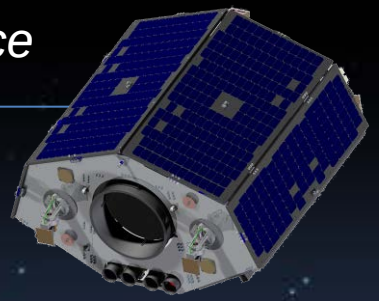
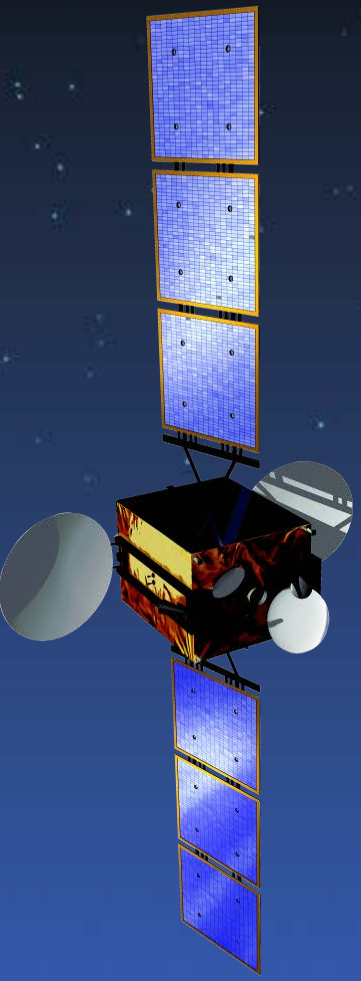
SURREY SATELLITE TECHNOLOGY LTD

Changing the economics of space





CEOI Technology Conference: 22nd April, 2015 TRUTHS Earth imager development

Dan Lobb

TRUTHS mission – requirements

- **TRUTHS will be an Earth-observation system with wide spectral range, moderate spectral resolution and extremely accurate absolute calibration**

- Climate benchmark (CB):
  monitoring long-term changes in Earth radiance/reflectance
  - Spectral range ~320nm to 2400nm
  - Spectral resolution <10nm
  - Coarse spatial and radiometric resolution (e.g. 100mm) are ok
  - Low signal-noise ratio (SNR) can be accepted
- Solar irradiance (SI) measurements
  - 320nm to 2400nm
  - Spectral resolution <1nm for UV, coarser for visible and SWIR
  - Spatial resolution not relevant
  - SNRs can be enhanced by long integrations etc.
- Reference calibration (RC) for other missions
  - 400nm to 2400nm @ 5-10nm resolution
  - Spatial resolution down to 50m is desirable for vicarious cross-calibration
  - Moderate SNRs are useful, e.g. 300s at high visible radiances

Earth imager parameters

- Orbit: polar, sun-synchronous, ~609km

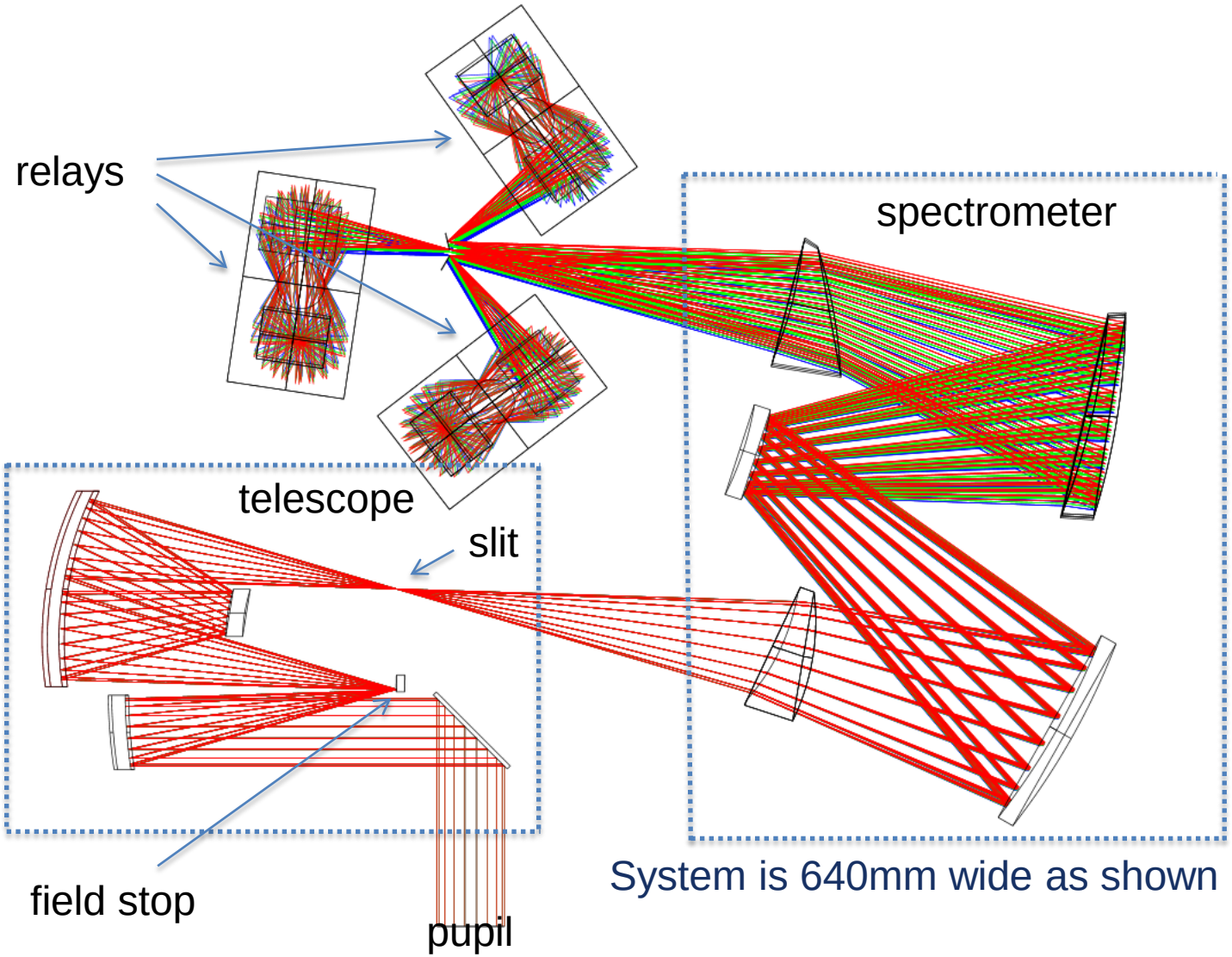
- Baseline targets for Earth imager
  - Spectral range: 320nm to 2400nm
  - Spectral resolution:
    - <1nm for 320nm to 400n
    - <5nm for 400nm to 900nm
    - <10nm for 900nm to 2400nm
  - Spatial resolution: 50m GSD
  - SNR: typically 300 at high radiances in visible range (mainly RC)

- Design requirements (altitude 609km)
  - Focal length 183mm for 0.015 mm detector elements
    - typical for SWIR MCT array, also ok for UV-visible detectors
  - Aperture diameter for SNR typically 45mm (f/4)
  - Field angle 4.7º total
  - Fairly easy targets for optics correction

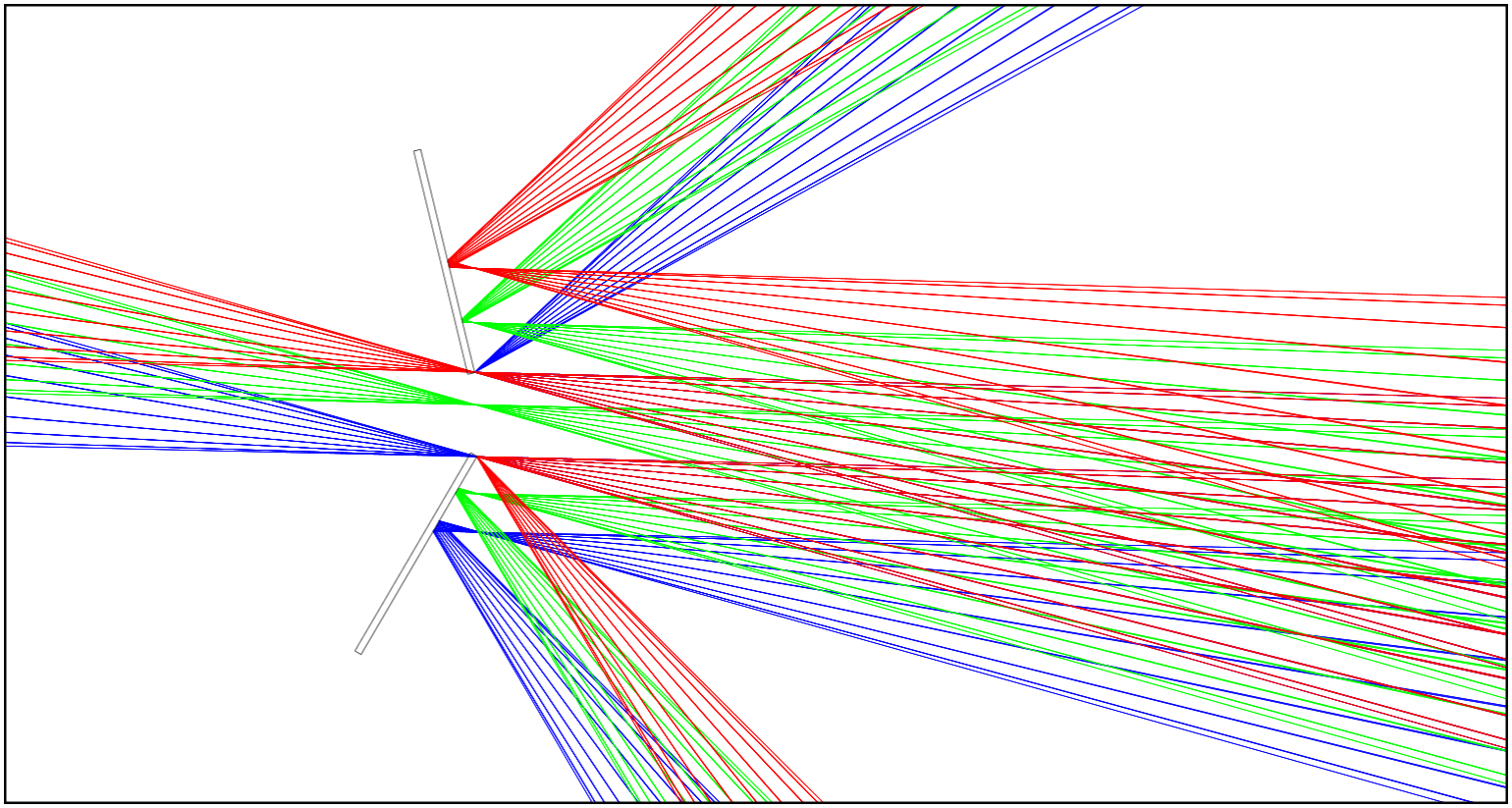
Earth imager design trade-offs

- Detectors
  - SWIR band detector probably an MCT array
    - Could also cover some visible, but not UV
  - Current preference for UV to ~900nm is a back-thinned APS
    - This avoids charge-transfer issues of CCDs
- The specification fits a design approach using prism dispersion
  - Fine spectral resolution in the UV range
  - Coarser for visible/NIR and SWIR bands
  - A single spectrometer can cover the whole range
  - Potential for good stray light control
- Several options for splitting the range between detectors
  - Current preference is a split in the spectrum-image plane, followed by relay optics
  - May also consider a dichroic split

Current baseline optical design



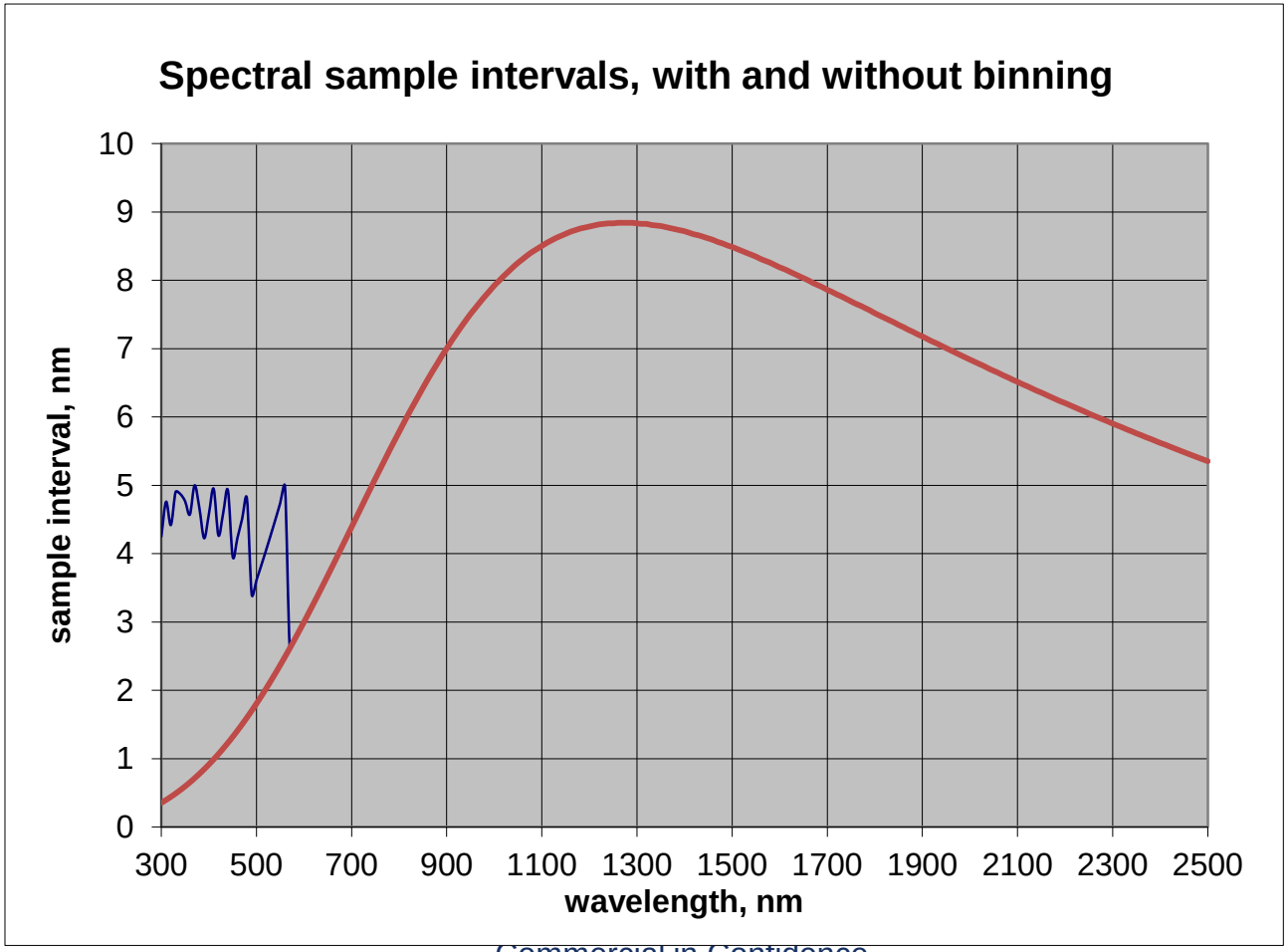
Band split at spectrum image



- Spectrum image formed by the spectrometer is split at mirrors parallel with slit-image lines
- Spectrum splits nominally at 420nm and 900nm

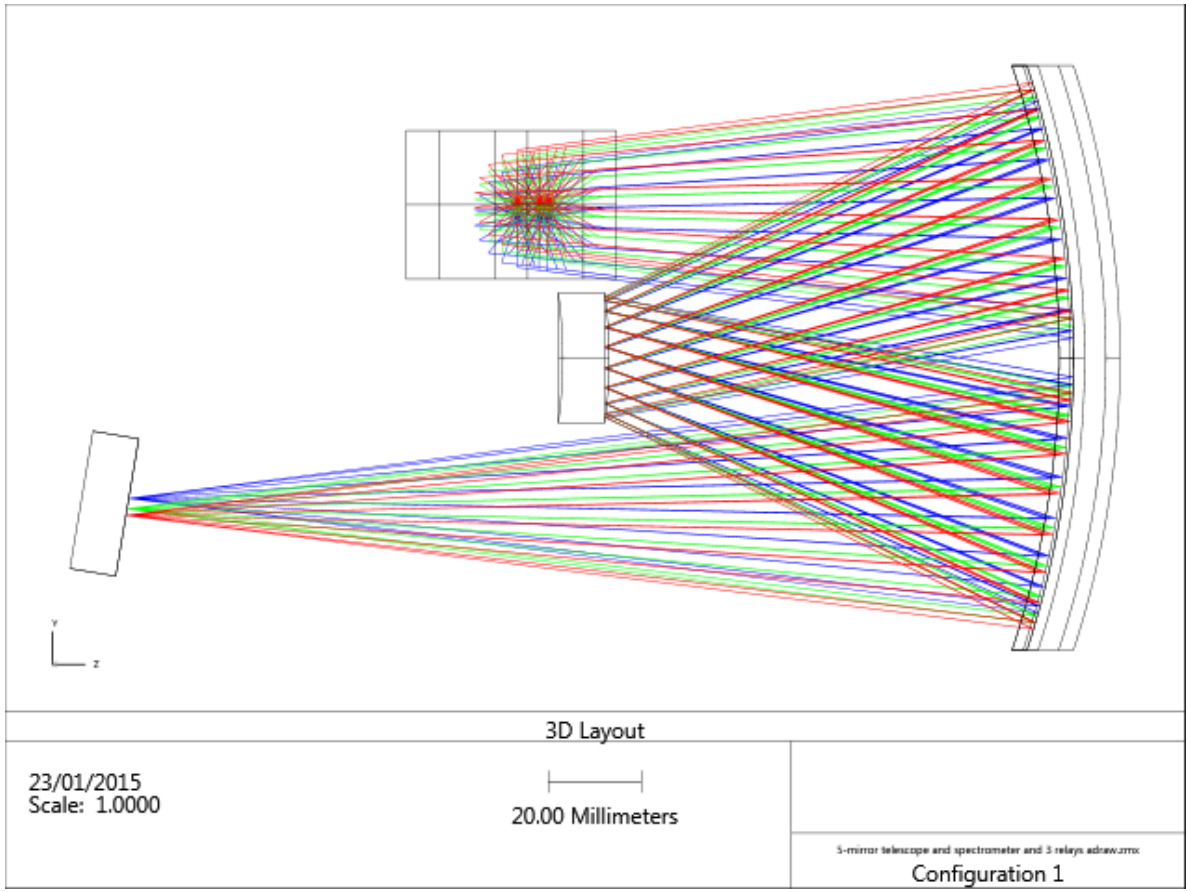
Spectral sampling

- UV binning 5 to 12 rows on chip
- Visible binning up to 1 to 4 rows on chip
- No binning for SWIR

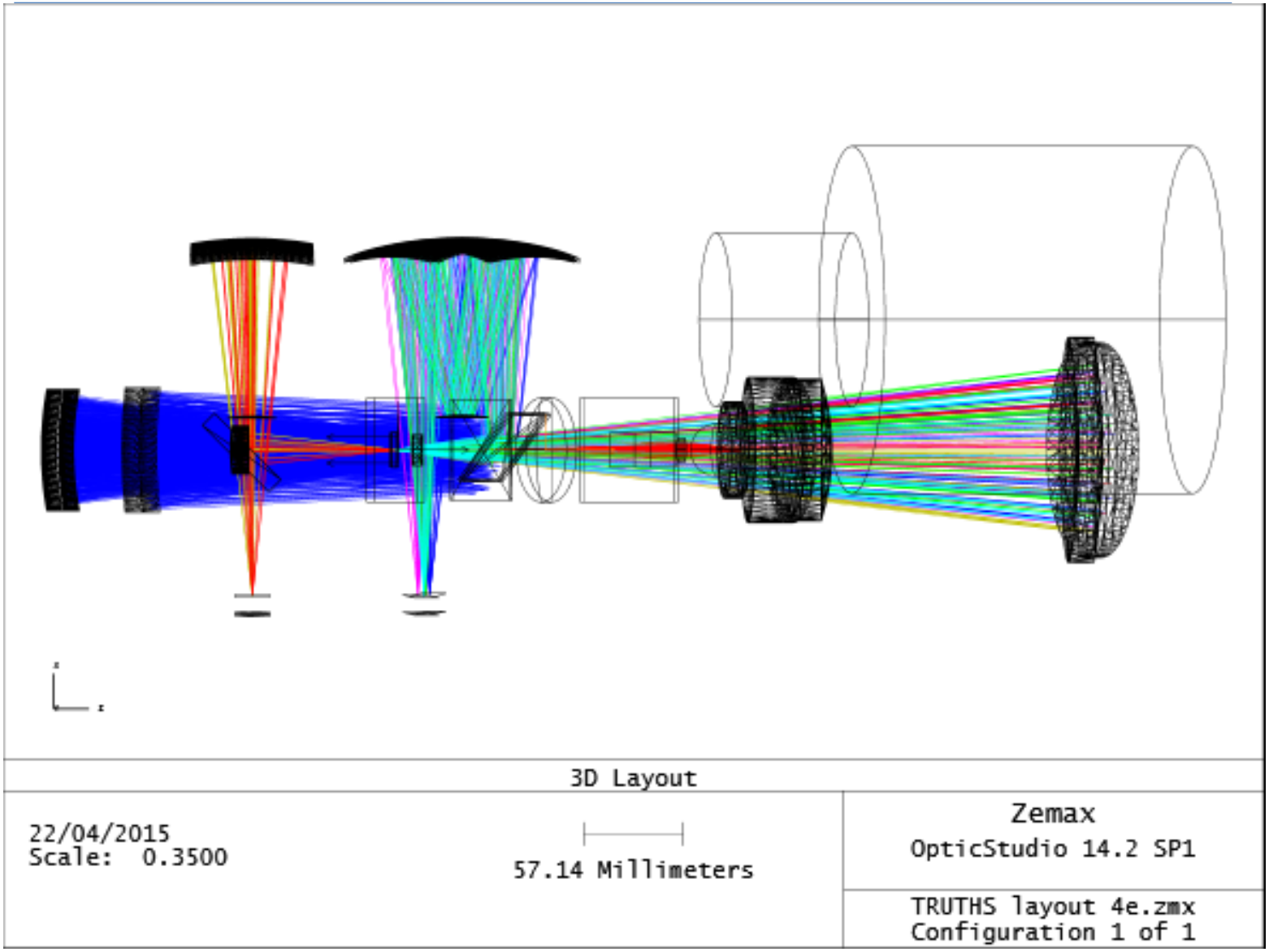


Relay optics

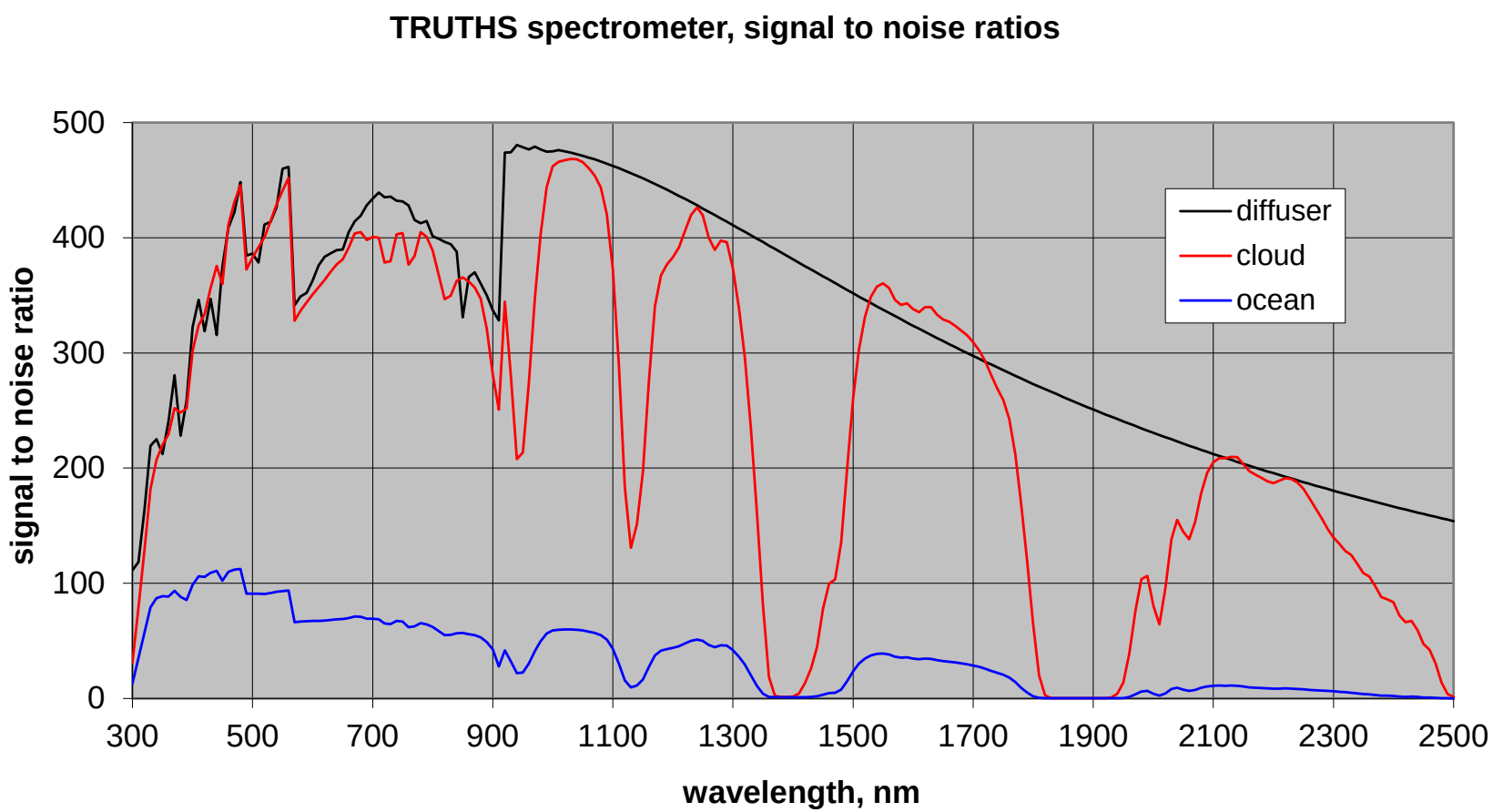
- Offner relay for each of 3 split-off bands
- Uses 3 reflections at 2 concentric spherical mirrors
- Coatings may be optimised for UV, visible and SWIR separately



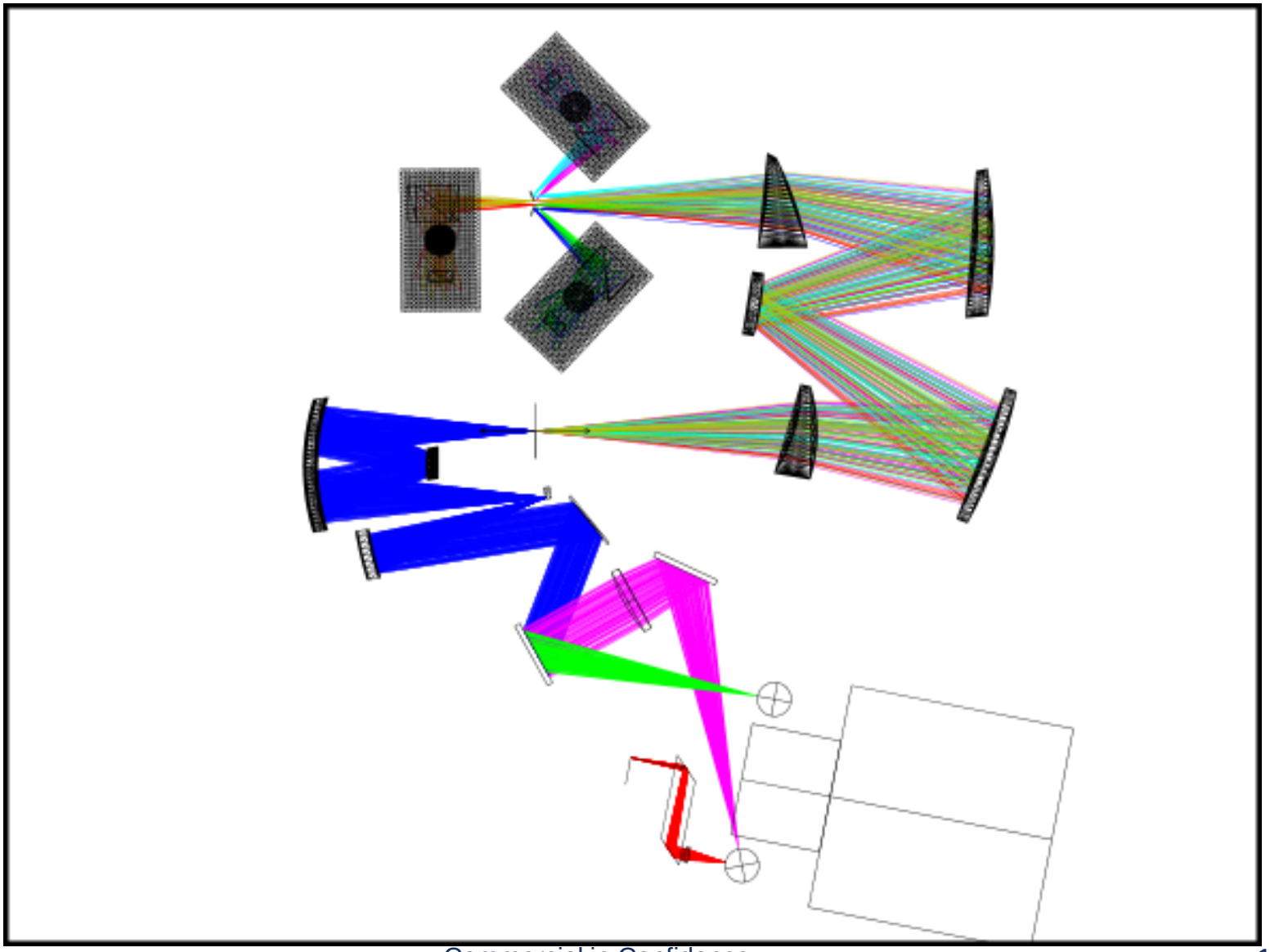
Earth imager view on nadir axis



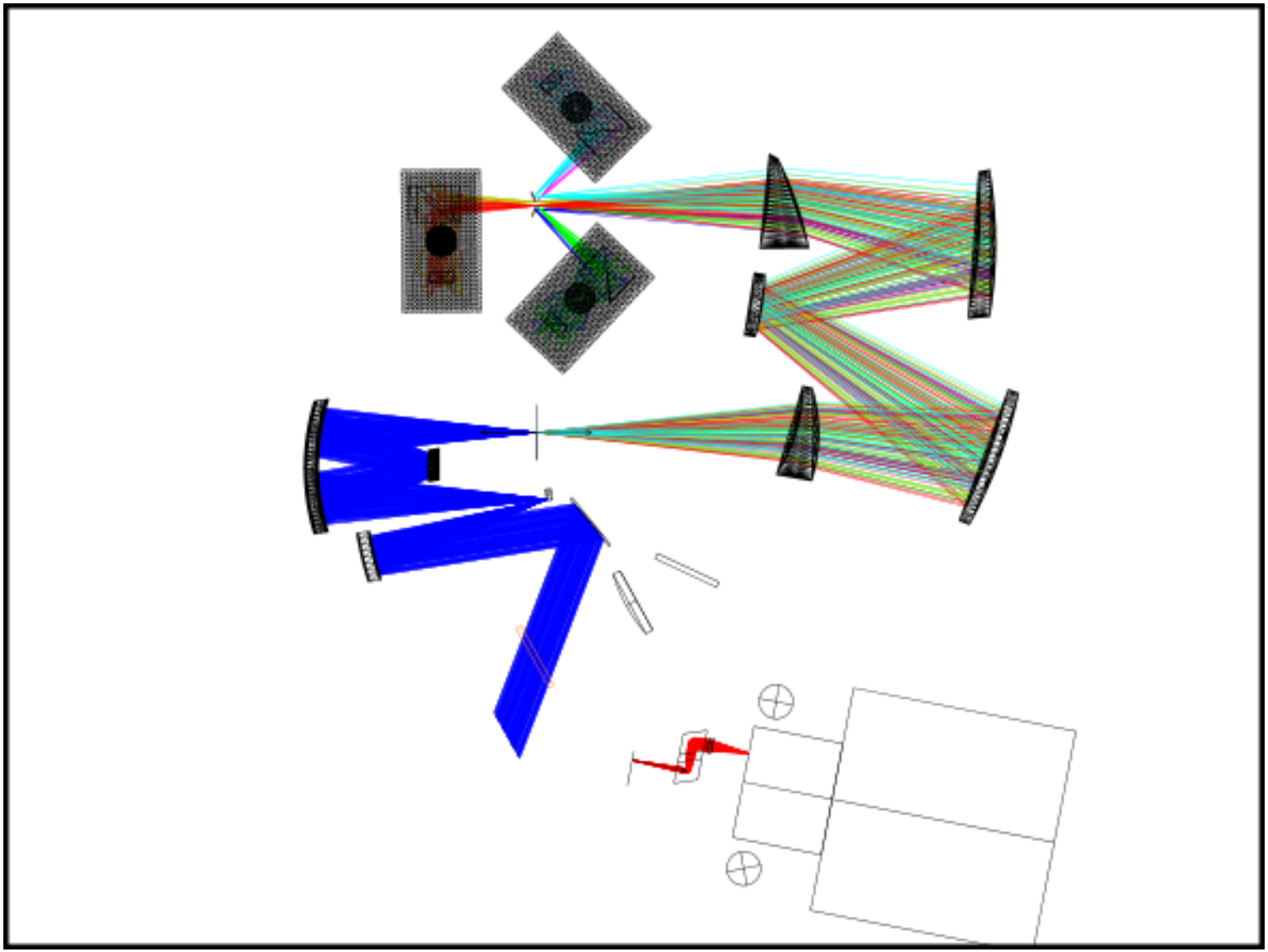
- SNRs for 45mm diameter entrance aperture



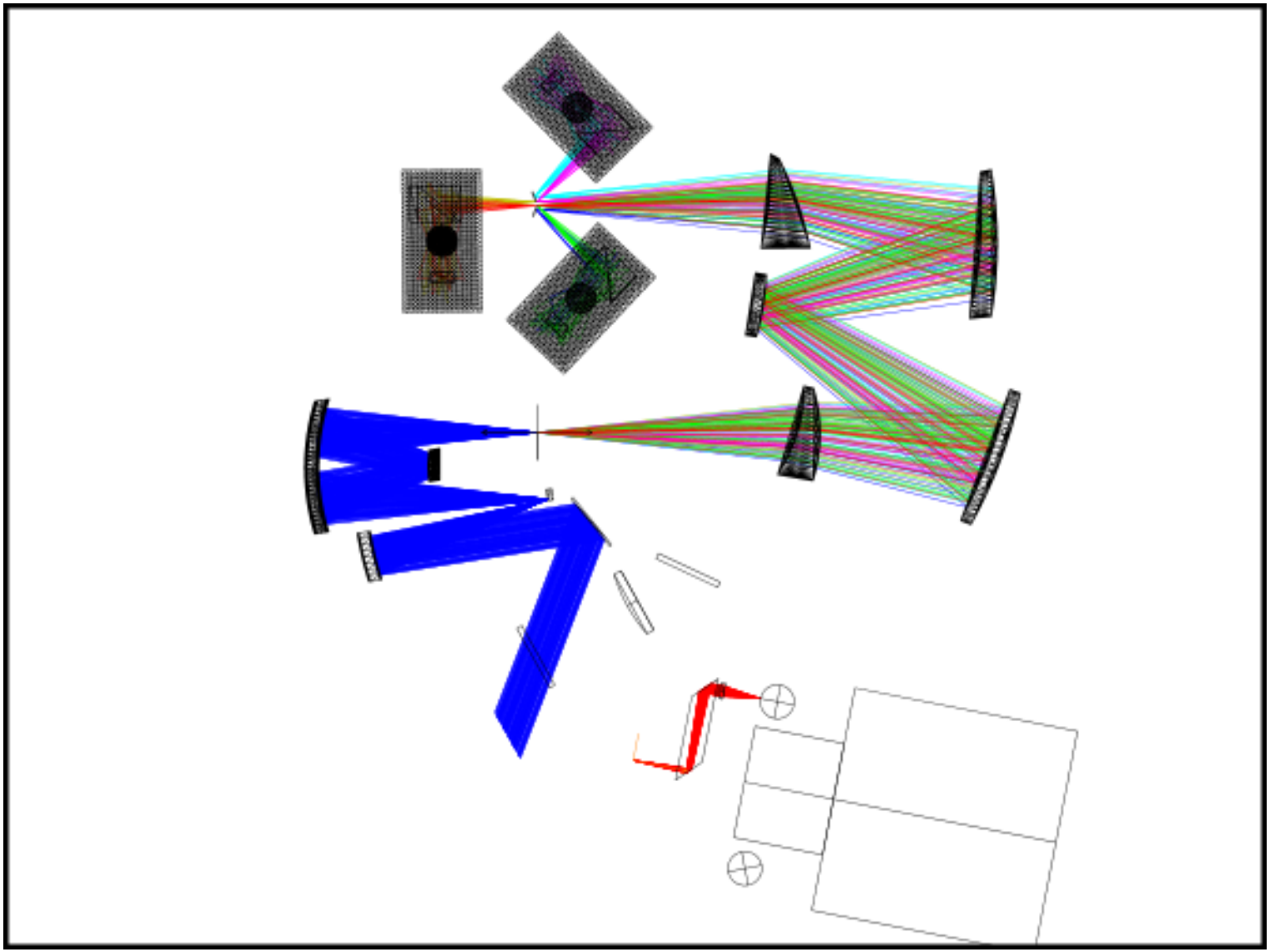
Earth imager with radiance calibration



Earth view laser calibration



Earth view radiance TR calibration



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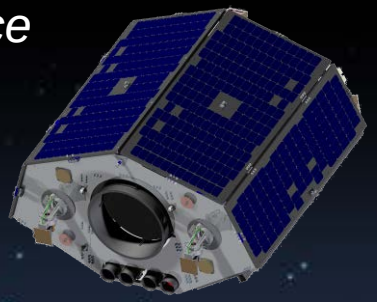

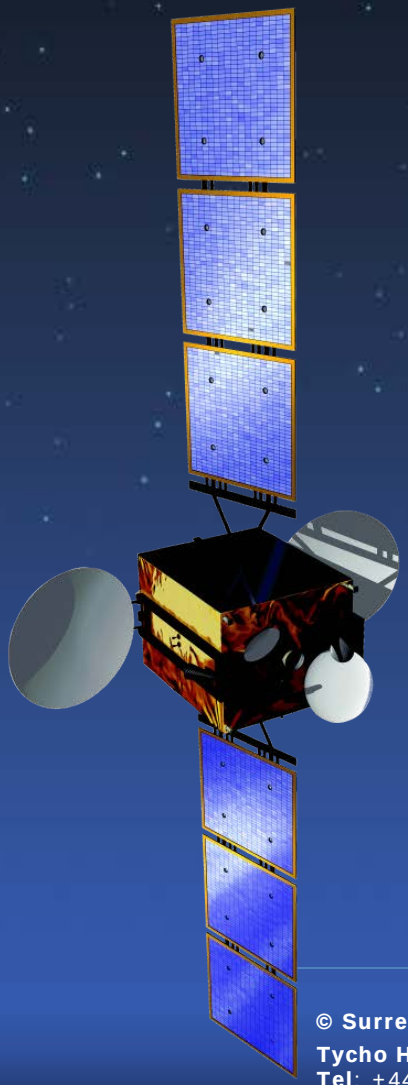

Thank You

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