CRISM: COMPACT RECONNAISSANCE IMAGING SPECTROMETER FOR MARS ON THE MARS RECONNAISSANCE ORBITER. S. Murchie[1], R. Arvidson[2], O. Barnouin-Jha[3], K. Beisser[1], J.-P. Bibring[3], J. Bishop[4], J. Boldt[1], T. Choo[3], R.T. Clancy[5], E.H. Darlington[3], D. Des Marais[4], D. Fort[1], J. Hayes[3], J. Lees[1], E. Malaret[6], D. Mehoke[3], R. Morris[7], J. Mustard[8], K. Peacock[3], M. Robinson[9], T. Roush[4], E. Schaefer[3], P. Silverglate[1], M. Smith[10], P. Thompson[3], and B. Tossman[1], [1]Applied Physics Laboratory, Laurel, MD 20723, [2]Washington University, St. Louis, MO, [3]Institut d'Astrophysique Spatiale, Orsay, France, [4]NASA/ARC, Moffett Field, CA, [5]Space Science Institute, Boulder, CO, [6]Applied Coherent Technology, Herndon, VA, [7]NASA/JSC, Houston, TX, [8]Brown University, Providence, RI, [9]Northwestern University, Evanston, IL, [10]NASA/GSFC, Greenbelt, MD.

Introduction: The Compact Reconnaissance Imaging Spectrometer for Mars (CRISM) on the Mars Reconnaissance Orbiter (MRO) will conduct a comprehensive series of investigations of the Martian surface and atmosphere. The investigations will be accomplished using an instrument design that provides high spatial and spectral resolutions, extended wavelength range, and ability to gimbal through a range of orientations. Baseline investigations include a near-global survey to find high science priority sites, full-resolution measurement of thousands of such sites, and tracking of seasonal variations in atmospheric and surface properties.

Science Overview: The Mars Exploration Payload Analysis Group [1] recommended specific hyperspectral imaging investigations to characterize Martian geology, climate, and environments of present or past life. CRISM's three groups of investigations address all of MEPAG's recommendations. The first two groups correspond to two primary objectives of MRO: *to search for evidence of aqueous and/or hydrothermal activity,* and *to map and characterize the composition, geology, and stratigraphy of surface features.* These investigations are implemented by high-resolution hyperspectral mapping of thousands of high priority targets including candidate sedimentary deposits [2], volcanic regions, crustal sections exposed in steep escarpments, and sites which exhibit evidence in Mars Express/Omega data for concentrations of aqueously formed minerals. The third group of investigations addresses the primary MRO objective *to characterize seasonal variations in dust and ice aerosols and water content of surface materials*, and the secondary objective to *provide information on the atmosphere complementary to other MRO instruments*. These investigations are implemented using a systematic, global grid of measurements of the emission phase function (EPF) acquired repetitively throughout the Martian year. EPF measurements allow accurate determination of column abundances of water vapor, CO, dust and ice aerosols, and their seasonal variations [3]. At the same time, the grid's repetitive coverage will track seasonal variations in water content of surface material. Additional, targeted observations of the polar caps will investigate their inventory of water and CO_2 ices.

When not taking targeted measurements, CRISM will conduct a ~100 m/pixel, 50-wavelength survey to search for evidence of aqueous activity that lacks morphologic expression and/or is below the resolution of previous spectral mapping. The survey addresses MRO's secondary objective *to identify new sites with high science potential for future investigation*, and will be particularly important for identification of key Noachian deposits. For example, even at low Martian erosion rates [4], morphologic expressions of Noachian hot spring deposits would have been removed in ~10^9 yrs, so that such deposits may now exist only as mineralized spots in morphologically unremarkable eroded escarpments, crater ejecta, and talus. Much of the survey will be completed before MRO's highest downlink rates, so that newly discovered sites can be targeted with full-resolution coverage.

Instrument Overview: An overview of the instrument is shown in **Figure 1**. CRISM consists of two major subassemblies, the Optical Sensor Unit (OSU) and the Data Processing Unit (DPU). The OSU contains visible (VIS) and infrared (IR) imaging spectrographs that share the same field-of-view. The VIS focal plane samples wavelengths 400-830 nm at 8 nm/channel; the IR focal plane samples 830-4050 nm at 7 nm/channel and is cooled with redundant cryogenic coolers. A side-facing radiator cools the spectrometer cavity to decrease instrument background, and a planet-facing radiator cools the electonics. An onboard source provides radiance calibration, and a shutter and dedicated dark pixels provide background measurements interleaved with Mars measurements. Optics and the focal planes are enclosed in a housing that is gimballed by a high-precision motor/encoder ±60° along-track from nadir. During measurement of a target, along-track scanning takes out most ground-track speed and allows long integration times and high signal-to-noise ratio (SNR) data to be obtained. At the same time, scanning provides the capability to remeasure a spot repeatedly at multiple emission angles to characterize the EPF. High spatial resolution (24 m/pixel at 400 km) allows characterization of the surface at the outcrop scale, and wavelength coverage to >4000 nm provides sensitivity to carbonates even at low abundances. The DPU provides lossless or lossy compression of the data stream in real time. Key design elements are adapted from the CONTOUR and MESSENGER optical instruments.

Operations Overview: Figure 2 summarizes CRISM's three complementary data acquisition strategies, which are built around the three steps needed to characterize high scientific priority, small-scale deposits: find the deposits, separate their signature from that of the atmosphere, and acquire high spectral and spatial resolution measurements with high SNR. Most of the time the OSU views nadir, building up coverage in multispectral survey mode. In the second mode of observing, for a group of ~36 orbits once every ~60 days, EPFs are measured on a 10° longitude x 10° latitude grid. The third mode is targeted observations, approximately 2500 of which will be obtained at key locations. At each site, gimballing is used to take out most along-track motion, so that the field-of-view is slowly scanned over a rectangular swath approximately 13x30 km in size (when measured from 400 km altitude). Measurements of the swath are bracketed by incoming and outgoing measurements of the EPF of the centerpoint of the swath at emission angles up to ±60°. Larger high-priority targets will be identified in Mars Express/Omega data and other data sets. The multispectral survey provides redundancy to Omega data in locating targets that have VIS-IR spectral signatures but lack obvious morphologic expressions, and it provides the spatial resolution needed to identify small targets not evident in Omega data.

References: [1] MEPAG, *Mars Exploration Program: Scientific Goals, Objectives, and Priorities*, 2000. [2] Cabrol, N. and E. Grin, *Icarus*, *142*, 160-172, 1999. [3] Clancy, R.T., and S. Lee, *Icarus*, *93*, 135-158, 1991. [4] Presley, M., and R. Arvidson, *Icarus*, *75*, 499-517, 1988.

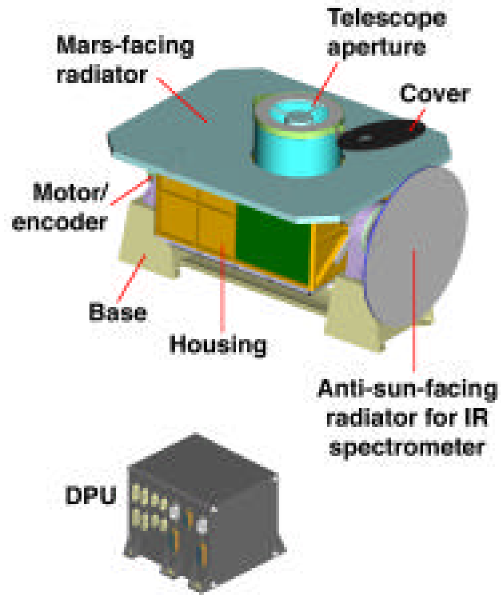

Fig. 1. Preliminary CAD renderings of CRISM's OSU and DPU.

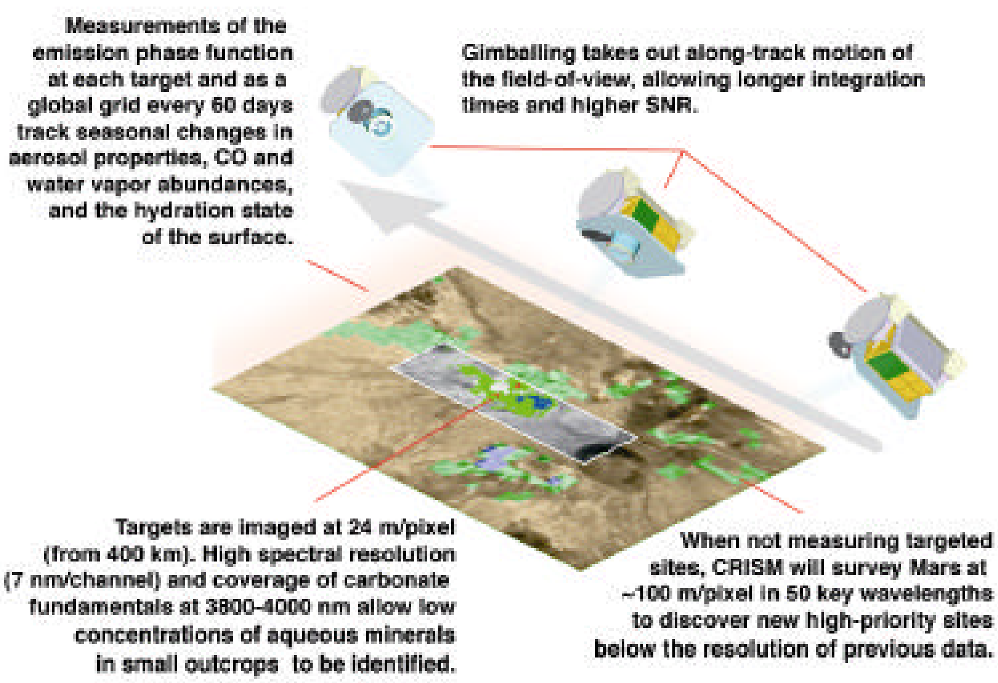

Fig. 2. Schematic depiction of key attributes of CRISM's measurement plan for the Martian surface and atmosphere.