LROC - LUNAR RECONNAISSANCE ORBITER CAMERA. M.S. Robinson[1], E.M. Eliason[2], H. Hiesinger[3], B.L. Jolliff[4], A.S. McEwen[2], M.C. Malin[5], M.A. Ravine[5], D. Roberts[1,6], P.C. Thomas[7], and E.P. Turtle[2], [1]Northwestern Univ., Center for Planetary Sciences, 1850 Campus Drive, Evanston, IL, 60208, robinson@earth.northwestern.edu, [2]LPL, Univ. of Arizona, [3]Brown Univ., [4]Washington Univ., [5]Malin Space Science Systems, [6]Adler Planetarium, [7]Cornell Univ.

The Lunar Reconnaissance Orbiter Camera (LROC) is designed to address two of the prime LRO measurement requirements [**1**]. 1) Assess meter and smaller-scale features to *facilitate safety analysis for potential lunar landing sites* near polar resources, and elsewhere on the Moon. 2) Acquire multi-temporal synoptic imaging of the poles every orbit to *characterize the polar illumination environment* (100 m scale), identifying regions of permanent shadow and permanent or near-permanent illumination over a full lunar year. The LROC consists of two narrow-angle camera components (NACs) to provide 0.5-m scale panchromatic images over a 5-km swath, a wide-angle camera component (WAC) to provide images at a scale of 100 m in seven color bands over a 100-km swath, and a common Sequence and Compressor System (SCS).

In addition to acquiring the two LRO prime measurement sets, LROC will return six other high-value datasets that support LRO goals, the Robotic Lunar Exploration Program (RLEP), and basic lunar science. These additional datasets include: 3) meter-scale mapping of regions of permanent or near-permanent illumination of polar massifs; 4) multiple co-registered observations of portions of potential landing sites and elsewhere for derivation of high-resolution topography through stereogrammetric and photometric stereo analyses; 5) a global multispectral map in 7 wavelengths (300-680 nm) to characterize lunar resources, in particular ilmenite; 6) a global 100-m/pixel basemap with incidence angles (60-80°) favorable for morphologic interpretations; 7) sub-meter imaging of a variety of geologic units to characterize physical properties, variability of the regolith, and key science questions; and 8) meter-scale coverage overlapping with Apollo era Panoramic images (1-2 m/pixel) to document the number of small impacts since 1971-1972, to ascertain hazards for future surface operations and interplanetary travel.

The LROC approach is to minimize risk in all aspects of the investigation in order to meet the schedule, mass, data volume, and cost constraints of LRO while meeting or exceeding the measurement requirements. LROC has high heritage from the MRO-CTX and MRO-MARCI instruments, with only minimal modifications needed to meet the primary measurement requirements. Each NAC has a 700-mm-focal-length, catadioptric telescope that images onto a 5000-pixel CCD line-array, providing a cross-track field-of-view (FOV) of 2.86°. The NAC readout noise is better than 100 e^-, and the data are sampled at 12 bits. By ground command, these 12-bit pixel values may be converted to 8-bit, square root encoded-values prior to downlink. The NAC internal buffer holds 256 MB of uncompressed data, enough for a full-swath image 25-km long or a 2x2 binned image 100-km long. The WAC electronics are a copy of those flown on cameras on Mars Climate Orbiter (MCO), Mars Polar Lander (MPL), and Mars Odyssey, and those planned for flight on Mars Reconnaissance Orbiter (MRO) and Mars Phoenix Lander. The WAC has two 6-mm-focal-length lenses imaging onto the same 1000 x 1000 pixel, electronically shuttered CCD area-array, one imaging in the visible/near IR, and the other in the UV. Each has a cross-track FOV of 90°. From the nominal 50-km orbit, the WAC will provide a nadir, ground sample distance of 100 m/pixel in the visible, and a swath width of ~100 km. The seven-band color capability of the WAC is provided by a color filter array mounted directly over the detector, providing different sections of the CCD with different filters [**2**]. Consequently the instrument has no moving parts; it acquires data in the seven channels in a "pushframe" mode, with scanning of the WAC FOV provided by motion of the spacecraft and target. Continuous coverage in any one color is provided by repeated imaging at a rate such that each of the narrow framelets of each color band overlap. The WAC has a readout noise of less than 40 e^-, and, as with the NAC, pixel values are digitized to 12-bits and may be subsequently converted to 8-bit values.

The NACs and WAC all interface with the Sequencing and Compressor System (SCS), the third element of the LROC. As the name implies, the SCS commands individual image acquisition by the NACs and WAC from a stored sequence, and compresses the NAC and WAC data as they are read out and passed to the spacecraft data system. The SCS provides a single command and data interface between the LROC and the LRO spacecraft data system. The SCS design is derived from the MARCI interface adapter, a digital converter unit that links the MARCI electronics on MRO to that spacecraft's data system.

Each NAC has an estimated mass of 5.4 kg, the WAC is 0.6 kg, and the SCS is 0.6 kg, for a total LROC mass of 12 kg. Each NAC will use 10 W during image acquisition or readout, 6 W at all other times; the WAC will use 4 W (continuous), and the SCS will use 6 W (continuous), for a total LROC power dissipation of 30 W peak, 22 W average.

The LROC Mission Operations Facility (MOF) will be located at Northwestern University where all uplink and downlink activities will take place. The MOF has been scaled assuming a 30% share of the LRO downlink with lossless compression, producing a total of 20 TeraBytes (TB) of raw data. Production of higher-level data products will produce a total of 70 TB for Planetary Data System (PDS) archiving, 100 times larger than any previous missions. To reduce schedule risk we are leveraging existing software, with targeting and sequencing software derived from MGS-MOC and MRO-CTX, and automated downlink processing derived from MRO-HiRISE procedures with the USGS Integrated Software for Imagers and Spectrometers (ISIS) package for radiometric and geometric processing [**3**]. LROC data will be disseminated via web interface in raw, calibrated, and mosaicked versions.

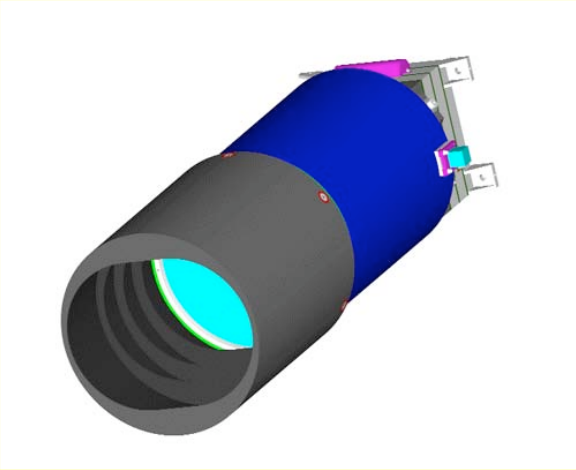

Figure 1. LROC Narrow Angle Component (NAC), 70 cm by 24 cm diameter.

The LROC team is experienced in all aspects of the investigation, with cumulative participation in 14 successful imaging experiments and 6 others in development or recently launched. MSSS has built six planetary imaging systems that have flown on four spacecraft, and has just delivered the MARCI and CTX instruments to the MRO spacecraft. Key tasks in phase C/D for the Co-Is include populating a prioritized target database for the NAC, development of processing procedures, and participation in instrument calibrations; during phase E, duties include verification of the returned data, initial analyses, and delivery of products to the LRO project and RLEP.

The LROC Team is committed to bringing the excitement of lunar exploration to the public and into varied educational environments. We have assembled an experienced E/PO team that will work with the LROC Team and the LRO project to engage the public. The Adler Planetarium and Astronomy Museum in Chicago will manage all E/PO efforts, including coordination with partners and consultants. The DePaul Space Science Center will manage an educational program targeting minority-serving Chicago-area colleges and outreach to the small planetarium community. The primary goals of this E/PO program are: 1) communicate the goals and results of the LROC to students and the public, 2) provide tools to enable various audiences to view and analyze images from LROC, 3) contribute to the E/PO activities of the NASA forums and brokers and the LROC mission as a whole through GSFC.

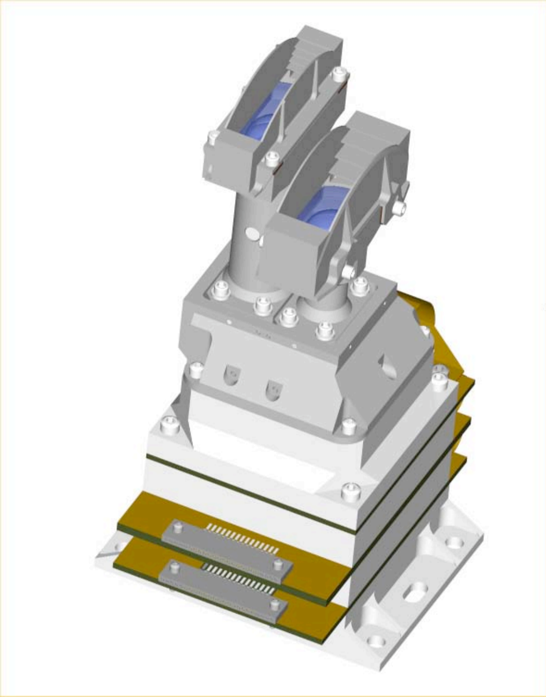

Figure 2. LROC Wide Angle Component (NAC), 14.5 cm by 9.2 cm by 7.6 cm.

References: [1] NASA, *Lun. Recon. Orb. Meas. Invest. AO NNH04ZSS003O.* [2] Malin et al., JGR, 106, 17651-17672, 2001. [3] Eliason et al., abstracts 30th *Lun. Planet. Sci, Conf.* 1999.