Staying Within the Box

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ACADEMY OF PROGRAM/PROJECT & ENGINEERING LEADERSHIP
APPEL

SMD SCIENCE MISSION DIRECTORATE

SOMA SCIENCE OFFICE FOR MISSION ASSESSMENTS

PI-Team Masters Forum 3

HiSCI

High-resolution Stereo Color Imager (HiSCI)

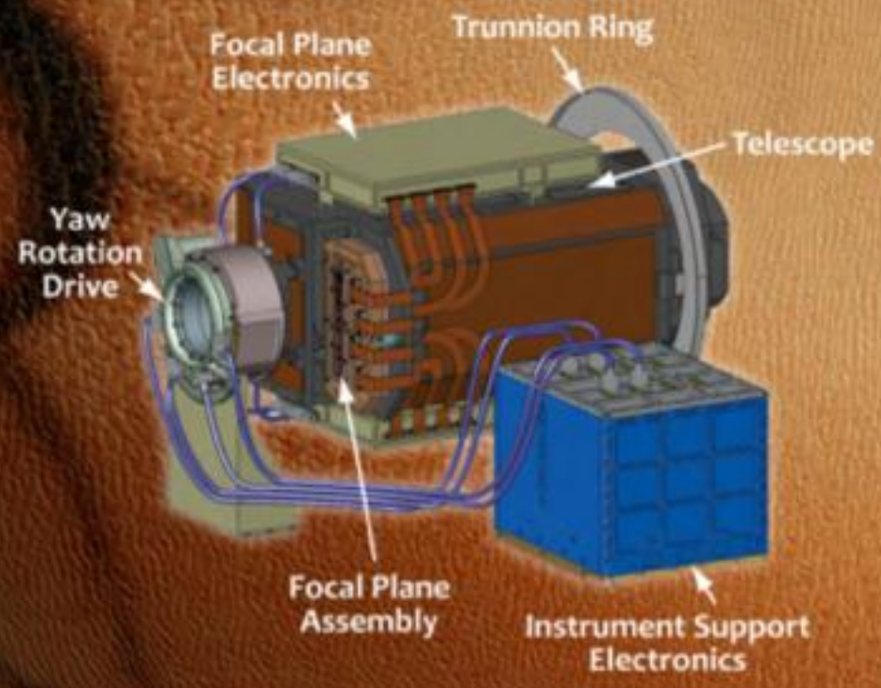
PI Forum Annapolis

PI: Alfred McEwen,
University of Arizona

Co-PI: Nicolas Thomas,
University of Bern

Ball Aerospace & Technologies Corp.
Boulder, Colorado

July 29, 2011



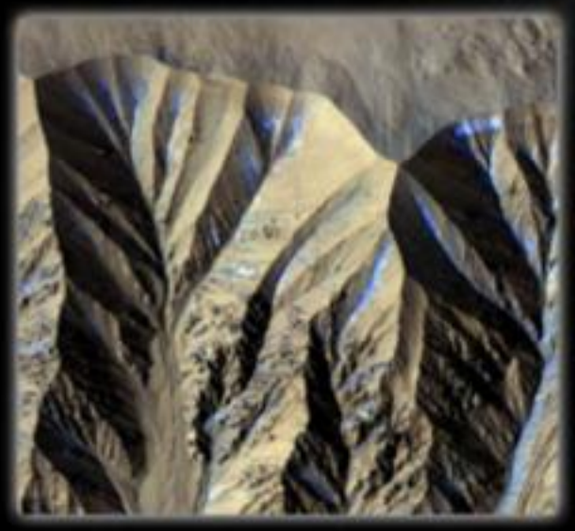
THE UNIVERSITY OF ARIZONA

UNIVERSITÄT BERN

Ball

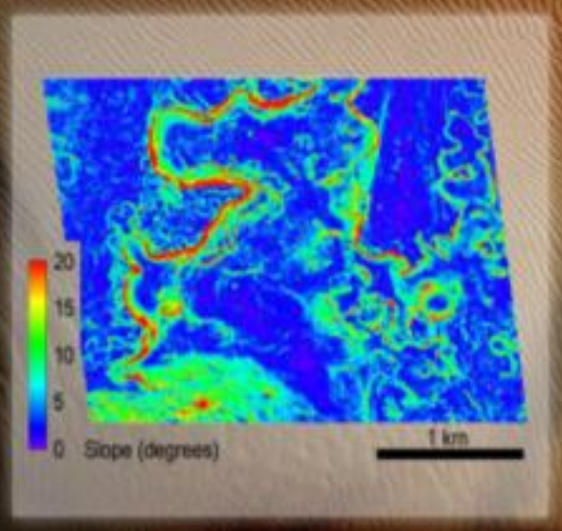
Program Manager: Hop Bailey, UA
Ball Instrument Manager: Tom Ebben

Simulated HiSCI Images



Understand active surface processes

Image regions discovered by EMTGO to be source regions for trace gases

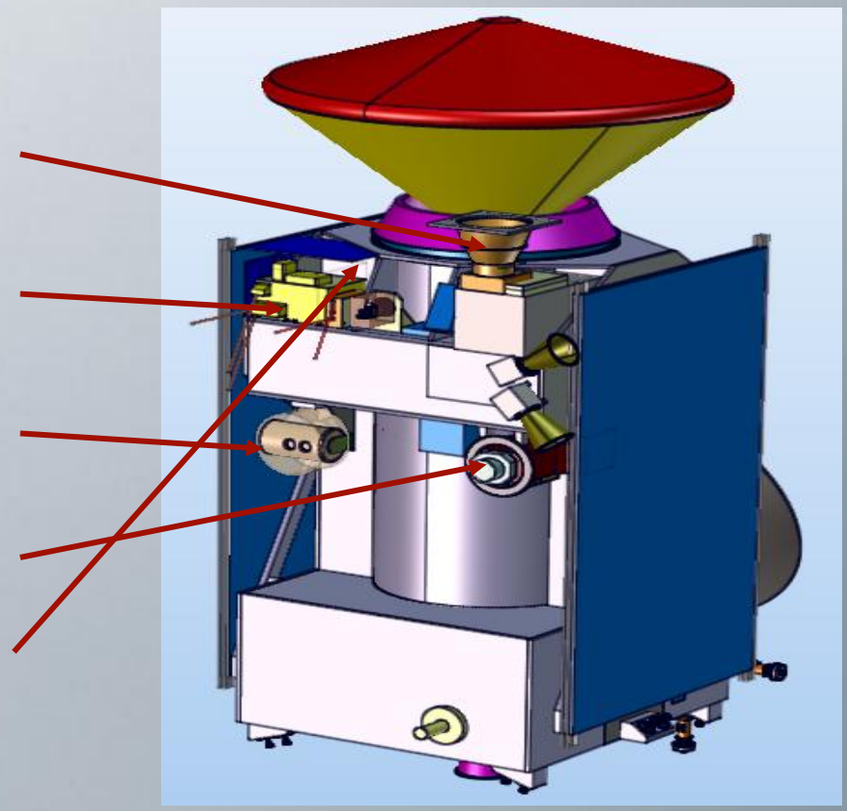


Map slopes to certify new candidate landing sites

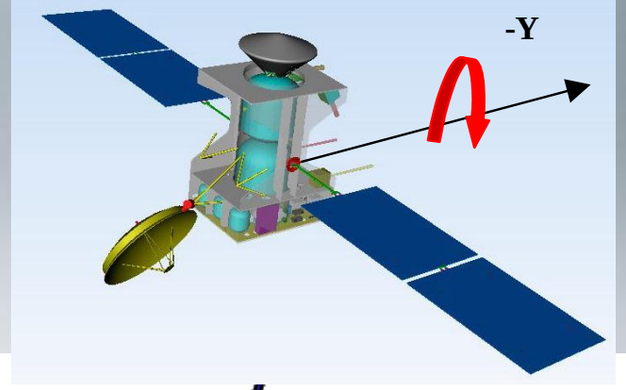
ESA/NASA Trace Gas Orbiter

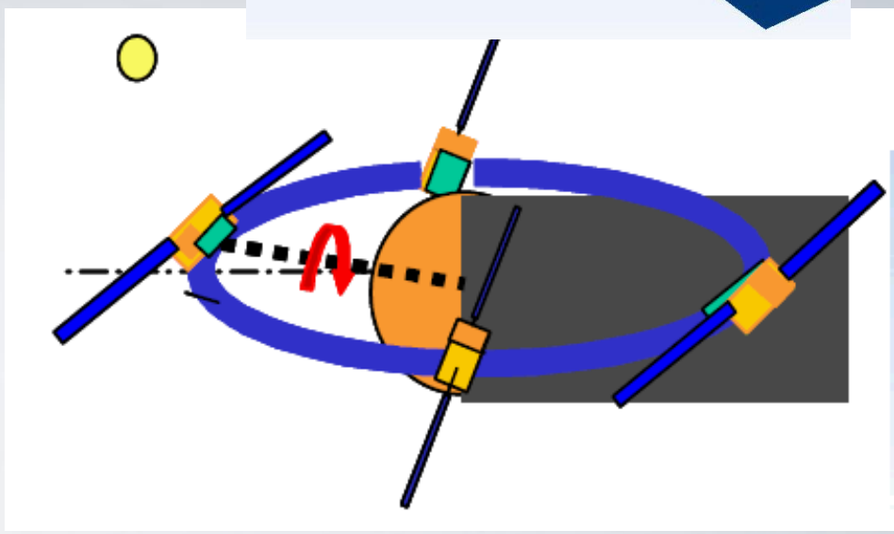
- **Project Scientists:**
  - ✓Mark Allen, JPL
  - ✓Olivier Witasse, ESA

MATMOS Solar occultation Fourier transform IR spectrometer
NOMAD Occultation + mapping IR, Vis, UV spectrometer (supplied by EU)
EMCS Thermal IR spectrometer
HiSCI High resolution , colour, stereo camera
MAGIE Wide-angle Vis-UV camera



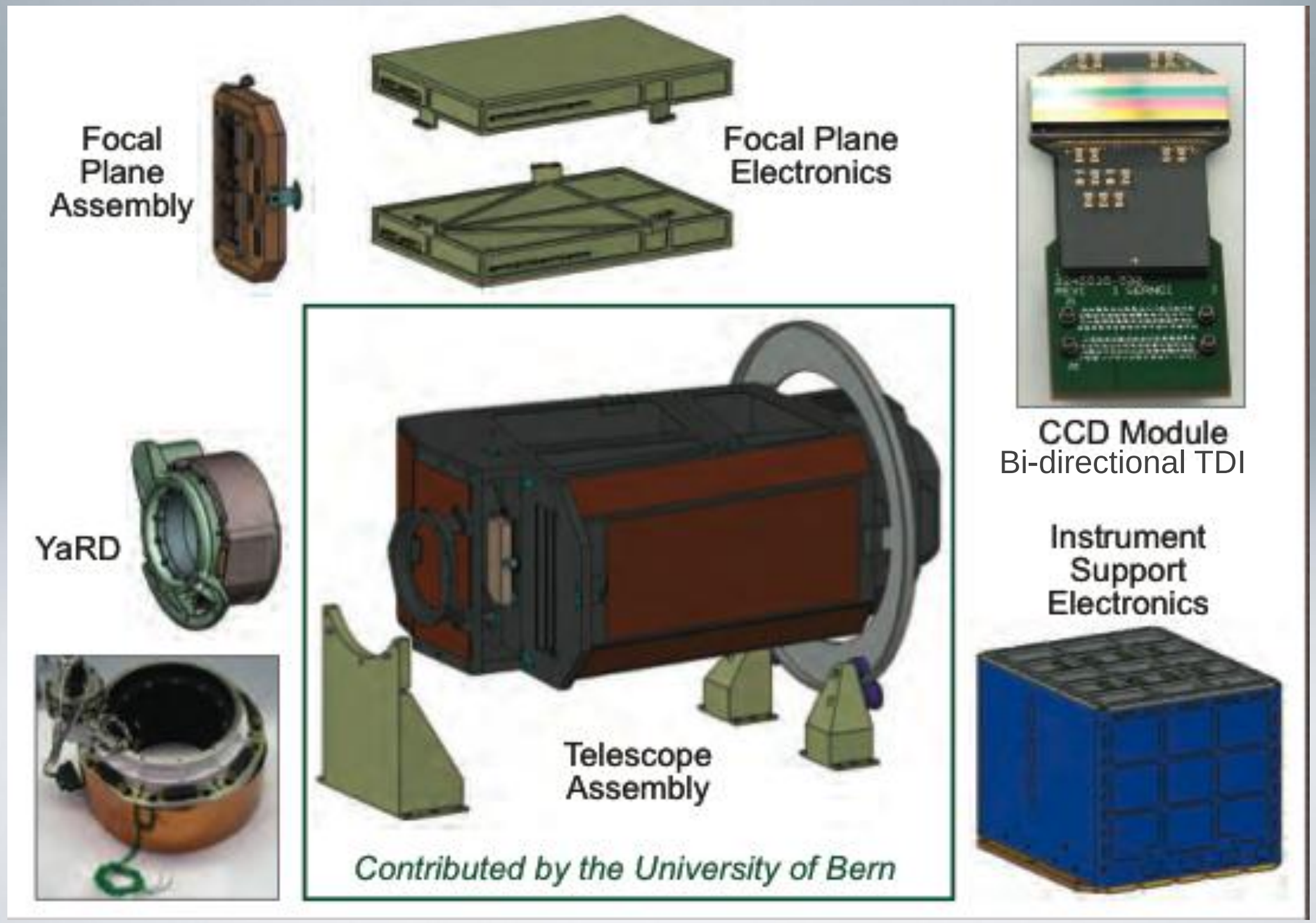
- **Yaw Steering Mode**
  - ➢3-axis stabilised spacecraft
  - ➢Allows for keeping – Y axis always Mars Nadir oriented (with simultaneous Sun pointed Solar Arrays and Earth pointed High Gain Antenna)
    - ➢Max steering rate (around –Y axis) 1.5 mRad/s
    - ➢*Mode interrupted during Sun occultation measurements and high resolution imaging*

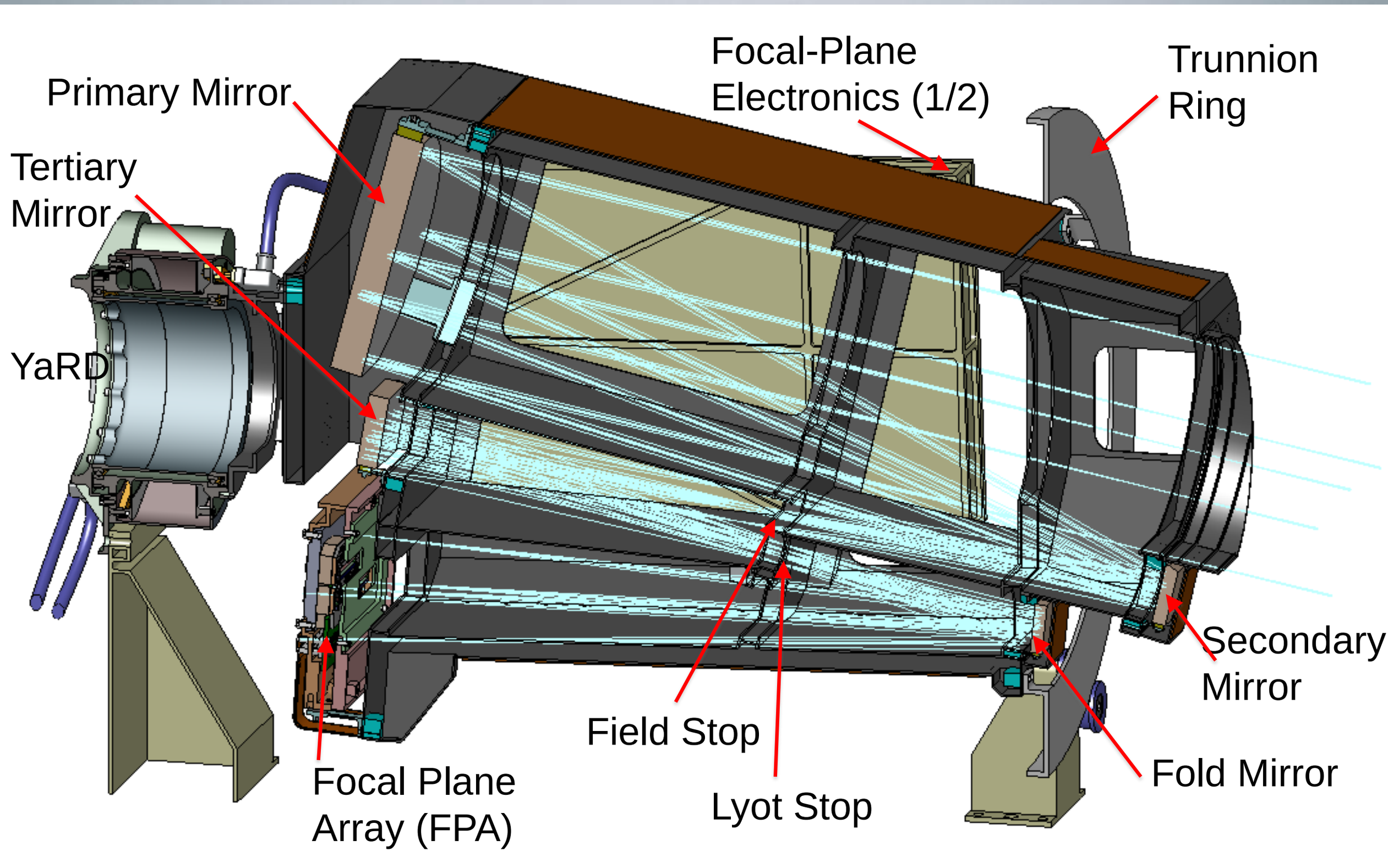




Attitude during Science and Relay Phases

Telescope assembly from Switzerland; Instrument Design, electronics and integration at Ball Aerospace in Boulder, Colorado.




Primary Mirror
Tertiary Mirror
YaRD
Focal-Plane Electronics (1/2)
Trunnion Ring
Secondary Mirror
Fold Mirror
Field Stop
Lyot Stop
Focal Plane Array (FPA)

Imaging Performance (at 400 km altitude)	
Pixel scale	2.0 m/pixel
Swath width	8.5 km
Colors	BG (400-600 nm), RED (550-850 nm), NIR (800-1000 nm), IR (900-1000 nm)
SNR	>100 in all colors at full resolution over low-albedo areas, 45° illumination
Compression	~10:1 via 14-->10 bits + wavelets
Coverage of Mars	~3 x 10^6 km^2 (~2%) in 1 Mars year At minimum data rate 2.9 Gb/day
Stereo DTM dimensions	6 m/pixel, 1.1 m vertical precision

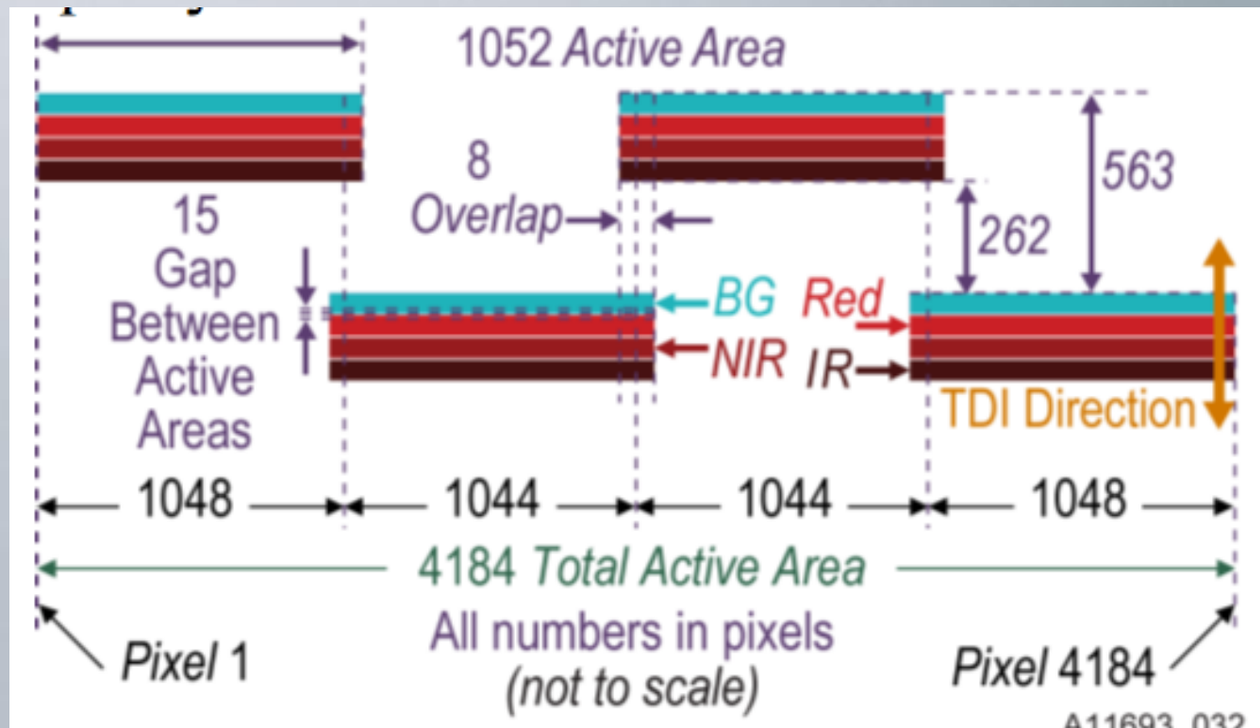
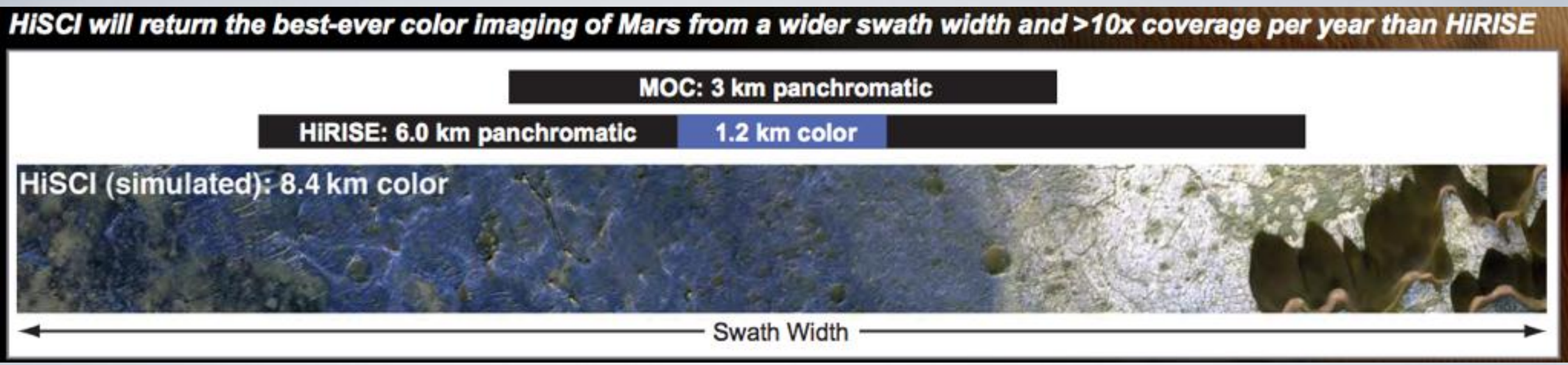
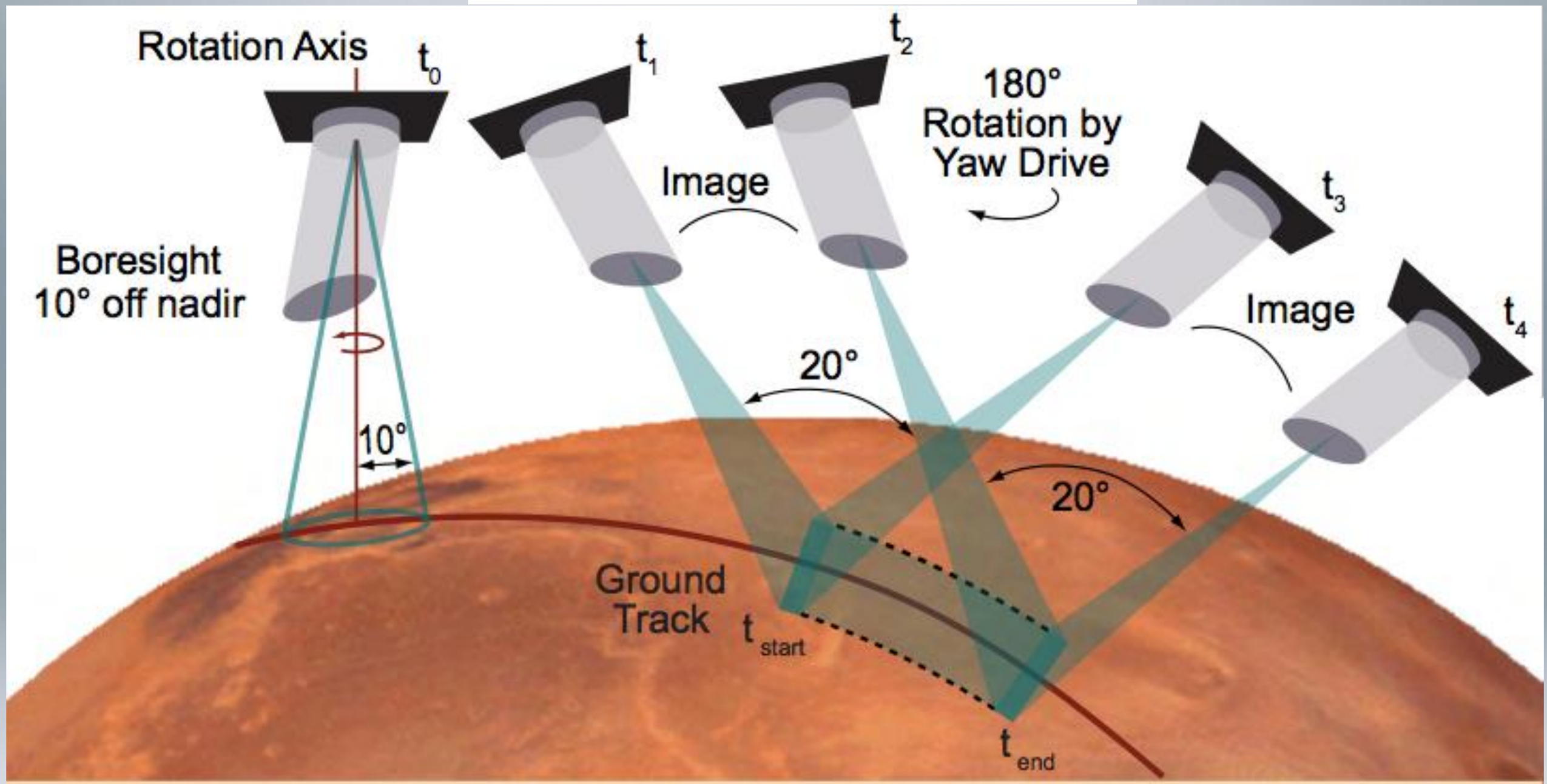


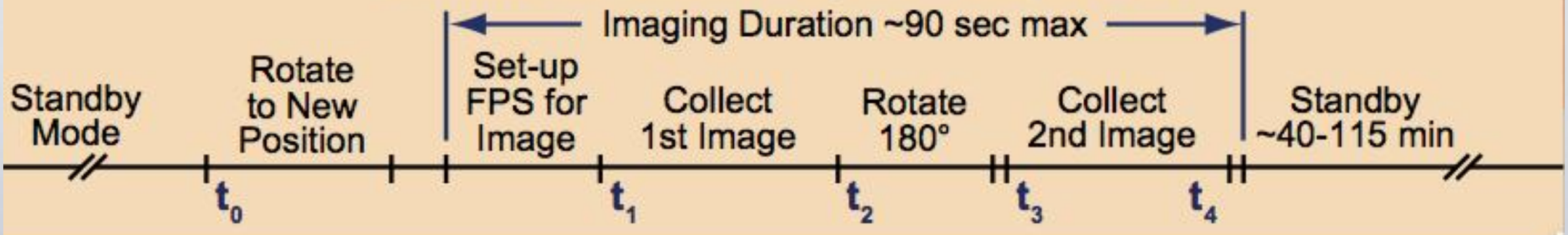
Figure 1-9. Four overlapping MS CCD modules provide seamless coverage and information on pointing jitter. *Physical layout of detectors is shown with scales in pixels.*



How HiSCI Images in Stereo



Timeline for Stereo Image Pair Acquisition



HiSCI Science Team

Name and Institution	Key Responsibility
Alfred McEwen LPL, UA, USA	**PI**: Responsible for the overall successful conduct of HiSCI.
Nicolas Thomas University of Bern, CH	**Co-PI:** European lead, hardware provision for telescope. Volatile processes.
Shane Byrne LPL, UA, USA	**Deputy-PI:** Prioritize and analyze targets for ice-related processes.
John Bridges U. Leicester, UK	Co-I: Landing site definition and support; layered deposits and alteration.
Gabriele Cremonese Astron. Obs., Padova, I	Co-I: DTM production, cratering statistics, wavelets compression analysis.
W. Alan Delamere DSS, USA	Collaborator: instrument design, calibration, and color analysis.
Candice Hansen PSI, (St. Geo., Utah)	Co-I: Uplink planning; prioritize and analyze targets for seasonal processes.
Ernst Hauber DLR, Berlin, D	Co-I: Periglacial, sedimentary, volcanic, tectonic processes; DTM production
Anton Ivanov EPFL, Lausanne, CH	Co-I: DTM production, targeting and analysis of icy Mars.
Laszlo Kestay USGS, Flagstaff, USA	Co-I: Volcanology; geometric star cals, oversee ISIS effort at USGS.
Randolph Kirk USGS, Flagstaff, USA	Co-I: Geometric calibration, geo-desy, and production of DTMs.
Nicolas Mangold University of Nantes, F	Co-I: Science planning and analy-sis for fluvial and other geologic processes.
Wojceich Markiewicz Max-Planck-Institut, D	Co-I: Atmospheric phenomena and effects on color data; season-al processes.
Matteo Massironi Astron. Obs., Padua, I	Collaborator: DTM production; crater chronology.
Sarah Mattson LPL, UA, USA	Other professional: jitter analysis and DTM production.
Chris Okubo USGS, Flagstaff, USA	Co-I: Tectonics, hydrothermal, and mass wasting processes.
James Wray Cornell University, USA	Co-I: Science planning and analy-sis for mineralogy and stratigra-phy.

HiSCI Science

Science Objectives		
1. Understand active surface processes that affect atmospheric exchange on Mars	**2. Follow-up study of specific areas where trace gas release has been discovered**	**3. Search for candidate landing sites driven by new discoveries and map small-scale slopes**
Example Targets		
Vents, gullies, exposed ice, faults, exposures of key minerals, recent impact sites, seasonal defrosting	Locations where trace gases are observed or inferred to originate	Potential landing sites with HiRISE coverage but insufficient topographic data
Measurement Objectives		
Quantify current activity of all types; well-calibrated measurements of color and topography	Quantify surface color, topography, and active processes over specific regions	Stereo topography at 6-m scales; down to 2-m scale by photoclinometry
Expected Benefits to State of Knowledge		
Detailed understanding of a broad range of active surface processes	Detailed understanding of locations of special interest for understanding trace gases	DTMs complete certification of sites for landed follow-up to EMTGO discoveries

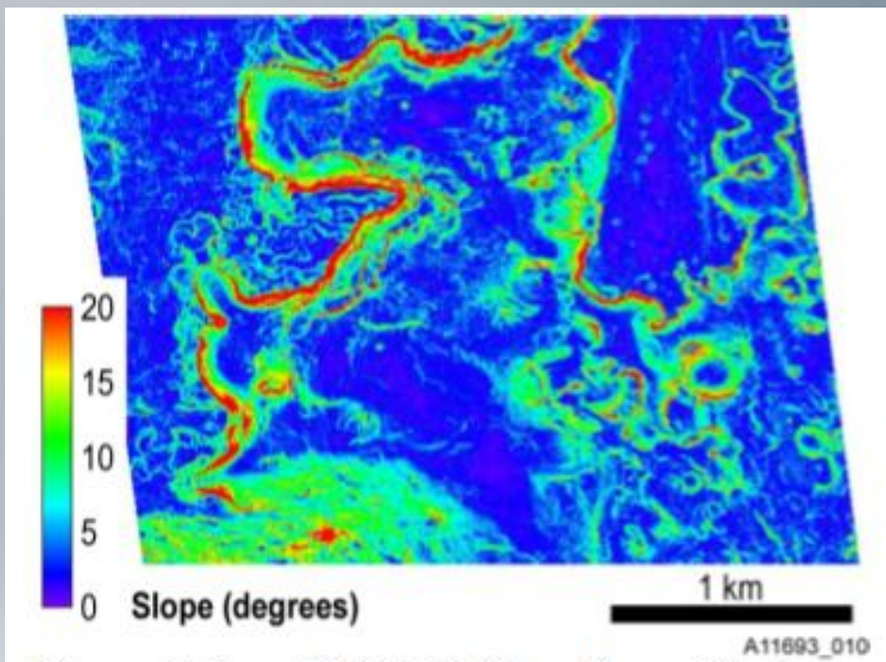


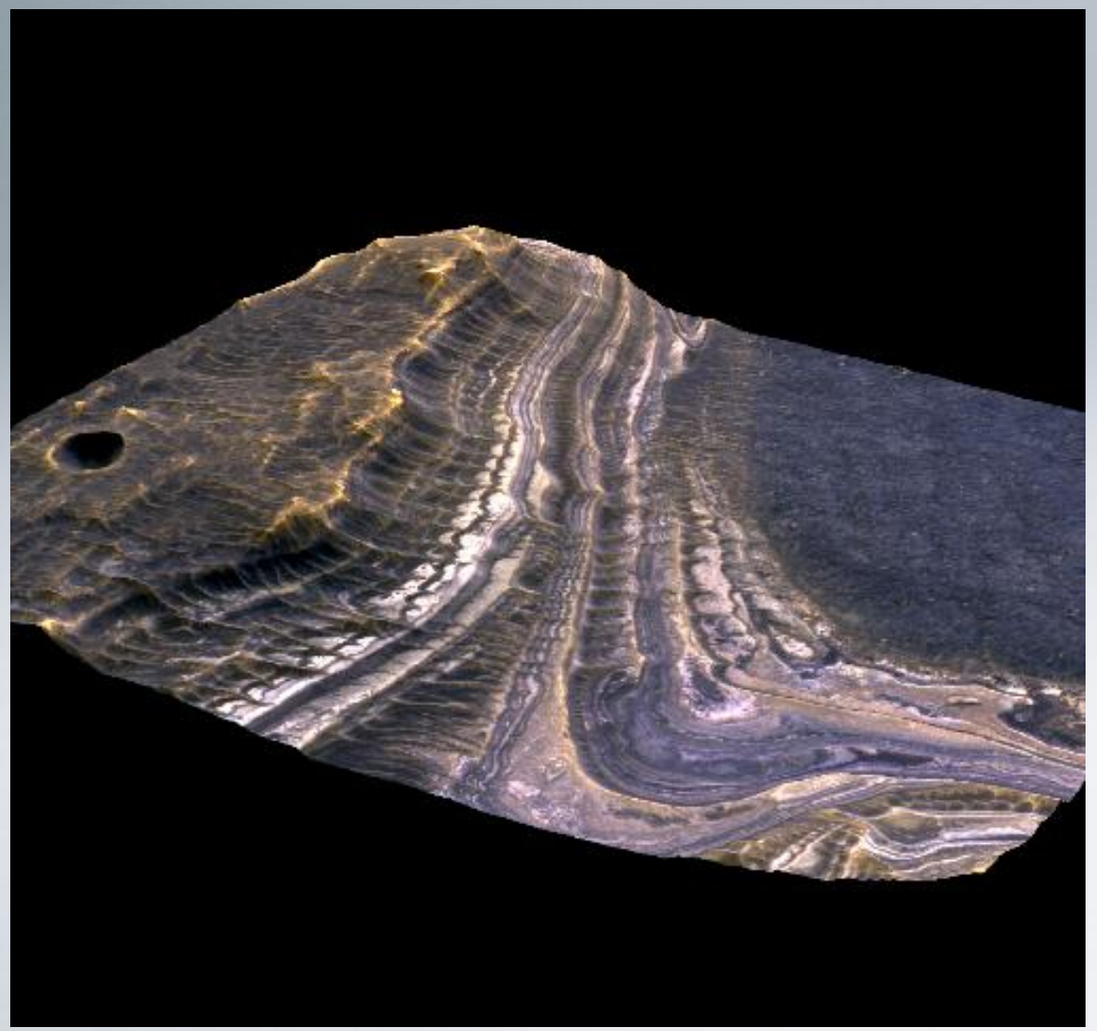
Figure 1-6. *HiSCI DTMs will provide information needed to certify candidate landing sites. Slope map at 6 m/pixel (reduced HiRISE DTM) over lake deposits in Holden crater.*

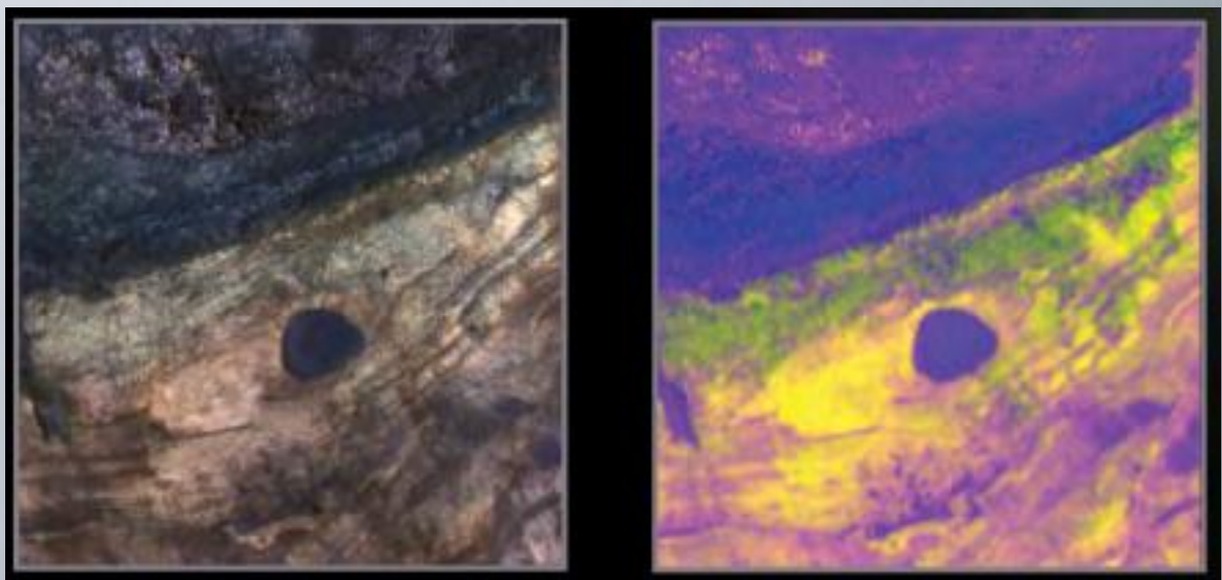
HiRISE/HiSCI Operations Center (HiROC)

- HiROC established in 2004 for HiRISE
  - Currently ~30 people, including part-time students and work on multiple projects.
  - Location: Sonett Bldg, University of Arizona
  - Facilities include basement computer center with extra cooling, security, fire and flood protection, backup generator.
- HiROC includes experienced people in all areas needed for HiSCI operations:
  - systems administration, software development, targeting/uplink specialists, downlink data processers, Digital Terrain Model (DTM) workstations and people, database management, administration, instrument health&safety
- Hopefully MRO/HiRISE will last to 2016 (and beyond) so we can transition experienced people to HiSCI.

HiSCI Data Products

- Calibrated and map-projected 4-color image cubes
- 3-color images and color-ratio composites
- Hundreds of Digital Terrain Models (DTMs)
- Stereo anaglyphs of all stereo pairs
- Slope maps
- Special products like color flyover movies for E/PO





HiSCI will produce quicklook color images (left) and atmospherically-corrected color ratio composites (right) to map color units