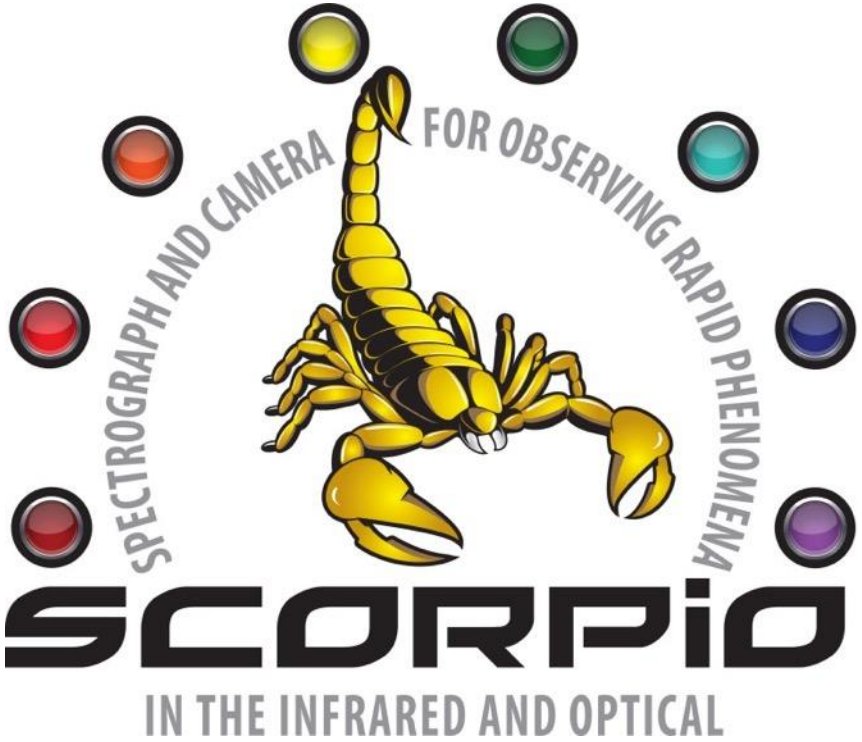


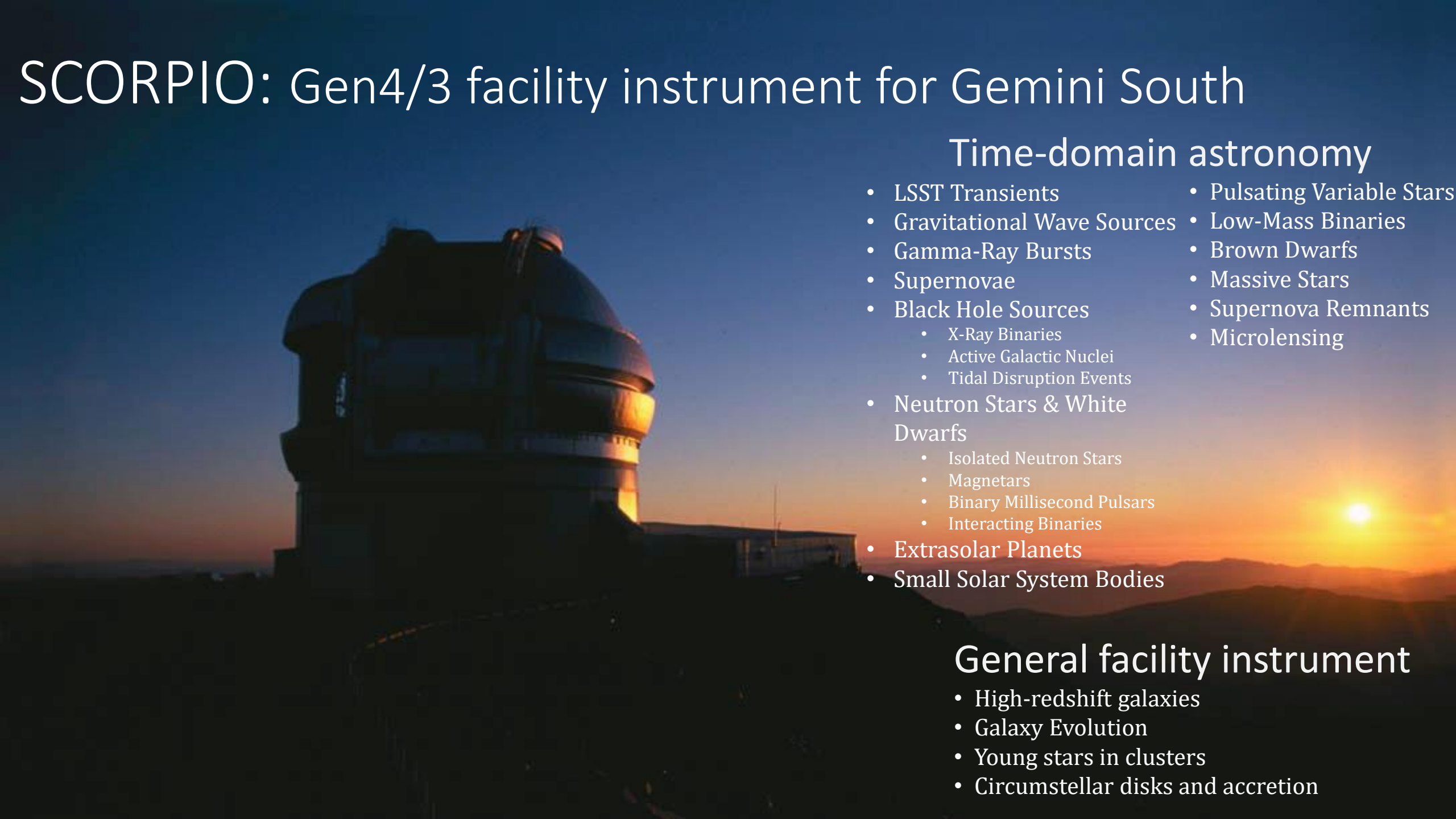
M. Robberto

Space Telescope Science Institute & Johns Hopkins University

and the SCORPIO Team:

Morten Andersen; Robert Barkhouser; Amanda Bayless; Brian Chinn; Ruben Diaz; Marisa Garcia Vargas; Stephen Goodsell; Tom Hayward; Scot Kleinman; Kathleen Labrie; Manuel Lazo; Manuel Maldonado Medina; Arturo Nunez; Ana Perez; Susan Pope; Ronnie Killough; Kristian Persson; Jeffrey Radwick; Ernesto Sanchez-Blanco; Stephen A. Smee; Kelly D. Smith; Jason Stange; Rebecca Thibodeaux; Alexander J. van der Horst; Todd Veach; Gerardo Veredas; Antonina Brody; Pete Roming

SCORPIO: Gen4/3 facility instrument for Gemini South



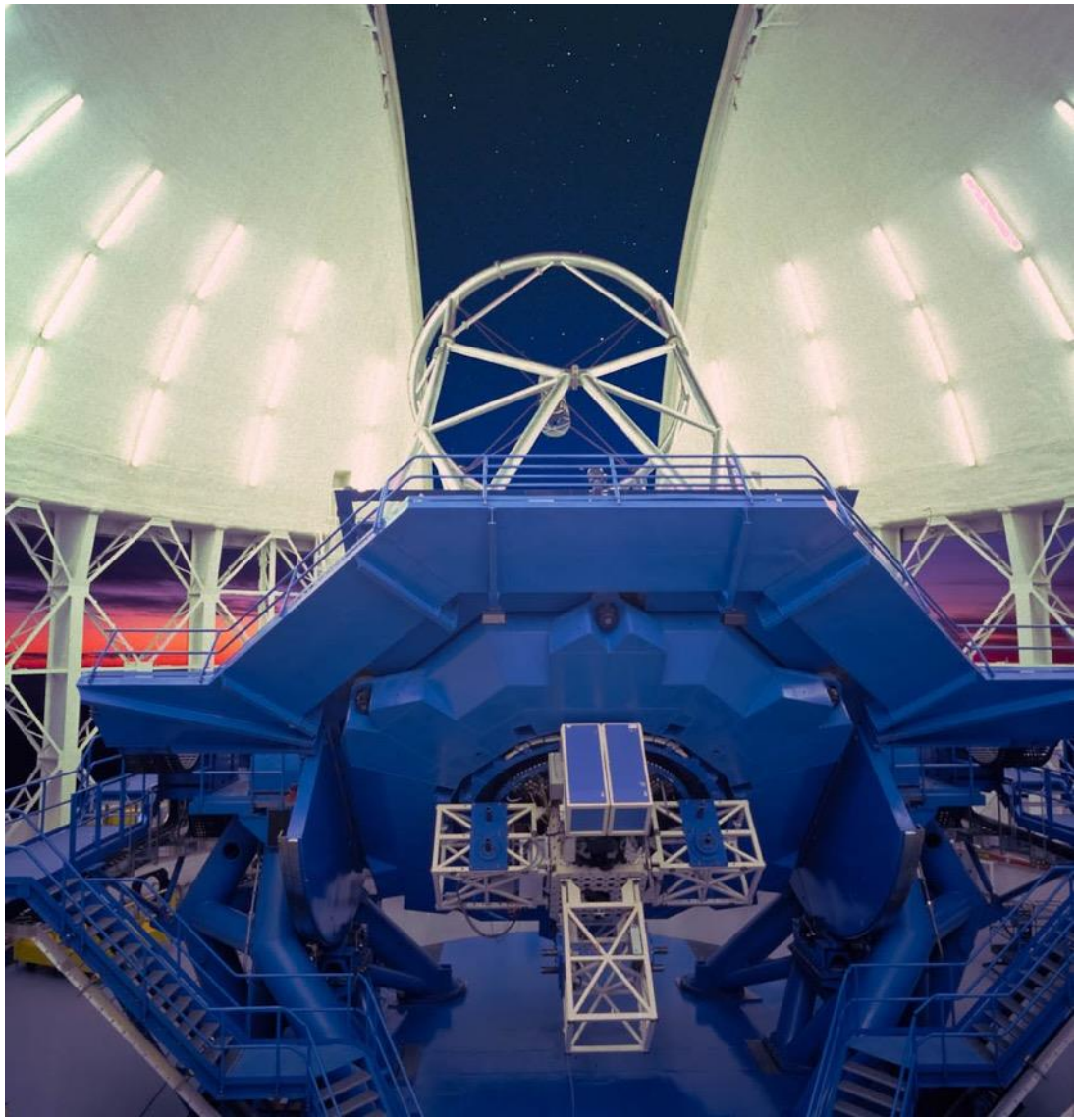
Time-domain astronomy

- LSST Transients
- Gravitational Wave Sources
- Gamma-Ray Bursts
- Supernovae
- Black Hole Sources
  - X-Ray Binaries
  - Active Galactic Nuclei
  - Tidal Disruption Events
- Neutron Stars & White Dwarfs
  - Isolated Neutron Stars
  - Magnetars
  - Binary Millisecond Pulsars
  - Interacting Binaries
- Extrasolar Planets
- Small Solar System Bodies
- Pulsating Variable Stars
- Low-Mass Binaries
- Brown Dwarfs
- Massive Stars
- Supernova Remnants
- Microlensing

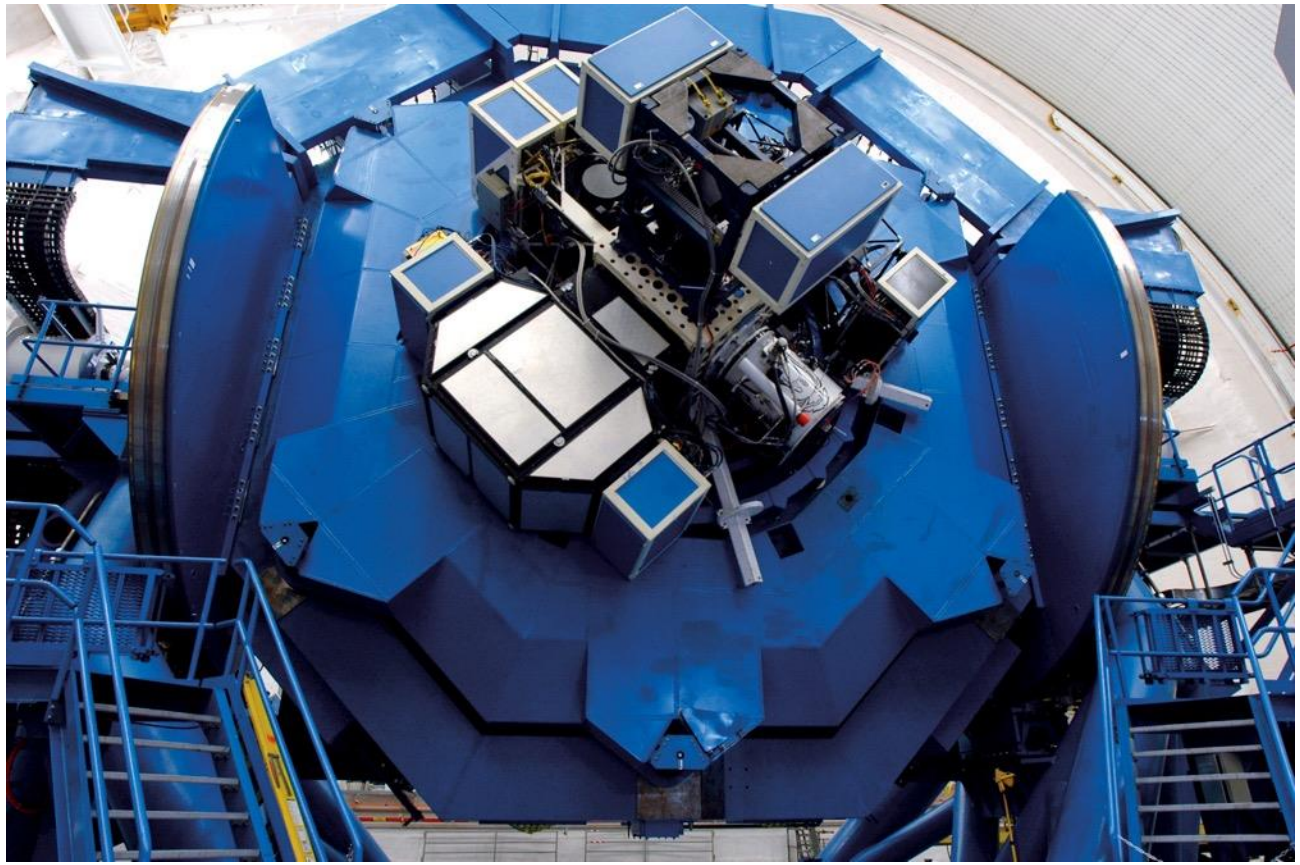
General facility instrument

- High-redshift galaxies
- Galaxy Evolution
- Young stars in clusters
- Circumstellar disks and accretion

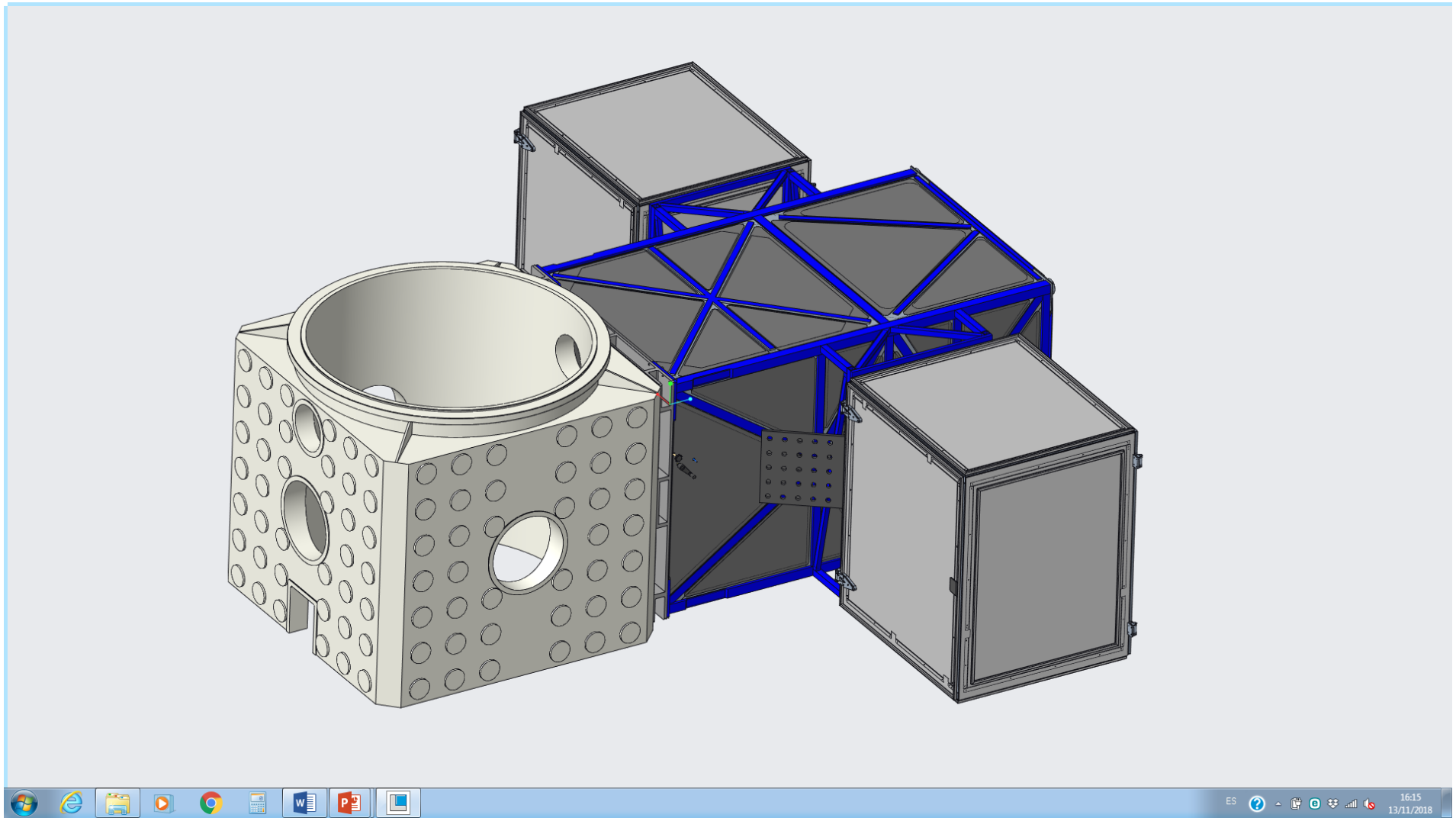
Gemini - Cassegrain Focus



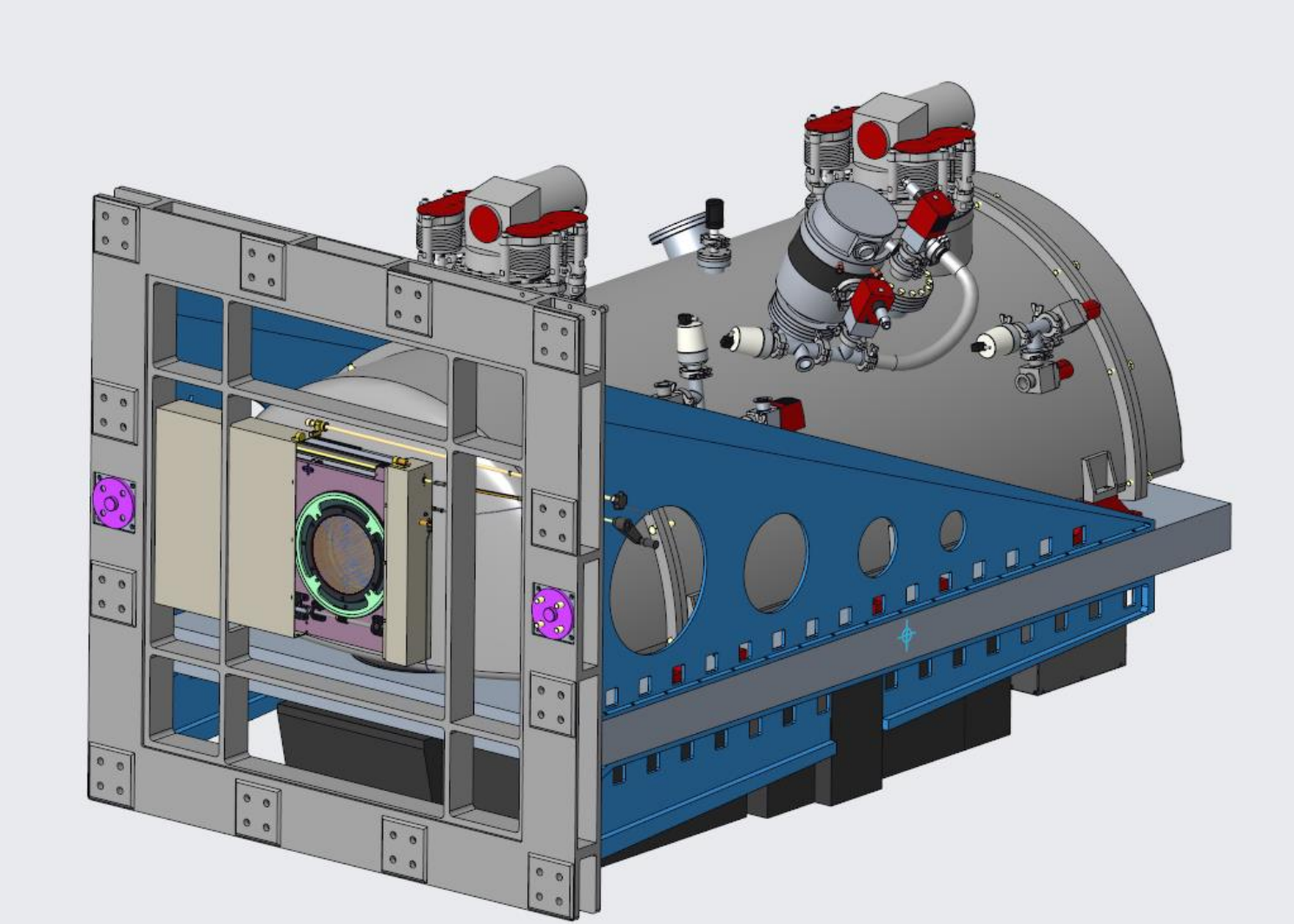
Instrument Support Structure (ISS)



SCORPIO on the ISS



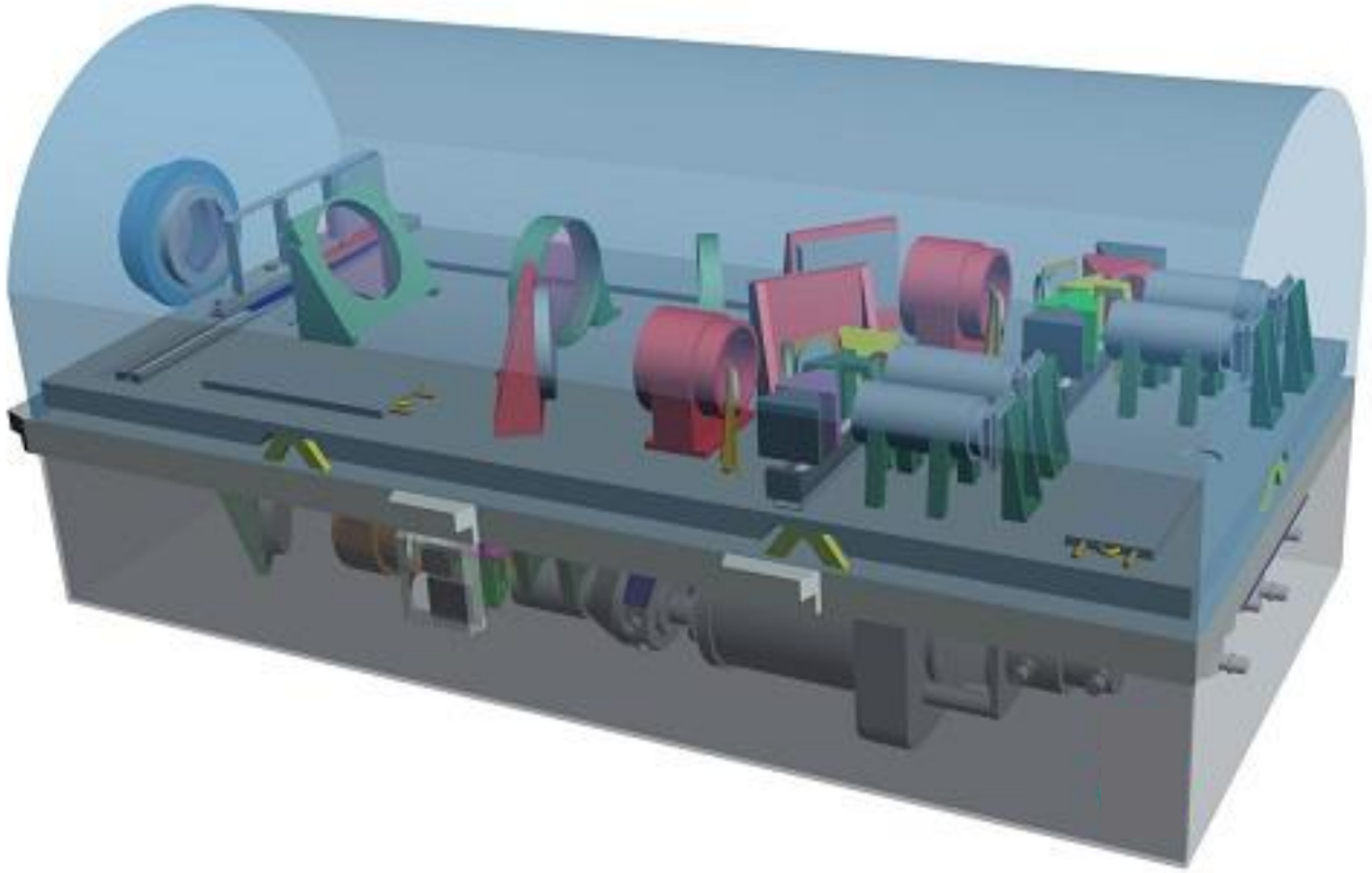
SCORPIO cryostat



Instrument layout

Infrarec

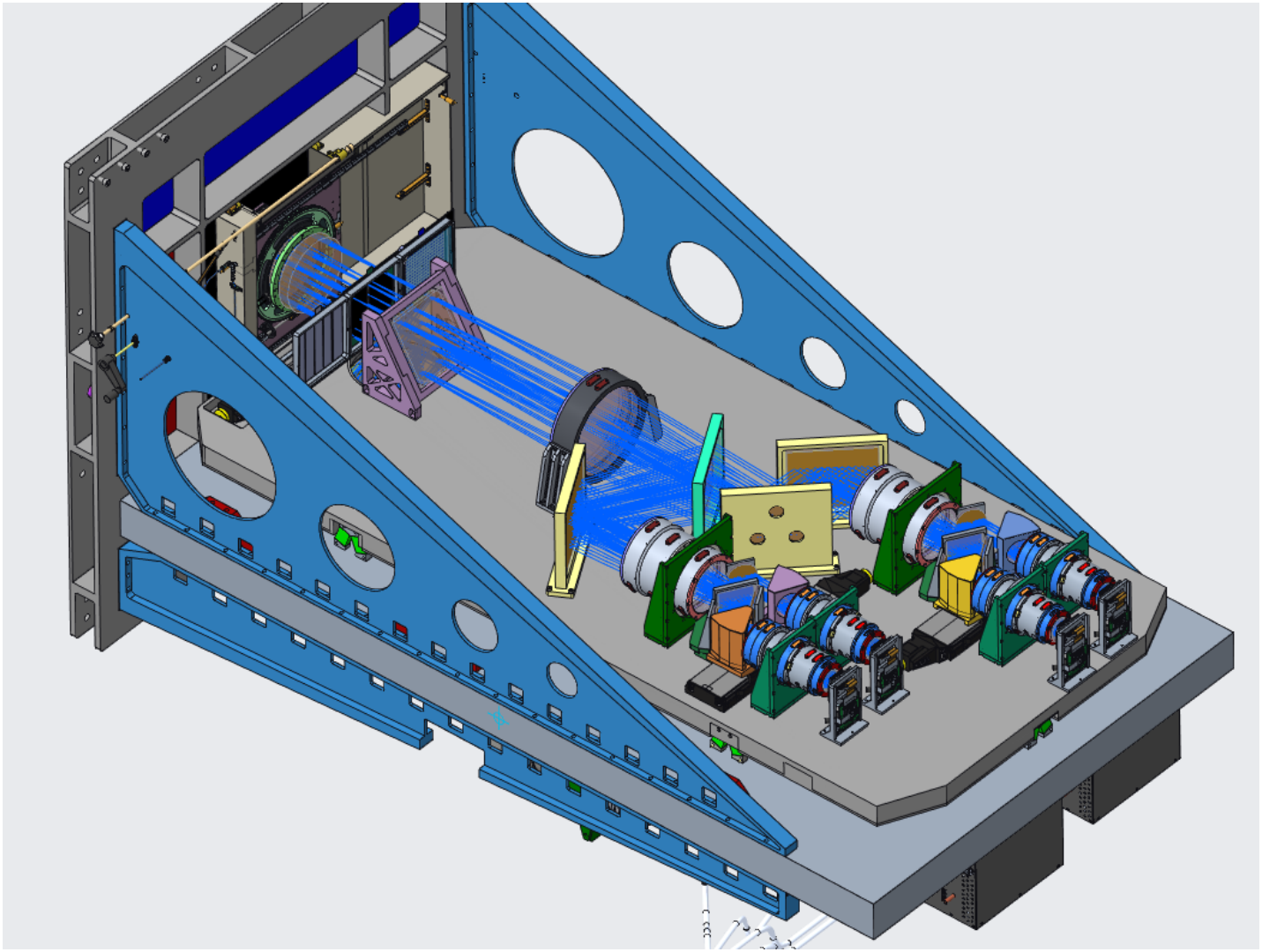
Visible



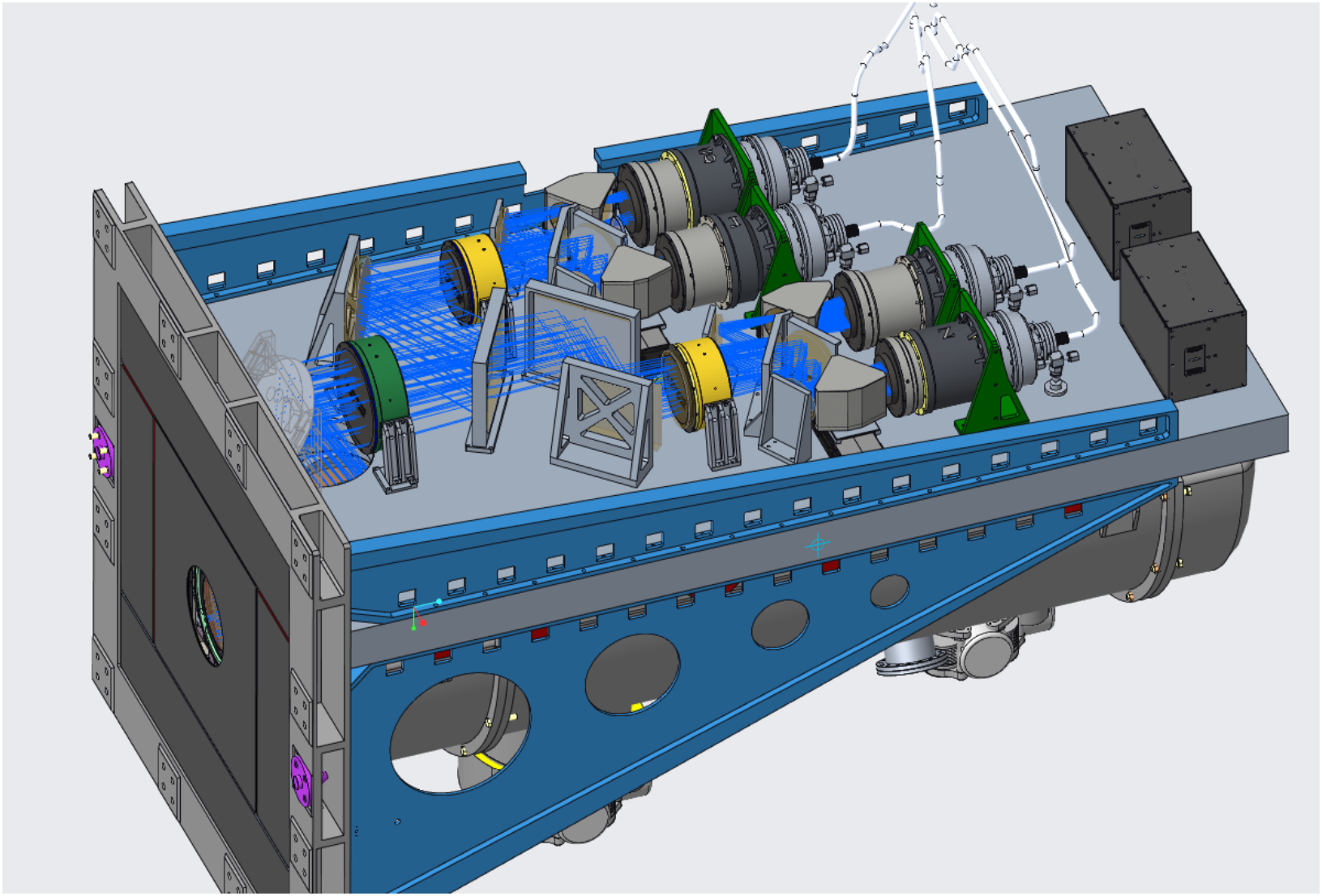
Y, J, H, K

g, r, i, z

NIR Channel

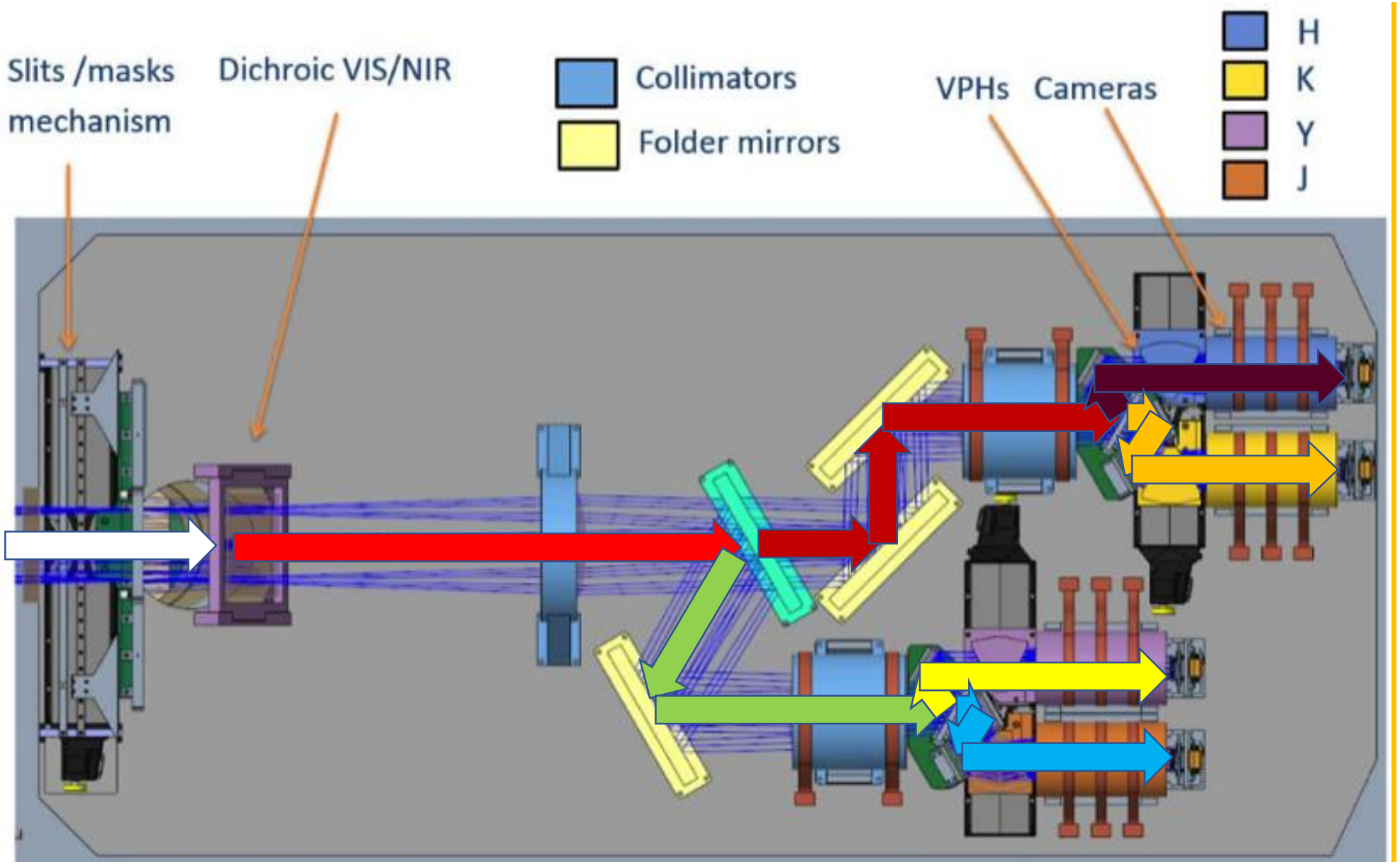


VIS Channel



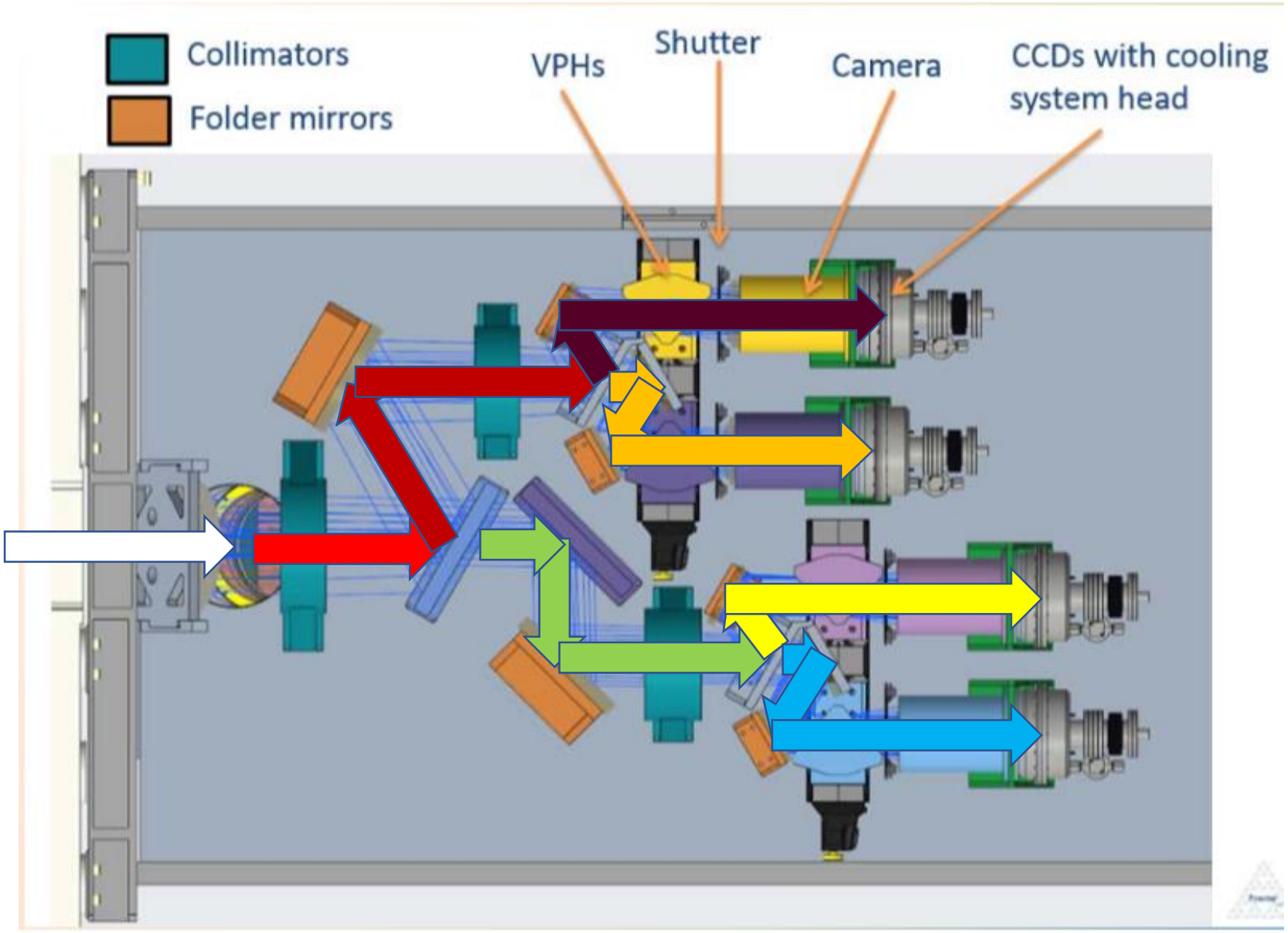
Infrared side

f/16 -> f/2.56



Visible side

f/16 -> f/2.15



Main instrument capabilities

Imaging mode

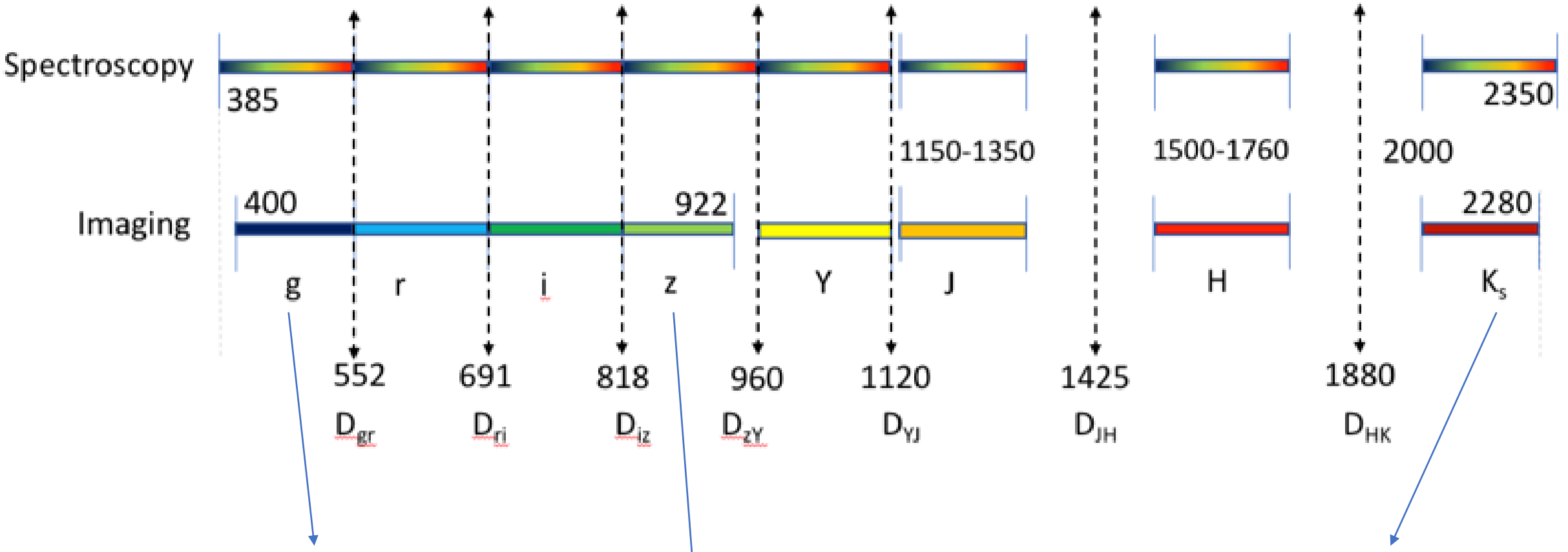
- 8-channel imager
- g, r, i, z, Y, J, H, and K_S bands
- 3'x3' field of view
- 0.18" pixel same for all cameras

Spectroscopic mode

- 8-channel spectrograph
- simultaneous 0.385-2.35 microns
- R ~ 4,000 @ 3 pixel sampling
- 3' long slits

- Large variety of observing modes
- Shutterless mode for ultra-high speed imaging
- Target acquisition in <10s through slit viewing camera

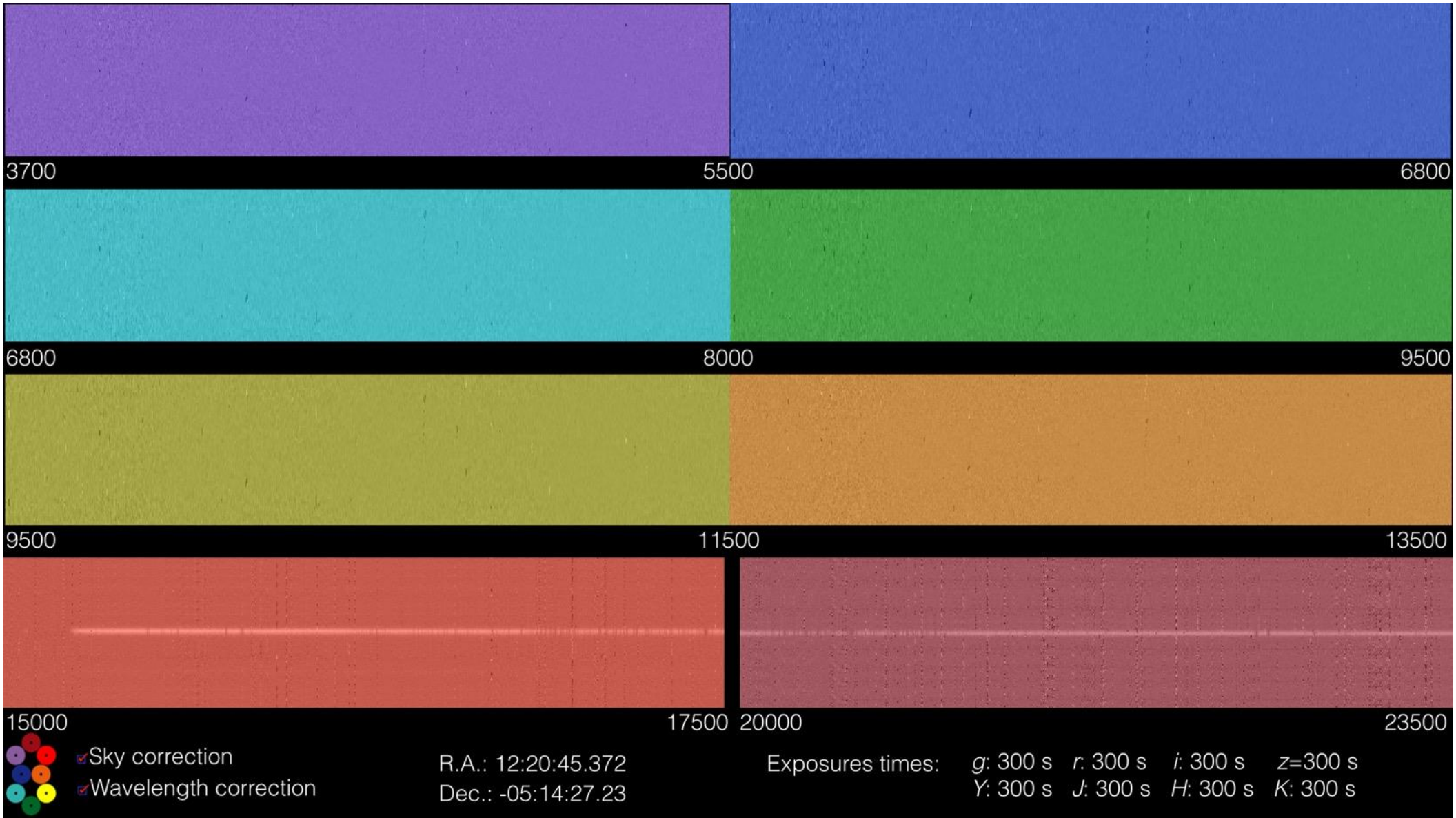
Bandpasses



3 retractable filters to delimit bandpass in imaging mode

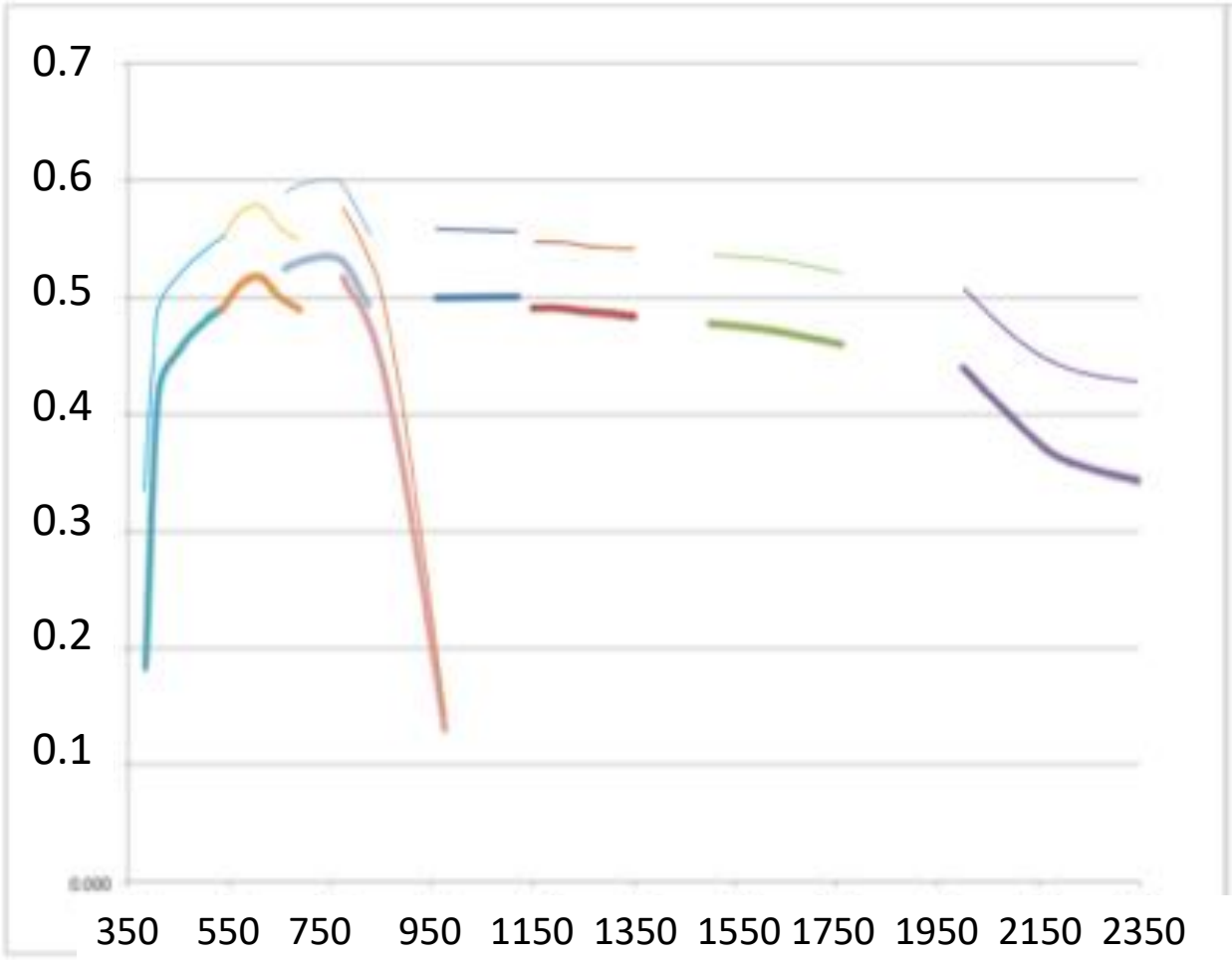
The power of multicolor imaging…

And full spectral coverage….

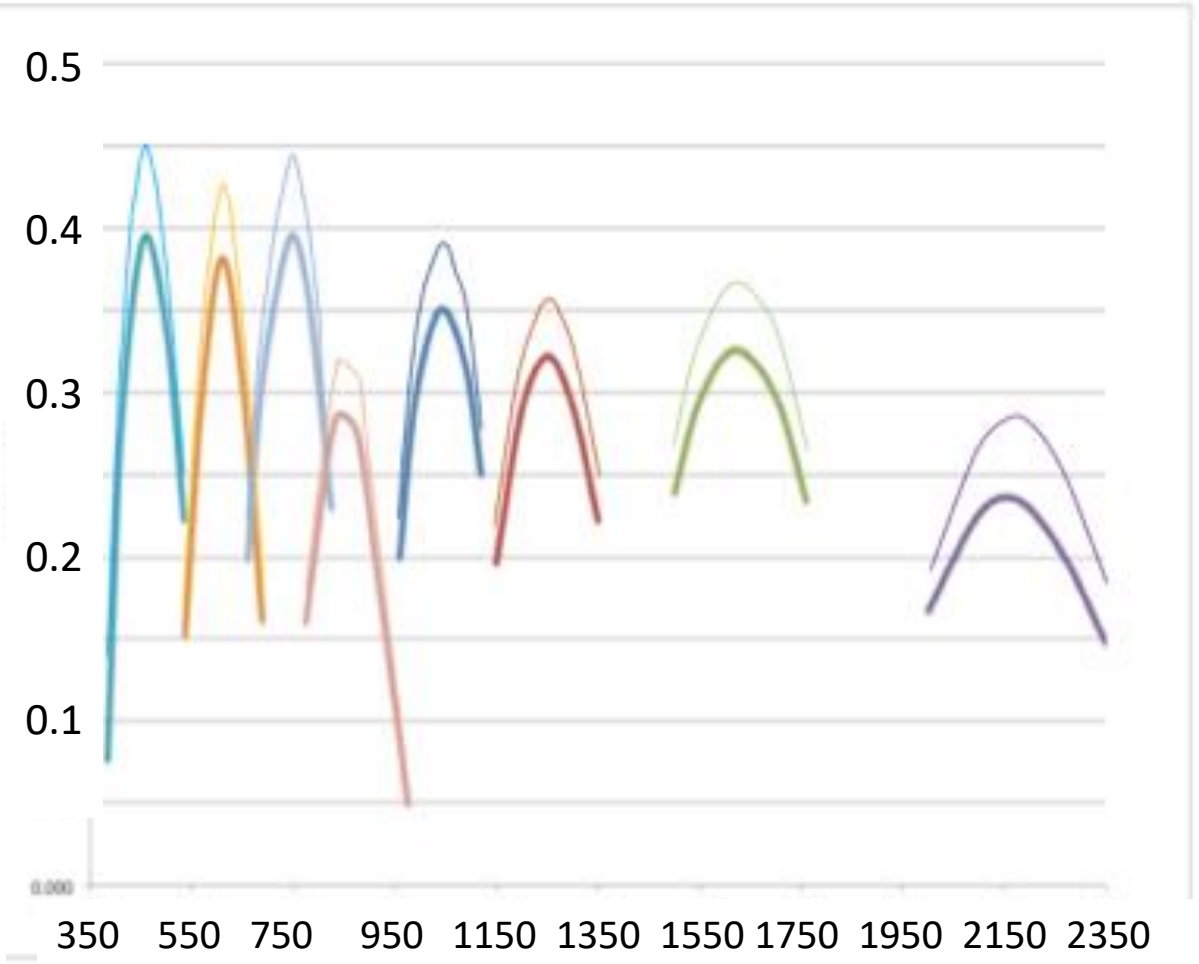


Throughput

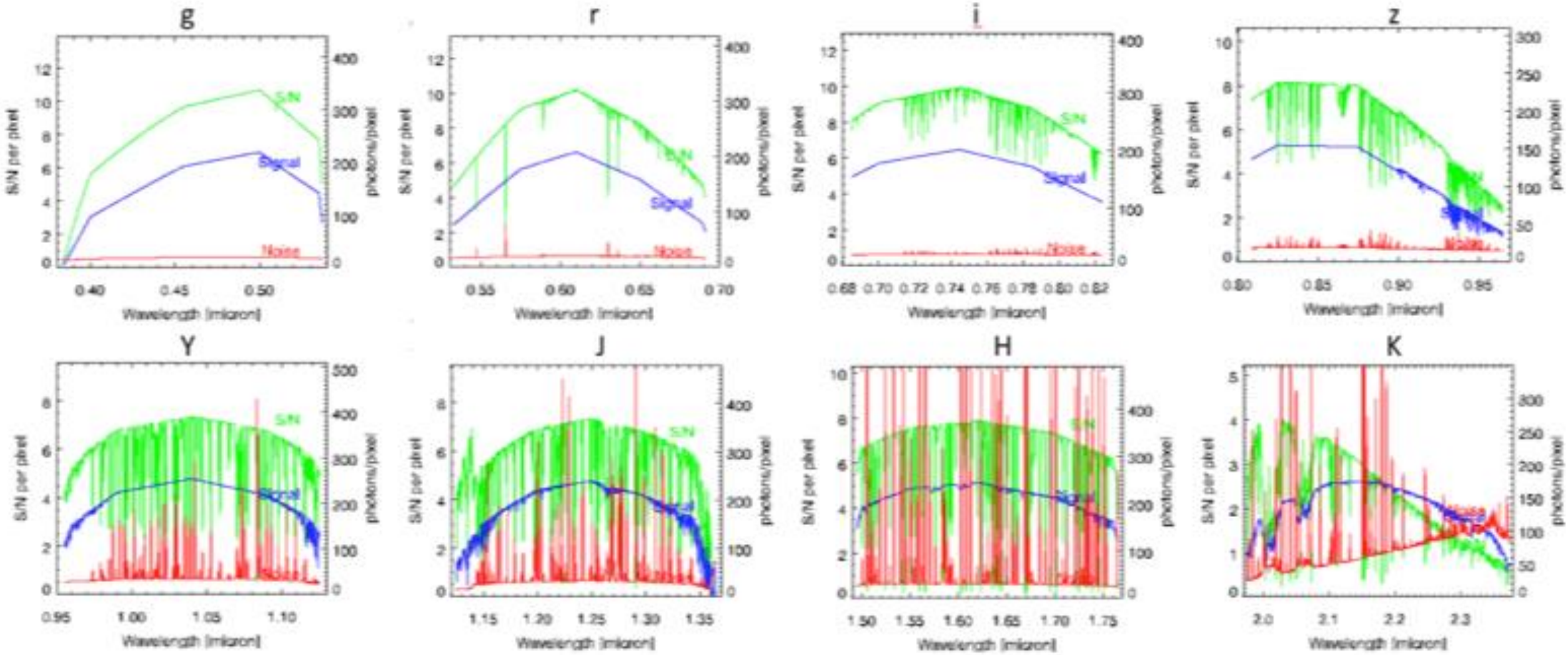
imaging



spectroscopy



Sensitivity: AB=21^{m}, 900s, spectroscopy

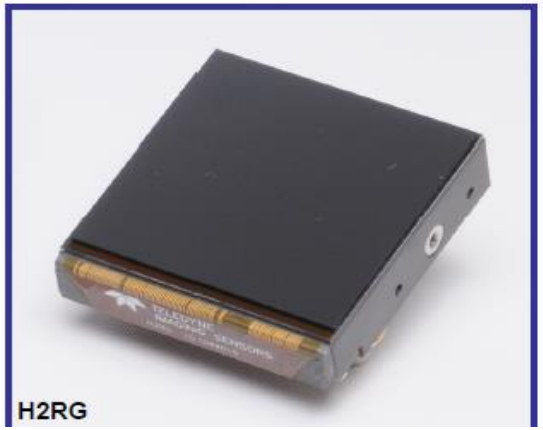


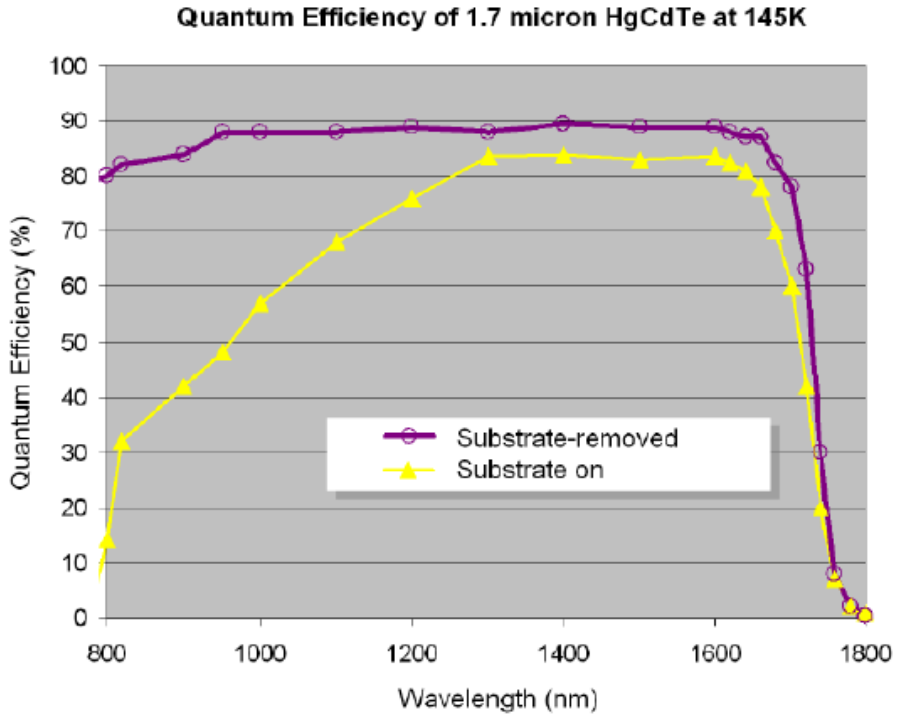
Sensitivity: SNR=5, 900s imaging

Band	AB	Vega
g	26.6	26.68
r	26.1	25.94
i	25.7	25.33
z	25.1	24.56
Y	24.7	24.07
J	23.5	22.59
H	22.3	20.91
K	22.6	20.75

IR Detectors: Teledyne H2RG

- 2.5 micron H2RG for all IR bands.
- 2048 x 2048; 18 micron size
- QE at all wavelengths is at least 70%, typically 80%, and at best ~90%.

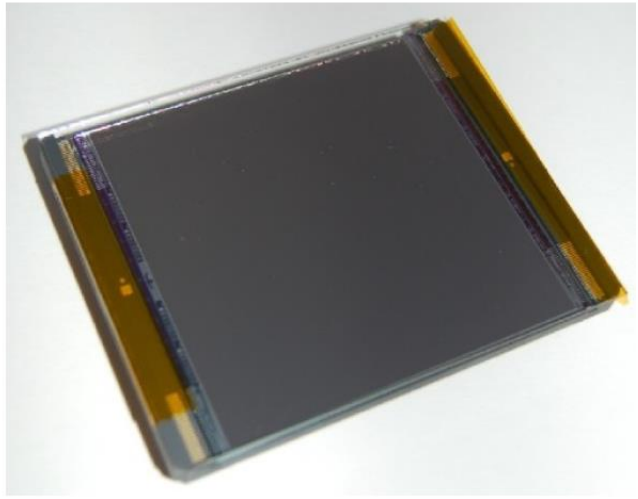




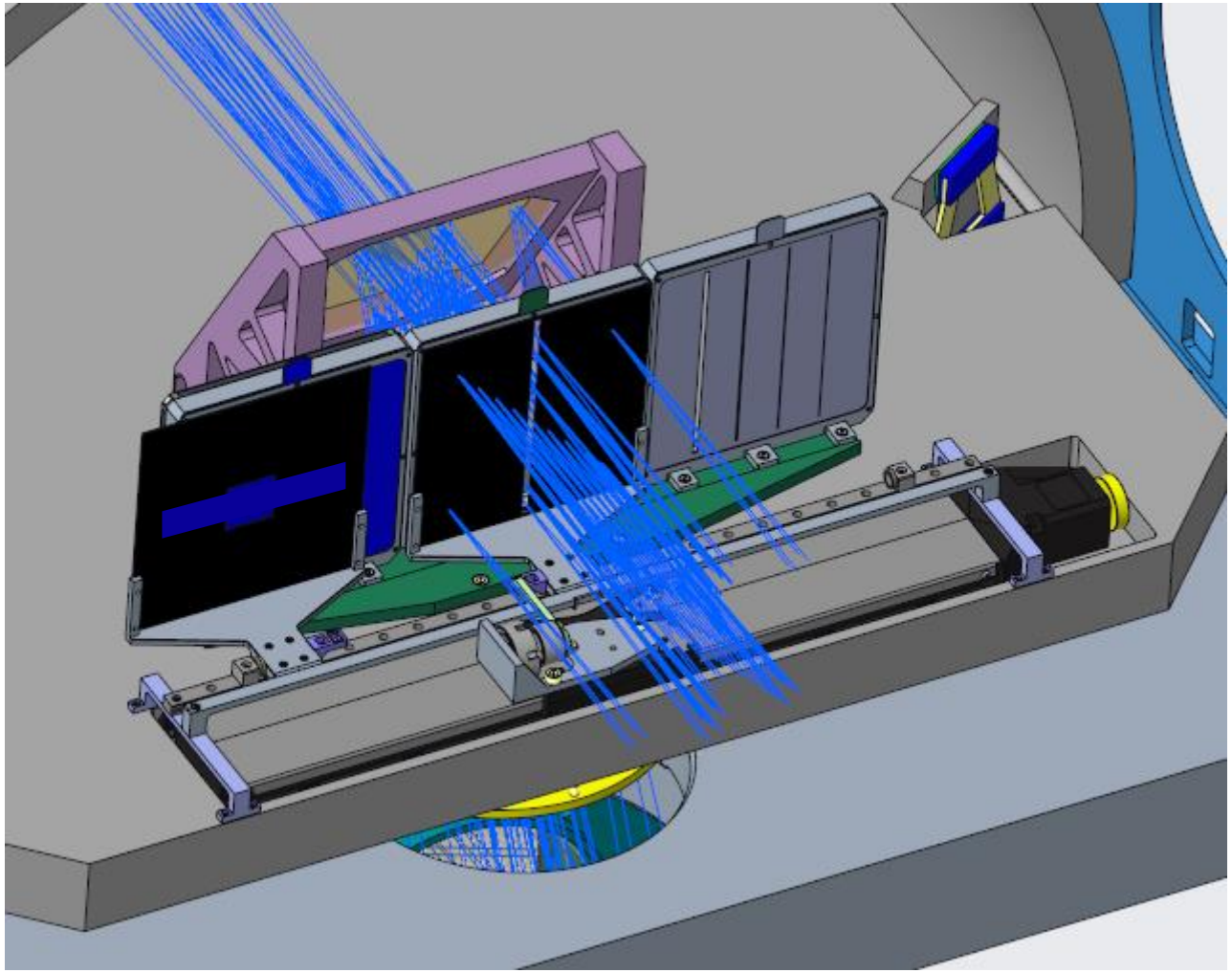
VIS detctors: E2V CCD 231-84

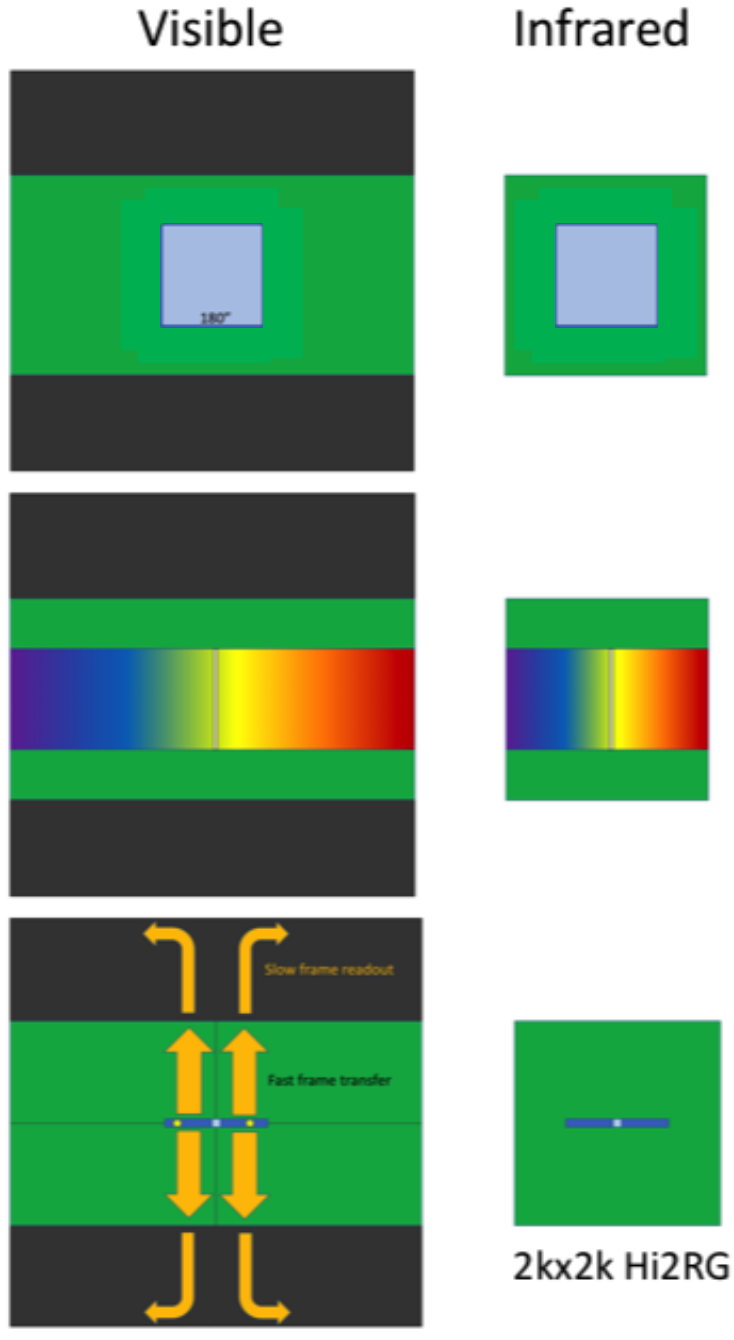
SUMMARY PERFORMANCE (Typical)

Number of pixels	4096(H) x 4112(V)
Pixel size	15 µm square
Image area	61.4 mm x 61.7 mm
Outputs	4
Amplifier sensitivity	7 µV/e^-
Readout noise (rms)	5 e^- at 1 MHz 2 e^- at 50 kHz
Maximum pixel data rate	3 MHz
Charge storage (pixel full well)	350,000 e^-
Flatness (both packages)	<20 µm (peak to valley)



Focal Plane Mechanism




Visible
Infrared
Imaging
180"
Spectroscopy
Slow frame readout
Fast frame transfer
High-speed
Imaging
2kx2k Hi2RG
4kx4k e2v CCD231-84

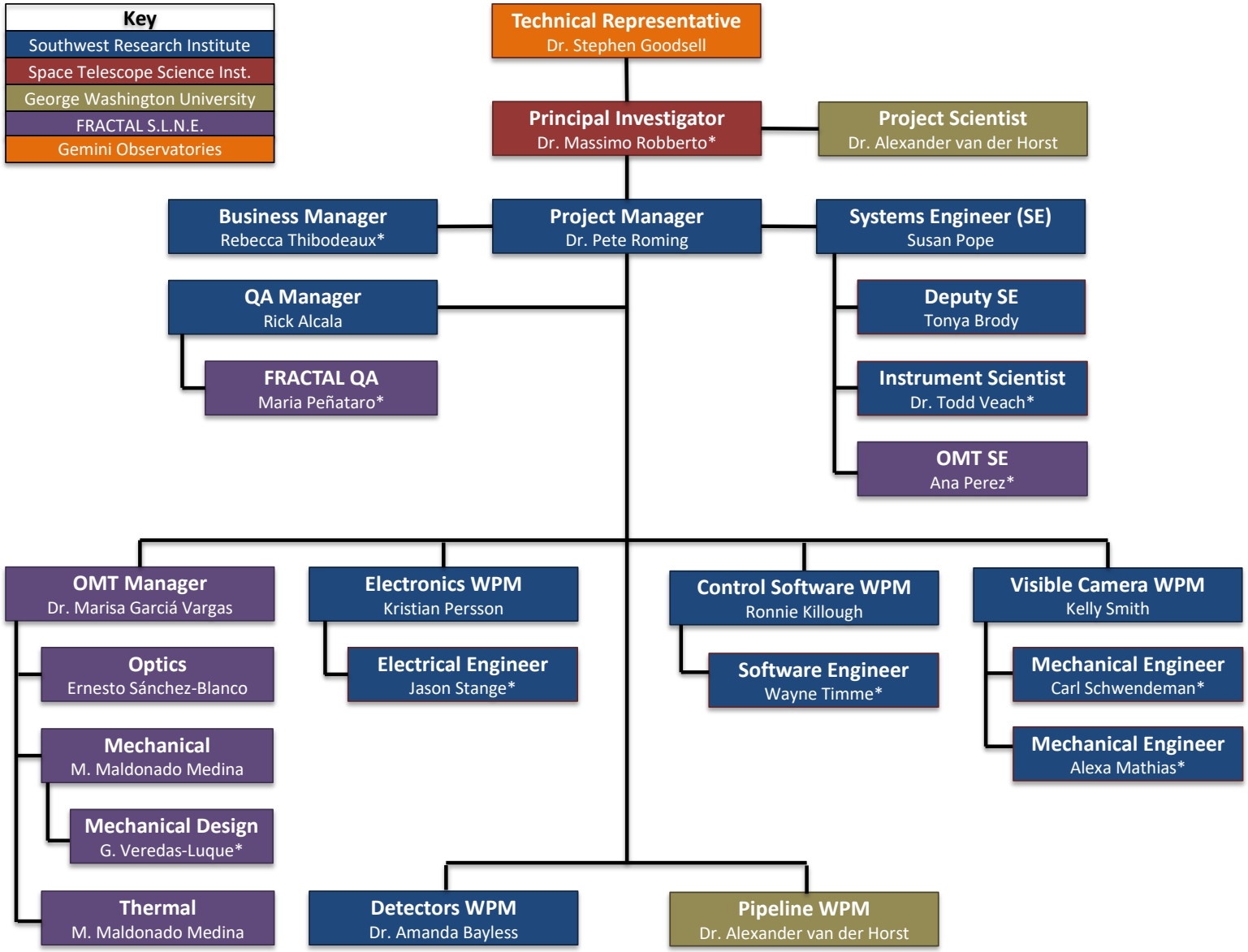
Fast readout modes in imaging mode

- 1. Exp.Time 5s and longer: FULL FIELD
  - VIS: Shutter
  - IR: multiple non-destructive sampling
- 2. Exp. Time 0.5s and longer: FULL FIELD
  - VIS: Frame transfer
  - IR: Correlated Double sampling
- 3. Exp Time 50ms and longer: WINDOWED mode (18”x180”)
  - VIS: frame transfer
  - IR: Correlated double sampling
- 4. Exp Time 5ms and longer: WINDOW with bursts of ~40 frames
  - VIS:line transfer
  - IR: single sampling

Schedule

- ✓Concept Design Kickoff (Mar 2017)
- ✓Systems Requirements Review (May 2017)
- ✓Concept Design Review (Aug 2017)
- ✓Preliminary Design Kickoff (Oct 2017)
- ✓Preliminary Design Review (Apr 2018)
- ✓Critical Design Kickoff (May 2018)
- ✓ Optical Design Review (Sep 2018)
- Critical Design Review (Apr 2019)
- Delivery to Gemini (Late 2021)
- Commissioning of Instrument & Ready for LSST (Early 2022)

Team organization



Science Team

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- Morten Andersen, Gemini Observatory, Chile
- Rodolfo Angeloni, University of La Serena, Chile
- Stefano Bagnulo, Armagh Observatory, UK
- Franz Bauer, Pontificia Universidad Católica, Chile
- Amanda Bayless, Southwest Research Institute, USA
- Melina Bersten, Universidad de la Plata, Argentina
- Marcelo Borges Fernandes, Observatório Nacional, Brazil
- Tom Broadhurst, Universidad del País Vasco, Spain
- Nat Butler, Arizona State University, USA
- Brad Cenko, NASA Goddard Space Flight Center, USA
- Lydia Cidale, Observatorio Astronomico de la Plata, Argentina
- Jesus Corral-Santana, Pontificia Universidad Católica, Chile
- Vik Dhillon, University of Sheffield, UK
- René Duffard, Instituto de Astrofísica de Andalucía - CSIC, Spain
- Robert Fesen, Dartmouth College, USA
- Gastón Folatelli, Universidad de la Plata, Argentina
- Jonathan Fortney, University of California Santa Cruz, USA
- Ori Fox, Space Telescope Science Institute, USA
- Anna Frebel, Massachusetts Institute of Technology, USA
- Bryan Gaensler, University of Toronto, Canada
- Lluís Galbany, Universidad de Chile, Chile
- Karl Glazebrook, Swinburne University of Technology, Australia
- Stephen Goodsell, Gemini Observatory & Durham University, UK
- Daryl Haggard, Amherst College, USA
- Eric Hintz, Bringham Young University, USA
- Julie Hlavacek-Larrondo, University of Montreal, Canada
- David Kaplan, University of Wisconsin-Milwaukee, USA
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- Jerome Orosz, San Diego State University, USA
- Thomas Pannuti, Morehead State University, USA
- Jennifer Patience, Arizona State University, USA
- Daniel Perley, California Institute of Technology, USA
- Noemí Pinilla-Alonso, Florida Space Institute, Univ. of Central Florida, USA
- Massimo Robberto, Space Telescope Science Institute , USA & Johns Hopkins University, USA
- Pete Roming, Southwest Research Institute, USA
- Brian Schmidt, Australian National University, Australia
- Steve Schulze, Pontificia Universidad Católica, Chile
- Denise Stephens, Brigham Young University, USA
- Nicole St-Louis, University of Montreal, Canada
- Rachel Street, Las Cumbres Observatory, USA
- Nial Tanvir, University of Leicester, UK
- Ezequiel Treister, Universidad de Concepción, Chile
- Stefano Valenti, University of California – Davis, USA
- Daniel Vanden Berk, St. Vincent College, USA
- Todd Veach, Southwest Research Institute, USA
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- Stefanie Wachter, Max-Planck-Institut für Astronomie, Germany