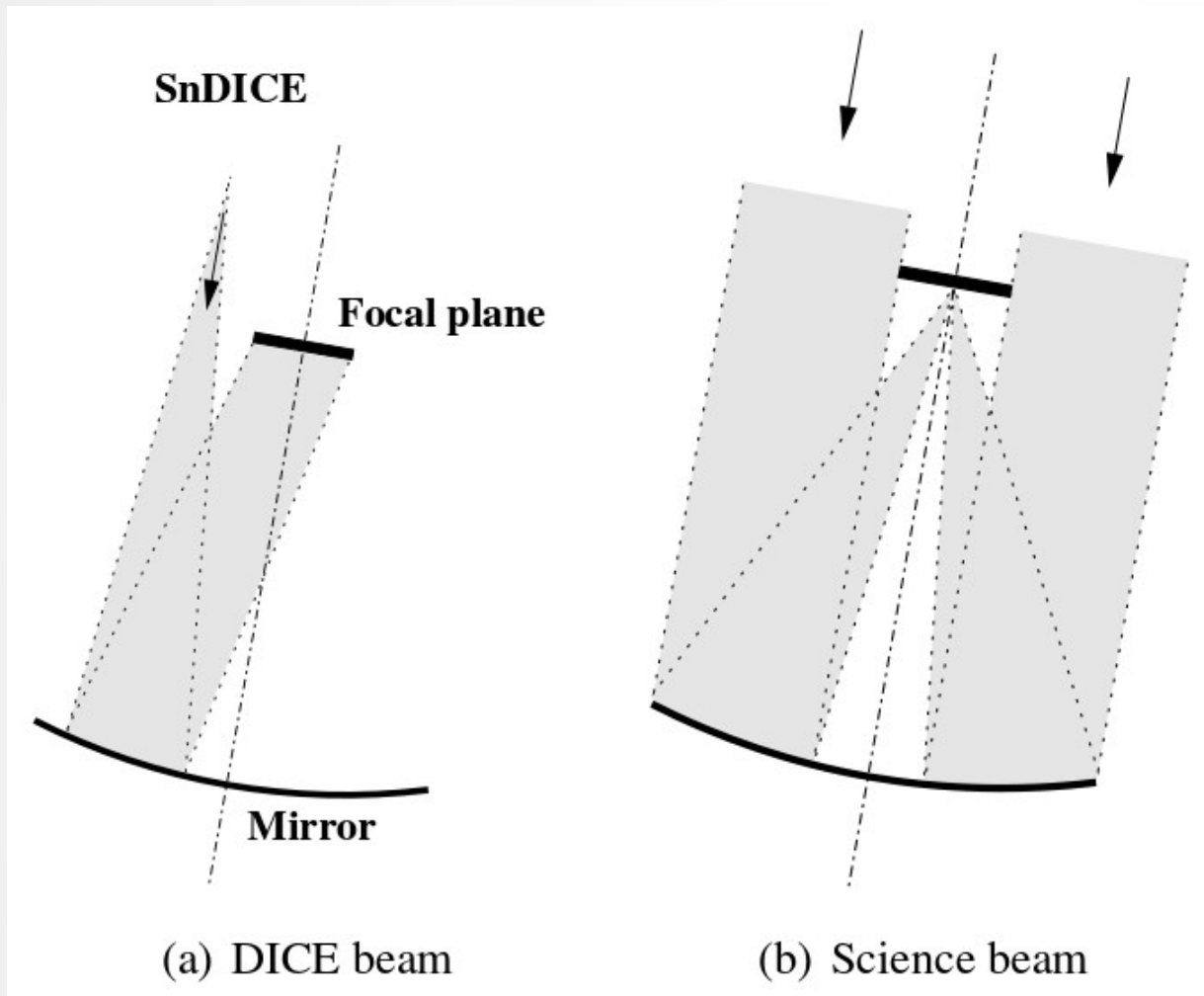
http://projectaltair.org/public/files/CalCon_2013_YJB_Proceedings.pdf

Balloon carries laser light source, producing an artificial star



<http://altair1.dartmouth.edu/images/A2-Hardware/ALTAIR2-Gondola.jpg>

SnDICE



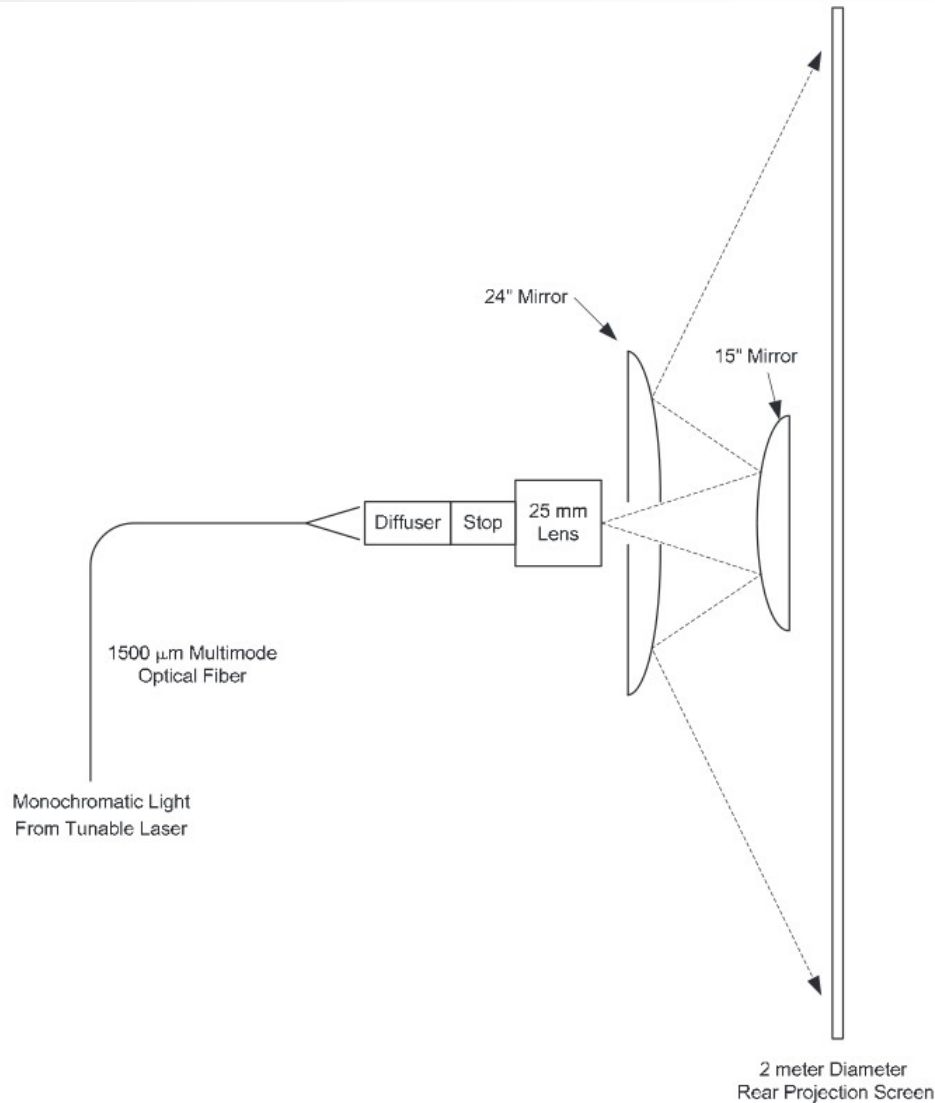
A&A 581, A45 (2015)

LED light source
at final distance,
illuminating the
focal plane

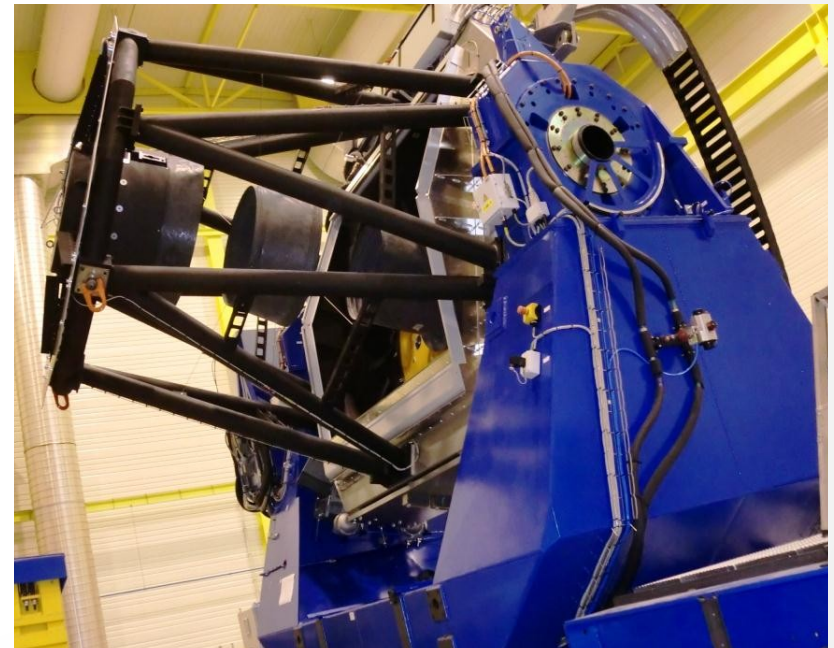


http://astro-canada.ca/_en/photo690.php?a2110_cfht2

PanSTARRS Calibrator



Tunable Laser light source
illuminating a flat field screen

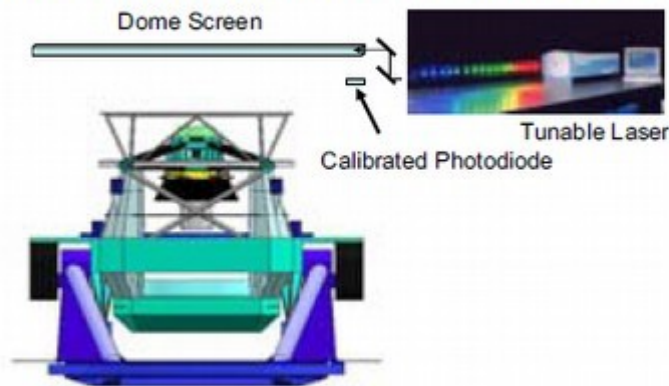


<http://pan-starrs.ifa.hawaii.edu/public/project-status/images/PS2-telescope.jpg>

LSST Calibration

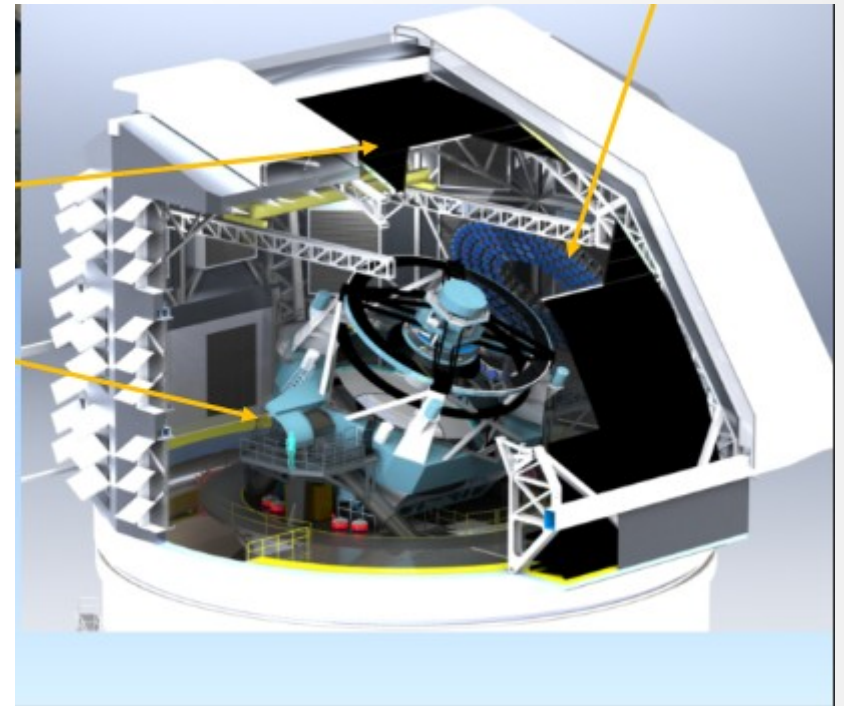
Measurement of Instrument Response

A system to use a tunable laser to calibrate the combined telescope and camera response function $I(x,y,v,t)$ is being developed. (Stubbs and Tonry 2006).



A photodiode calibrated to $\sim 0.1\%$ relative accuracy (NIST98) from 450nm to 950nm monitors the integrated optical exposure. Spatial uniformity of light from the screen need only be $\sim 10\%$, but the angular distribution must be uniform (Lambertian) over the 3.5° LSST FOV. First tests of a similar system on the CTIO Blanco telescope have been reported (Stubbs 2006).

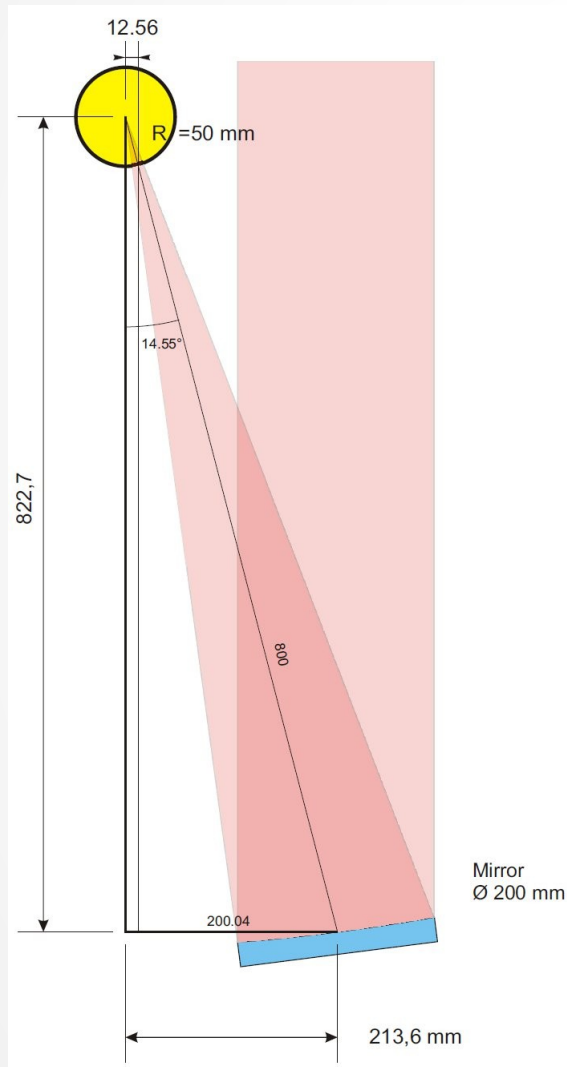
http://www.lsst.org/sites/default/files/docs/Burke_086.05.pdf



<https://www.noao.edu/meetings/lst-spec/files/overview-sci-reqs.pdf>

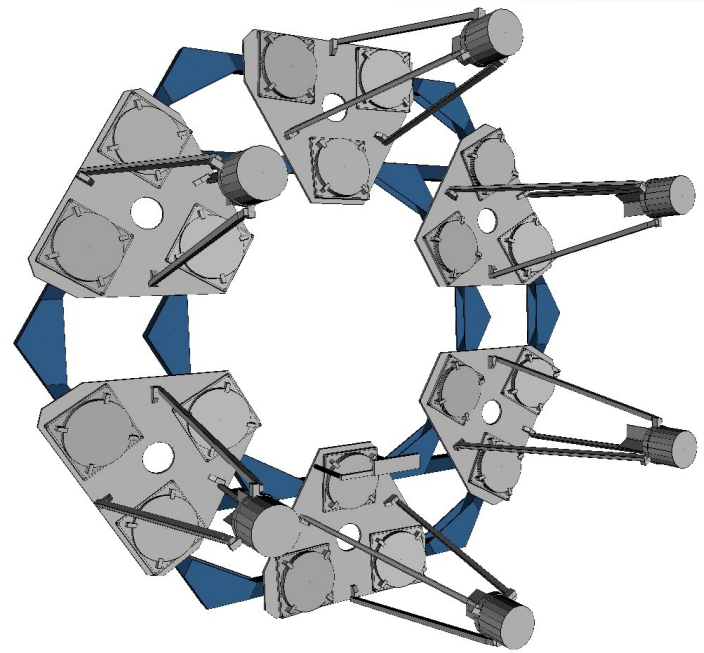
SNIFS Calibration Aparatus

Telescope



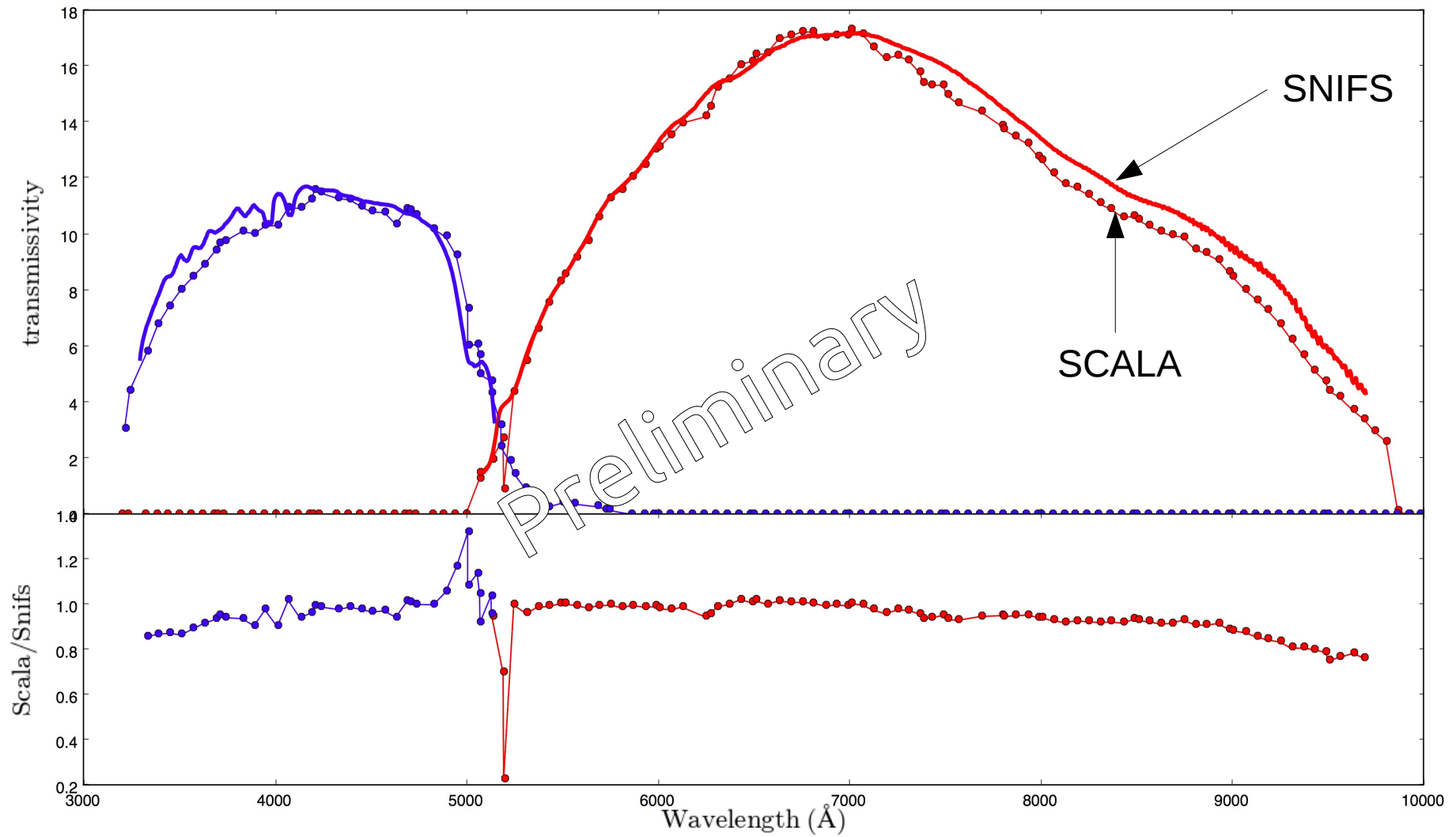
Monochromator light source producing an artificial planet with constant surface brightness

Mounted @ UH 88 Big Island, Hawaii

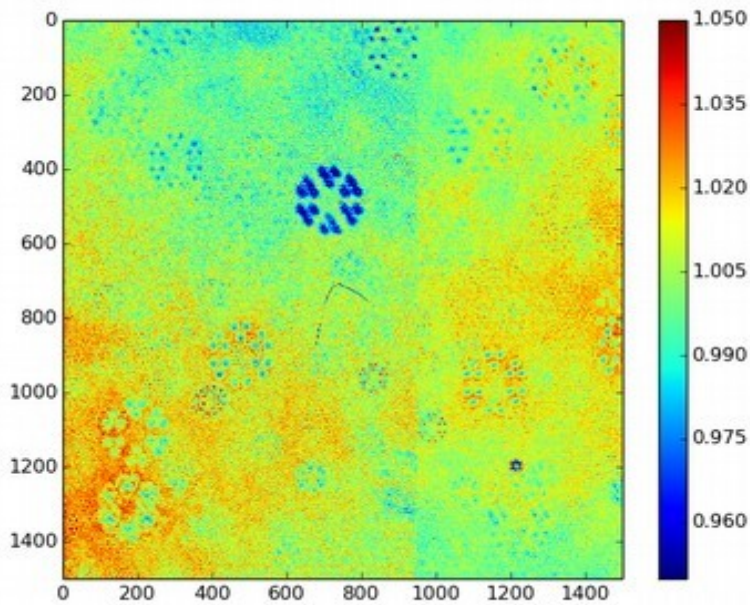


Proceedings of the SPIE, Volume 9147, id. 91474R 11 pp. (2014)

SCALA first Data

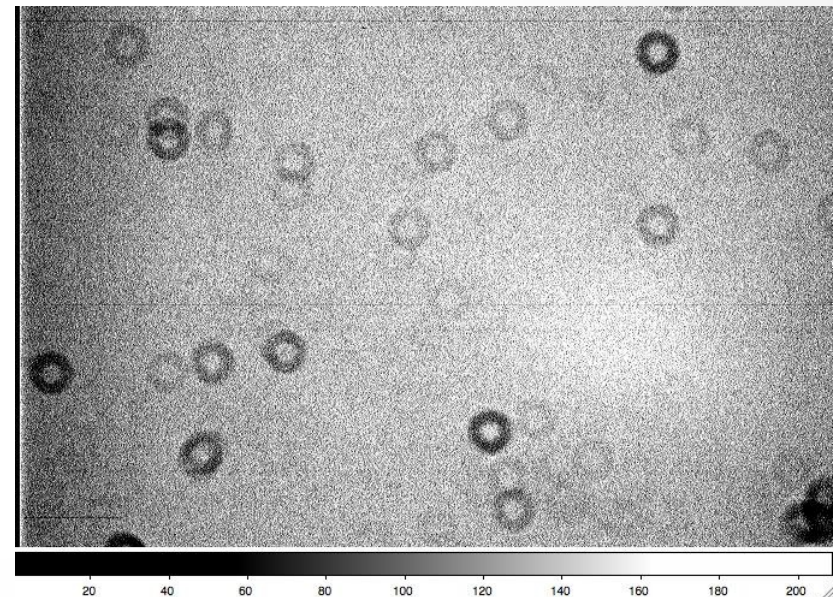


Illumination of the Entrance Pupil



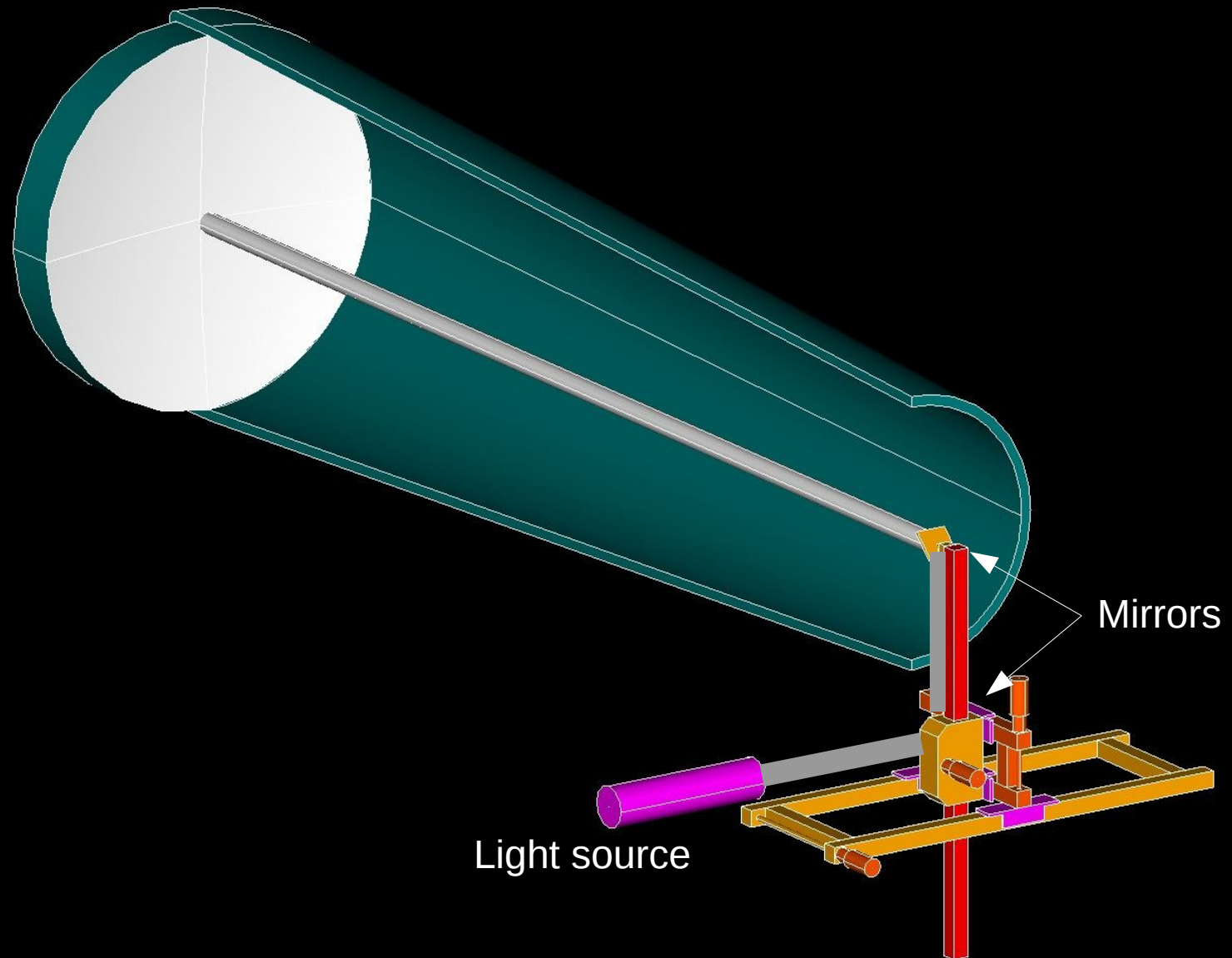
Proper dust correction needs
illumination of full entrance pupil

Movable device to cover the pupil



<http://www.astr.ua.edu/keel/techniques/dustflat.jpg>

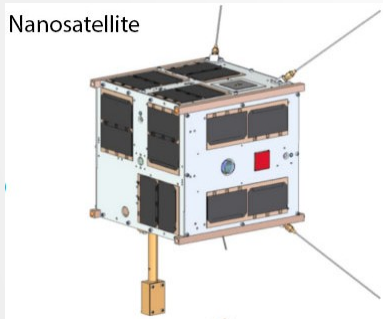
XY Moving Stage



Video

Conclusion

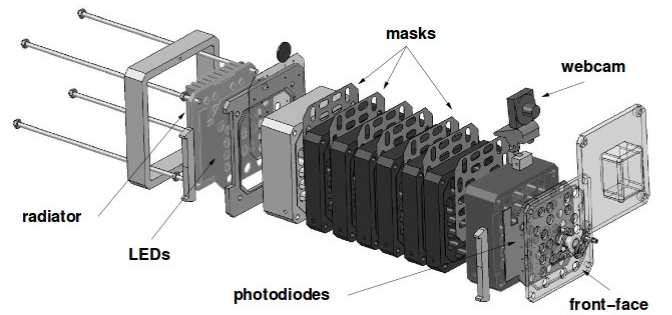
- Several calibration units working
- Physical calibration device needed for SNe Ia



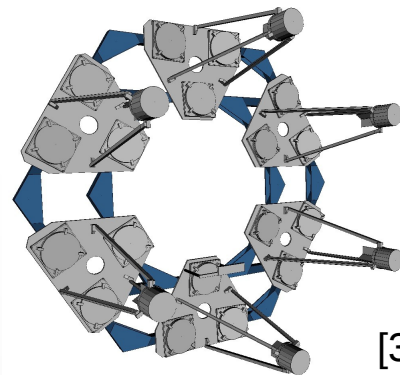
[1]



[1]



[2]



[3]



[4]

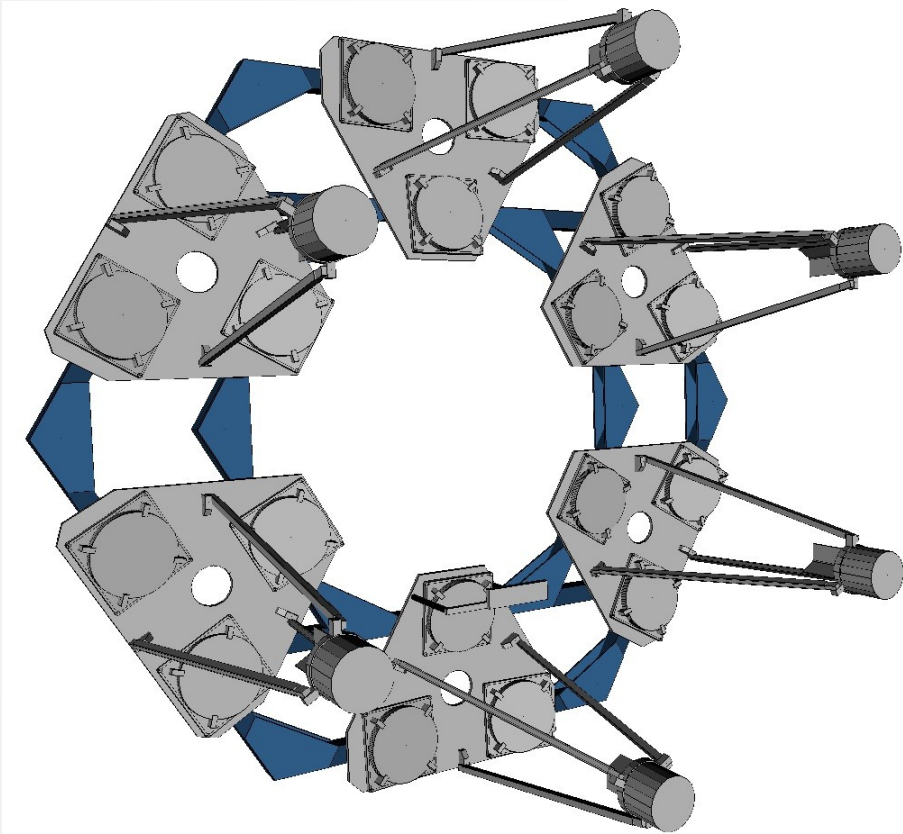
Sources

- [1] Altair Balloon Project
- [2] SnDice
- [3] Scala
- [4] http://www.astro.wisc.edu/~morscher/dome_flat.jpg

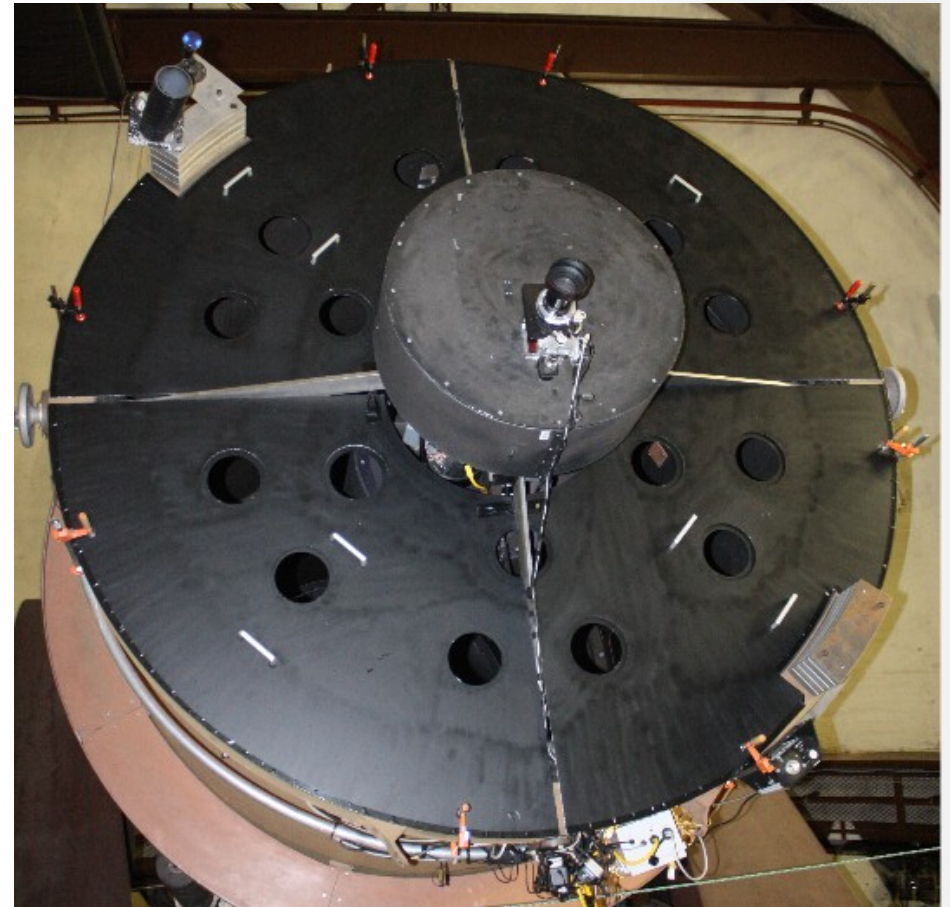
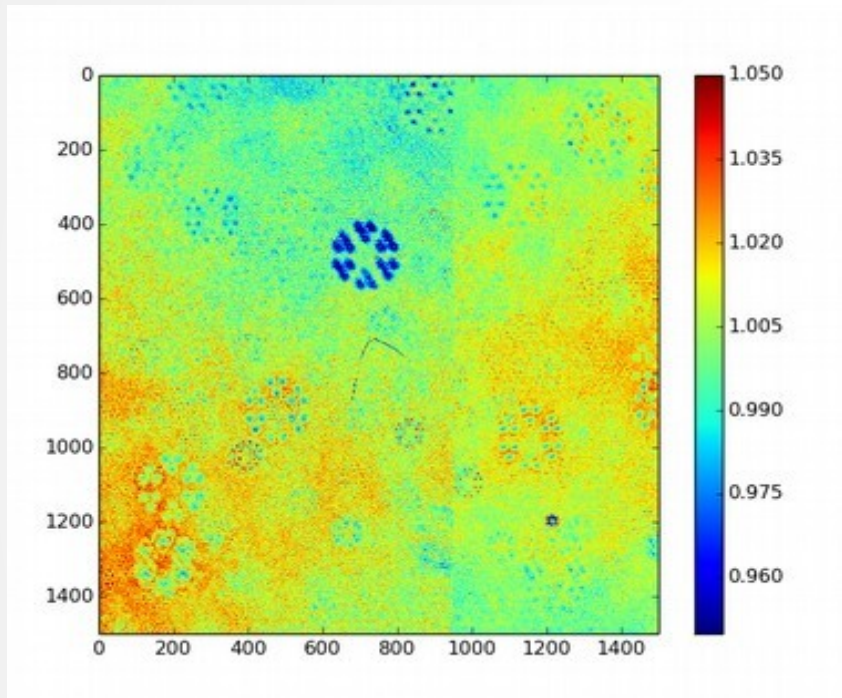
Back up

SCALA

- Six modules with 18 mirrors and 6 integrating spheres



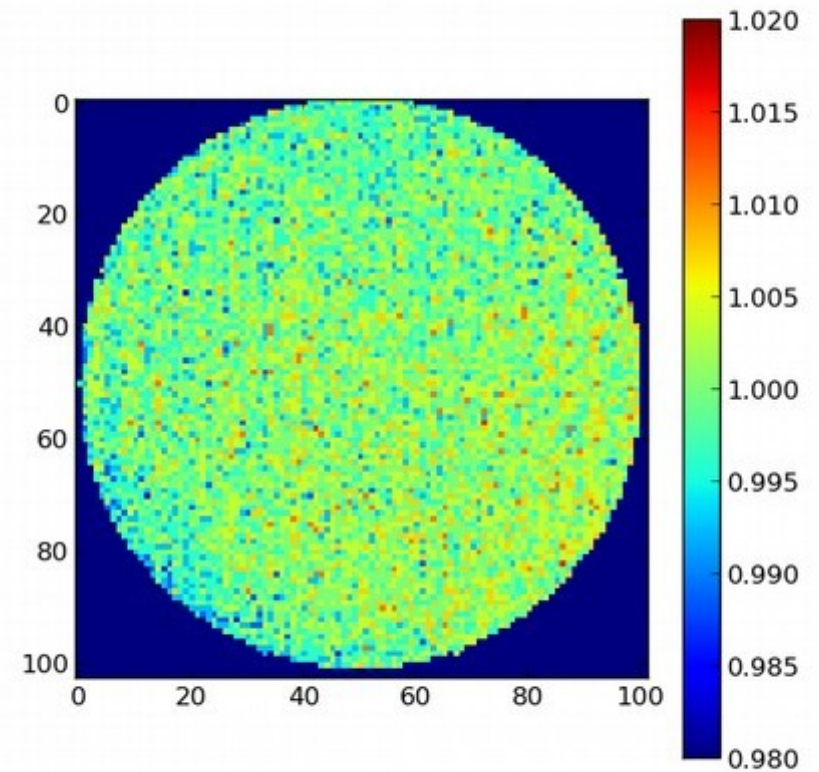
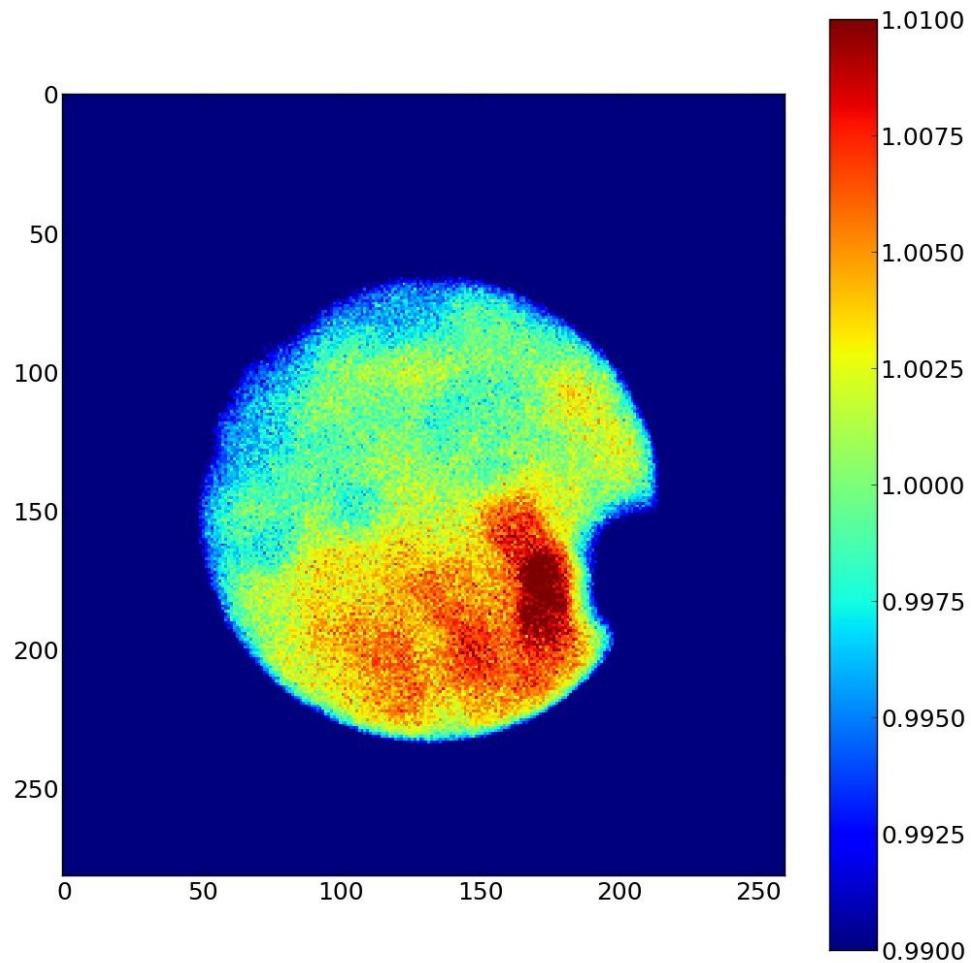
Illumination of the Entrance Pupil



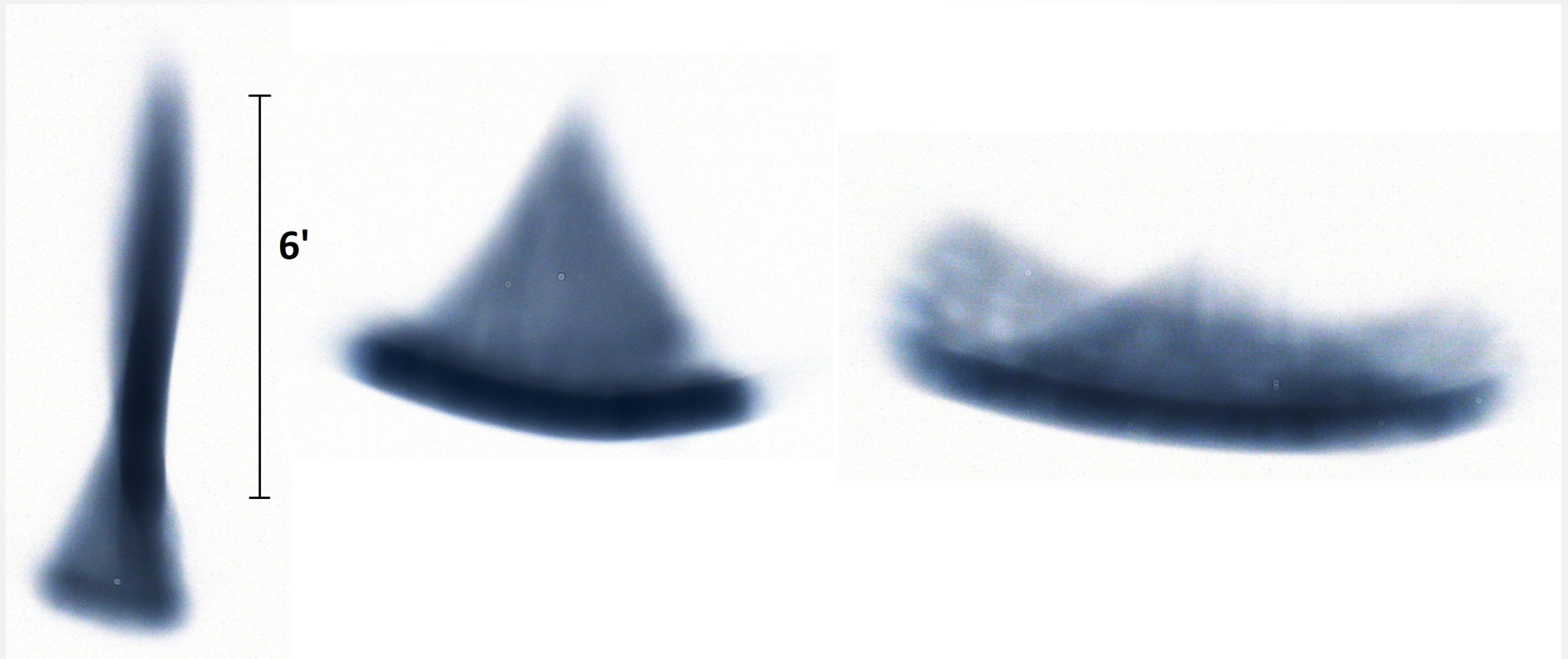
SCALA



SCALA Properties



SCALA Properties



DICE

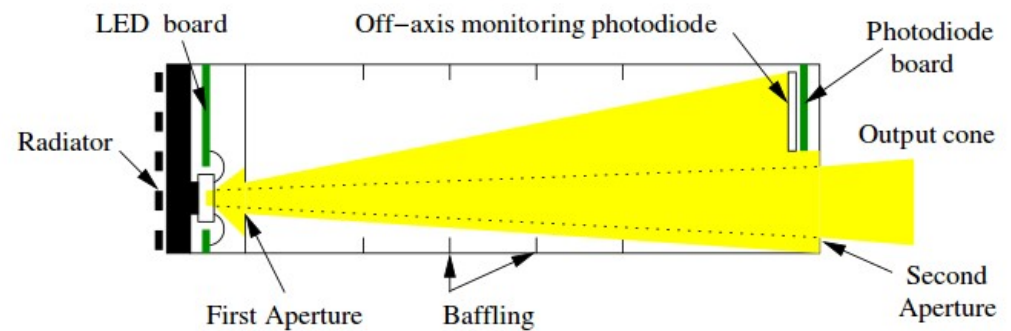
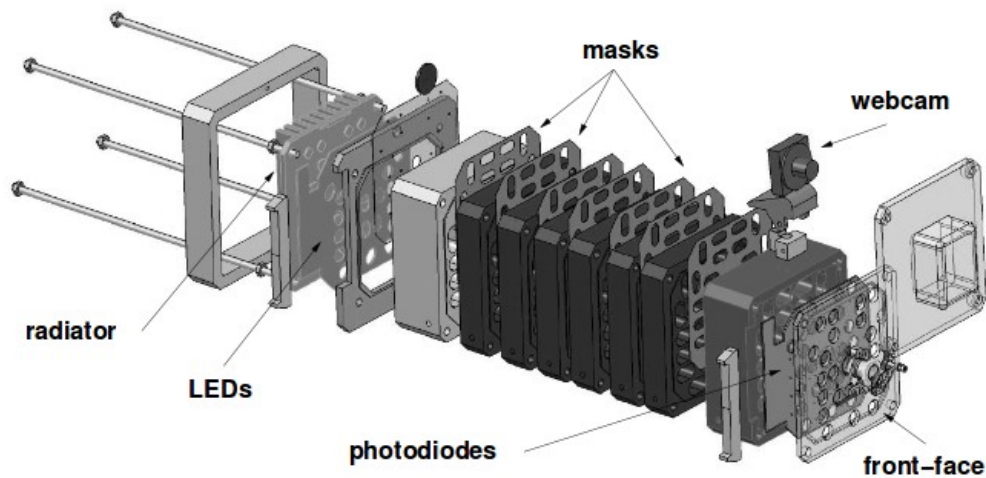


Fig. 5. Sketch of a calibration channel showing the emitting LED and the off-axis monitoring photodiode.

Palomar Schmidt



Daniel Küsters, 17.09.2016 Wikipedia: Palomar Observatory

Issues Flat Field

