SNAP Telescope Performance for Weak Lensing Surveys

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Science Requirements

Visible and NIR, 0.4 μm <λ< 1.7 μm

Two year SNe mission, 2000 SNe 0.3<z<1.7

One year WL survey, 1000 deg²

Three added years WL, total 4000 deg²

These drive observatory design......

* 592 megapixel imager, 9 wavebands
* Spectrometer with IFU, 0.4 μm <λ< 1.7 μm
* 0.7 deg² instantaneous pixellized field
* 70 deg solar avoidance angle

Telescope basics

Annular field three-mirror anastigmat

D.Korsch Appl.Optics 1972, 1977, 1980

Flat focal surface

No refractive correctors needed

2 meter class aperture

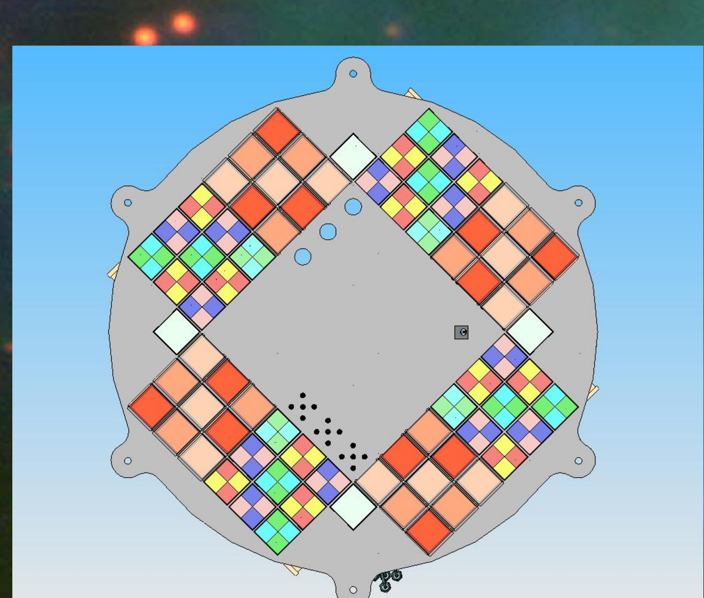
Protected silver coatings

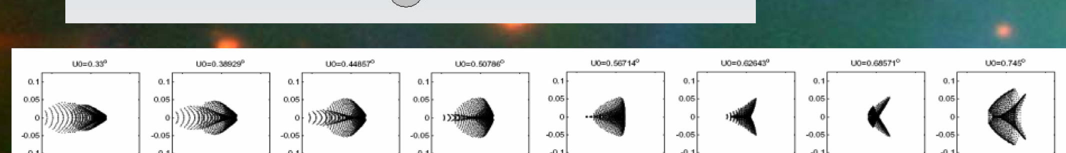
EFL = 22 meters, f/11 to f/12

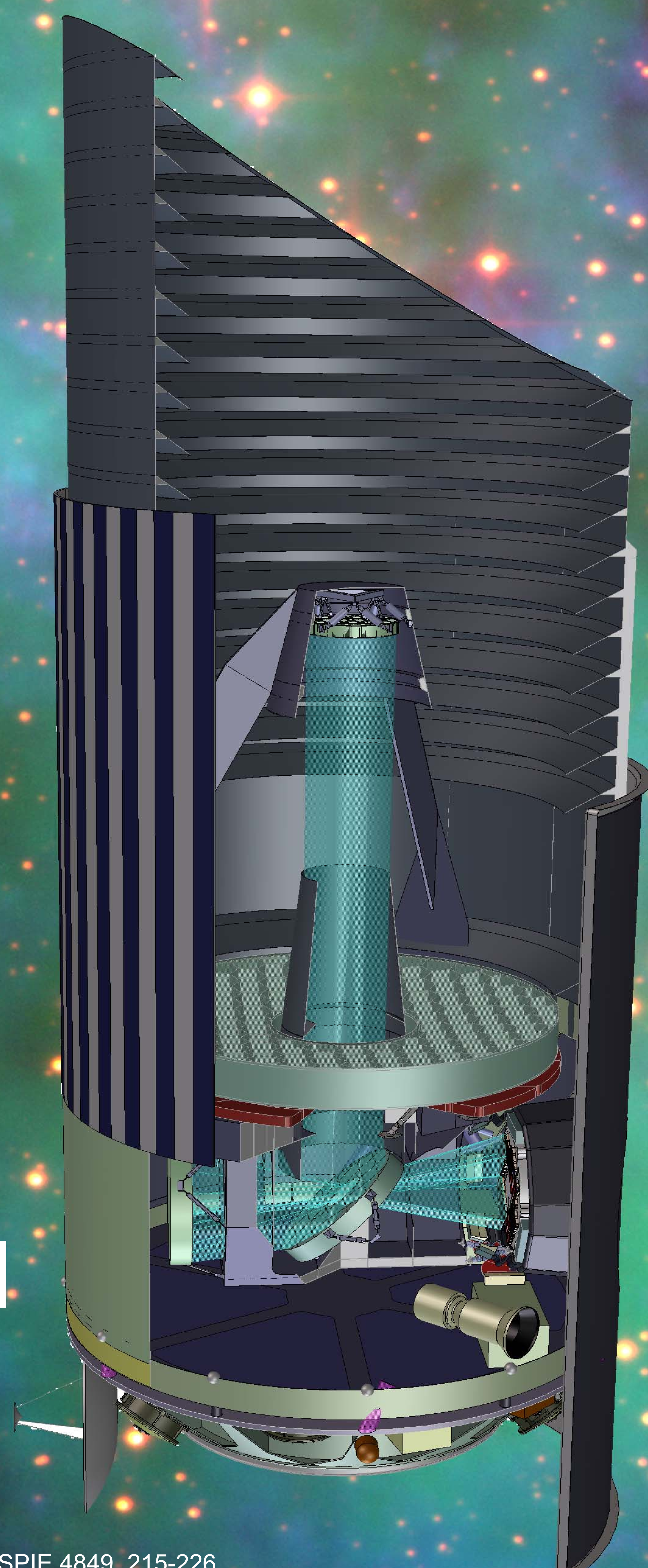
105 μm /arcsecond plate scale

0.1 arcsec 10.5 μm Si CCD pixels

1.56 deg (600mm) diameter annular field







Expect extreme PSF Stability

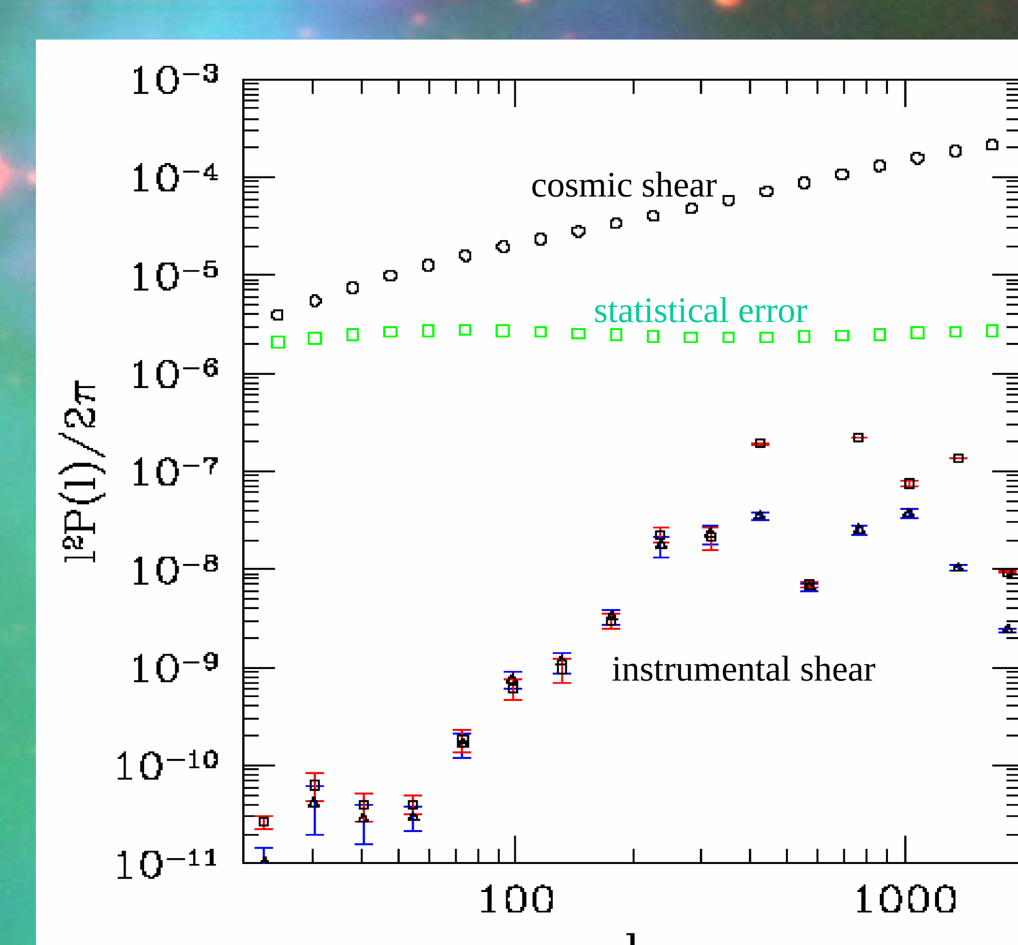
* telescope is thermally isolated from outer baffle
* no deployed panels, antennas, or radiators
* active thermal control on optics & structure
* benign L2 orbit location with no shadows
* low-CTE ULE™ or Zerodur™ mirror optics
* low-CTE carbon fiber cyanate ester structure
* comprehensive thermal modelling
* Sholl et al 2005 predict < 0.2 mas/24 hours

Instrumental PSF Determination

* approx 1000 usable stars in each exposure
* many step & stare exposures
* PSF is tracked on the fly using these stars

Simulated WL survey

* 32 x 32 degree region, spanning one year
* **thermal**: attitude varies; optics temperatures vary
  - time scales of hours to weeks
* structural **vibrations** from momentum wheels
  - time scale of minutes to hours
* star tracker guide **jitter** varies from field to field
  - time scales of minutes



In the plot above we show the power spectrum of shear over the range of spatial frequencies 20<l<2000. The black circles are modelled values of observable shear seen in a flat universe with Ω_m=0.27. The green squares show the errors in the shear power estimates, based on the statistics of the number of lensed targets. The red and blue points show the computed instrumental shear power contributions for the thermomechanical model described above. We conclude that the instrumental effects will be 10 to 1000 times smaller than the statistical errors in the SNAP 1000 deg² shear spectrum.

Instrumental effects will be small.

References:

Lampton,M., et al 2002 "SNAP Telescope" Proc SPIE 4849, 215-226

Lampton,M., et al., 2003, "SNAP Telescope: an Update" Proc.SPIE 5166, 113-123

Sholl,M., et al., 2004 "SNAP Telescope" Proc SPIE 5487, 73-80

Sholl,M., et al., 2005 "SNAP Point Spread Function" Proc. SPIE 5899, 27-38

Stabenau, H., et al 2007 "Systematic Errors in the SNAP Lensing Survey induced by PSF anisotropy" Experimental Astronomy, submitted Oct 2006

Dumbbell Nebula, recorded with an LBL CCD, courtesy of NOAO

Telescope artwork by R.E.Lafever

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