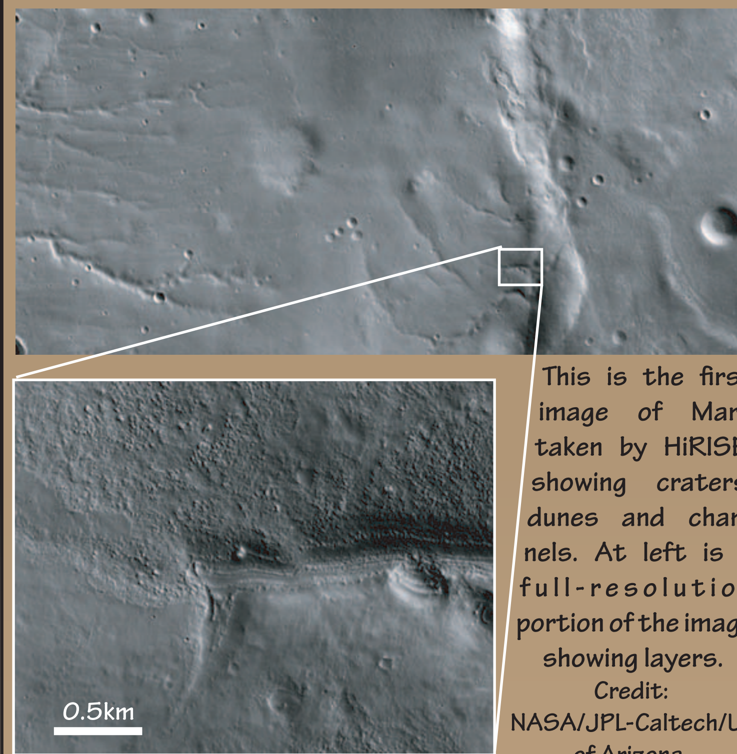
HiRISE High Resolution Imaging Science Experiment

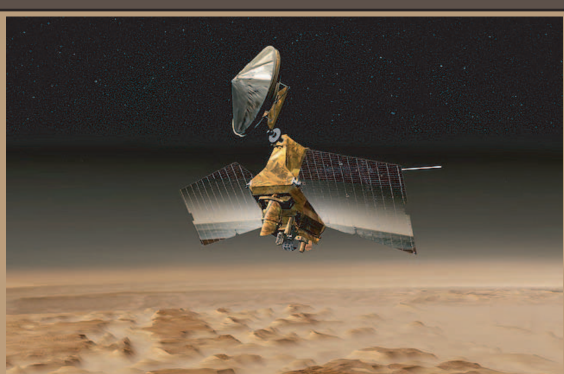
Imaging Mars at high resolution on Mars Reconnaissance Orbiter

Introduction

The High Resolution Imaging Science Experiment (HiRISE) is a camera flying on the Mars Reconnaissance Orbiter (MRO). MRO was launched on August 12, 2005, and was inserted into Mars orbit in March 2006. Over the course of its lifetime orbiting Mars, HiRISE will collect thousands of color and black & white images of the Martian surface. HiRISE will take detailed images (0.25 to 1.3m/pixel) covering about 1% of the Martian surface during the two-year Primary Science Phase (PSP) beginning November 2006. This means that we will be able to see objects as small as a few feet across! Images may include color data over 20% of the field of view. A top priority is the acquisitiuon of about 1000 stereo pairs in order to create Digital Elevation Models (DEMs) allowing scientists to calculate the thickness of features with better than 25 cm precision. This is especially important for getting an idea of the roughness of an area, a critical piece of information when choosing a landing site. Multiple images will also be taken to see seasonal changes or other active processes occurring on the surface. All images will be available to scientists and the public through the web within a few weeks of acquisition.
The camera features a 0.5 m diameter primary mirror, 12 m effective focal length, and a focal plane mechanism that can acquire images containing up to 28 Gb of data in as little as 6 seconds. We expect to return about 12 Tb of data during the PSP.



This is the first image of Mars taken by HiRISE, showing craters, dunes and channels. At left is a full-resolution portion of the image showing layers.
Credit: NASA/JPL-Caltech/U. of Arizona



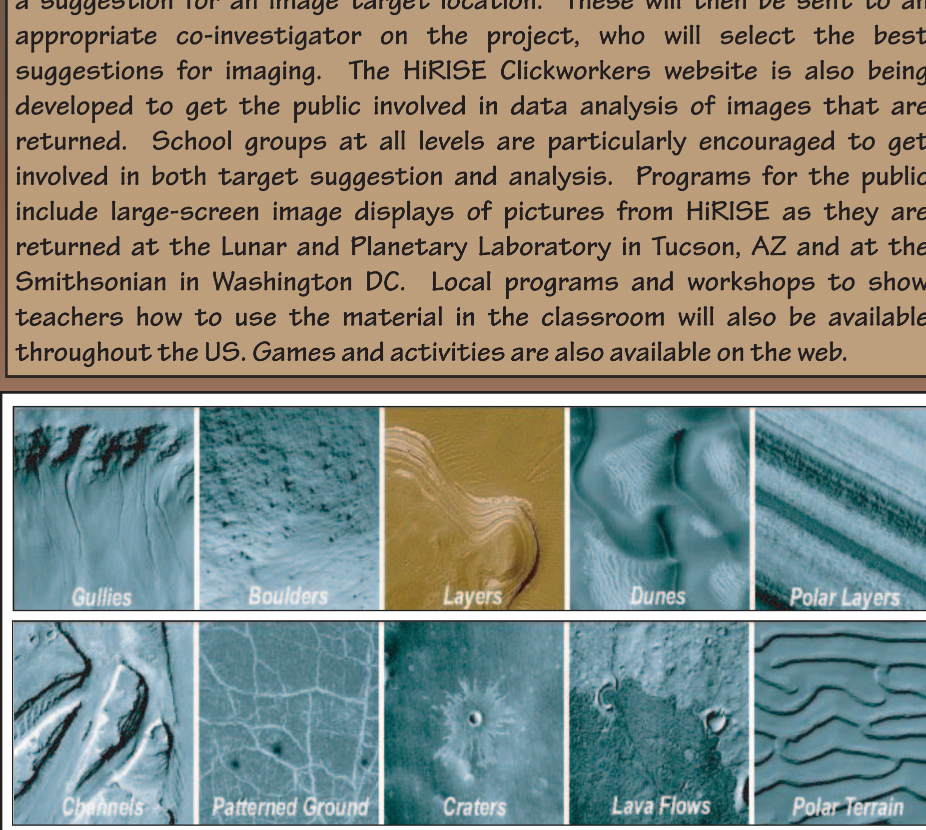
Above is an artist's rendition of MRO flying over Mars. The HiRISE camera is the large cylindrical object at the center of the spacecraft. Credit: NASA/JPL

"The People's Camera"

HiRISE is called "The People's Camera" because the entire science community and the broader public as a whole are encouraged to participate in HiRISE targeting and data analysis. This is made possible by the development of a user-friendly image targeting website, HiWeb, that will allow anyone to submit a suggestion for an image target location. These will then be sent to an appropriate co-investigator on the project, who will select the best suggestions for imaging. The HiRISE Clickworkers website is also being developed to get the public involved in data analysis of images that are returned. School groups at all levels are particularly encouraged to get involved in both target suggestion and analysis. Programs for the public include large-screen image displays of pictures from HiRISE as they are returned at the Lunar and Planetary Laboratory in Tucson, AZ and at the Smithsonian in Washington DC. Local programs and workshops to show teachers how to use the material in the classroom will also be available throughout the US. Games and activities are also available on the web.

What are the goals of HiRISE?

To understand the geologic and climatic processes and history of Mars, including origins, relative ages, and distributions of:
(1) channels and valleys
(2) former lakes or oceans
(3) recent gullies
(4) sedimentary and other layers
(5) volcanic and tectonic landforms
(6) glacial and periglacial landforms
(7) hydrothermal alteration
(8) eolian (created by wind) and polar deposits
(9) near-surface crusts and horizons
(10) mass wasting events and deposits
HiRISE photos will also help provide more information for selecting future landing sites.



HiRISE Capabilities (at 300 km altitude)	
Ground Sampling Dimension (GSD)	30 cm/pixel (1 microrad IFOV[†])
Resolution	~90 cm (3 pixels across)
Swath width (Red CCDs[‡])	6 km (1.14 degrees FOV[*])
Color swath width	1.2 km (0.23 degrees FOV[*])
Maximum image size	20,000 x 63,780 pixels (14-bit data)
Signal:Noise Ratio	90:1 to 250:1 in Red with TDI[**] 128 & full-res
Effective central wavelengths	Red: 694 nm Blue-Green: 536 nm NIR[***]: 874 nm
Stereo topographic precision	~25 cm vertical precision over ~1 m^2 areas
TDI[**] lines	8, 32, 64 or 128
Pixel binning	None, 2x2, 3x3, 4x4, 8x8, 16x16
Bits per pixel	14, can be compressed to 8 via LUTs[#]
Compression (8-bit image only)	FELICS[##], >1.6:1

‡CCD = Charge-Coupled Device (an image sensor)
**TDI = Time Delay and Integration

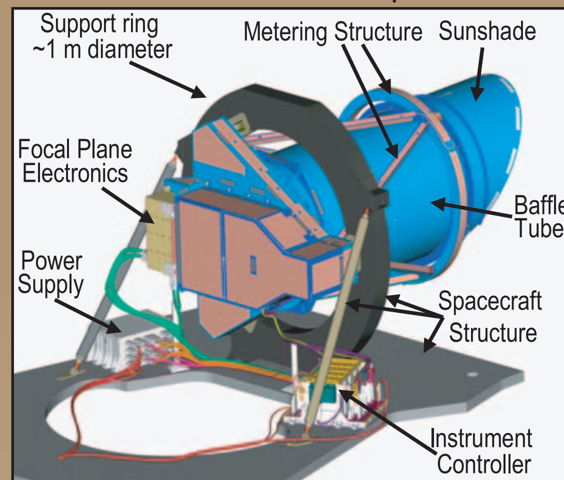
†IFOV = Instantaneous Field Of View
*FOV = Field of View
***NIR = Near Infrared
#LUT = Look Up Table
##FELICS = Fast and Efficient Lossless Image Compression

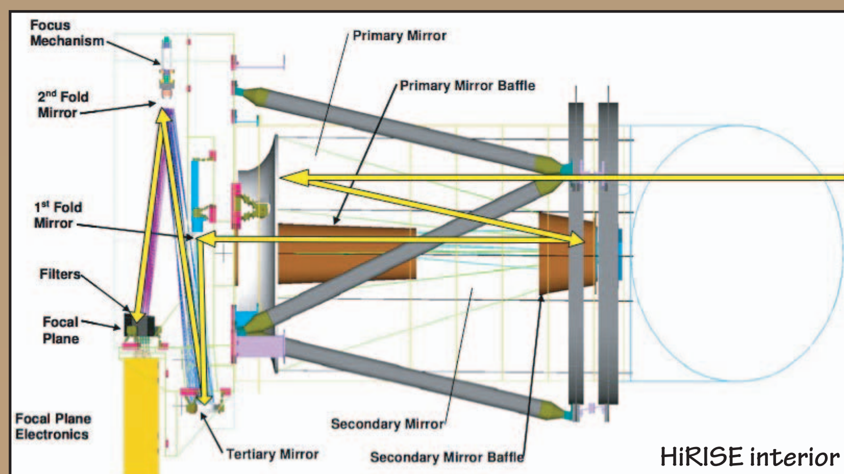
Picture of the HiRISE camera as it is being built by an engineer at Ball Aerospace & Technology Corp. Photo credit: NASA/JPL/Ball Aerospace

Technology

HiRISE is not like a traditional camera. Instead of lenses, there are three mirrors. It is composed of 14 CCDs in a large telescope. These CCDs act like cameras, capturing and storing the data, but they are much better at taking pictures in low light than regular cameras. Most of the CCDs in HiRISE use a red filter that just allows red light to enter the detector. In the very center of the camera, there are four extra CCDs, two each behind blue-green and infrared filters. Therefore, the central 20% (2/10) of each image will be obtained in 3 different filters, allowing image-processing specialists back on Earth to reconstruct the central part of each image in color. These CCDs sit in the 'focal plane array'.

HiRISE exterior





HiRISE interior

Websites to visit

To learn more about HiRISE (HiWeb):
http://marsoweb.nas.nasa.gov/HiRISE/
http://hirise.lpl.arizona.edu

For HiRISE games, activities, curriculum materials and to learn how to suggest a target: **http://hirise.seti.org/epo/**

For local Arizona public outreach and info about the HiRISE Operations Center (HiROC): **http://hiroc.lpl.arizona.edu/**

To analyze images using Clickworkers:
http://clickworkers.arc.nasa.gov

Images from HiRISE are also available in NASA's Planetary Photojournal:
http://photojournal.jpl.nasa.gov/instrument/HiRISE

To learn more about MRO:
http://marsprogram.jpl.nasa.gov/mro/

Team Member	Roles and Responsibilities/Scientific Specialty	Institution
Alfred McEwen	Principle Investigator/Cratering, Mass Wasting	U. of Arizona
Candice Hansen	Deputy PI, uplink design/ Seasonal Processes	JPL
Alan Delamere	Engineering support, Radiometric calibration	Delamere Support Systems
Eric Eliason	HiROC manager, GDS design	USGS/U. of Arizona
Virginia Gulick	E/PO lead, HiWeb lead/ Fluvial & hydrothermal processes	NASA Ames/SETI Inst.
Ken Herkenhoff	Radiometric calibration/ Polar geology	USGS
Nathan Bridges	JPL Investigation Scientist/ Aeolian Processes	JPL
Nick Thomas	European operations/ Spectrophotometry	U. of Bern
Randolph Kirk	Geodesy & DEM production, Geometric calibration	USGS
John Grant	Landscape evolution, MSL Landing Sites	Smithsonian Inst.
Laszlo Keszthelyi	Observation planning process/ Volcanology, Tectonics	USGS
Mike Mellon	Coordination with Phoenix mission/ Periglacial, Glacial and Regolith processes	U. of Colorado
Steve Squyres	Future exploration, MER landing sites	Cornell U.
Cathy Weitz	Layering processes and stratigraphy	Planetary Science Inst.