INITIAL RESULTS FROM MINI-RF: A SYNTHETIC APERTURE RADAR ON LUNAR RECONNAISSANCE ORBITER., D.B.J. Bussey[1], P. D. Spudis[2], B. Butler[3], L. Carter4, J.J. Gillis-Davis[5], E. Heggy[6], R. Kirk[7], C. Neish[1], S. Nozette, G.W. Patterson[1], M.S. Robinson[8], R. K. Raney[1], T. Thompson[6], B.J. Thomson[1], E. Ustinov[6] [1]Applied Physics Laboratory, Laurel MD 20723, [2]Lunar and Planetary Institute, Houston TX, [3]NRAO, Soccorro NM [4]NASM, Washington DC, [5]Univ. Hawaii, Honolulu HI 96822, [6]JPL, Pasadena CA, [7]USGS, Flagstaff AZ, 8ASU, Tempe AZ

Introduction: Mini-RF on LRO is a lightweight Synthetic Aperture Radar (SAR) flying on NASA's Lunar Reconnaissance Orbiter. It is the sister instrument to one which flew on the Indian Chandrayaan-1 lunar orbiter [1]. Mini-RF operates in both S band (like Chandrayaan-1) and X-band. Also as well as the baseline resolution (150 meters) it can also operate in zoom mode with a spatial resolution of 30 meters. Mini-RF uses an hybrid dual polarization technique, transmitting a left circular polarized signal and then receiving Horizontal and Vertical polarization signals, as well as the phase information between the two polarizations [2]. This is an unusual architecture, but it preserves all of the information conveyed by the reflected signals. From these data we determine all four Stokes parameters of the backscattered field. The Stokes parameters offer a very powerful tool to investigate the nature of lunar radar backscatter. In addition to calculating the response at both circular polarizations, and therefore also the circular polarization ratio, it will also be possible to ascertain properties which should help to distinguish between multiple surface reflections versus volume scattering. This is key in trying to determine if the nature of the returned signal is due to an ice-regolith mixture, or simply rocks on the lunar surface. Examples of these key properties include the Degree of Polarization and the Degree of Linear Polarization.

Goals: The goal of Mini-RF is to acquire data in support of mission goals [3]. Some of the goals that Mini-RF data can help address include:- 1. Landform-scale imaging of the permanently shadowed craters. 2. Search for ice deposits. 3. Provide information on meter-scale features of the Constellation landing site list. 4. Acquire global topgraphic information. 5. Characterize lunar mineralogy. All of these level 1s are best served by combined analysis of several of the LRO data sets. However Mini-RF can make a major contribution to the level 1s listed above.

Current Progress: Mini-RF is operating well and has demonstrated an ability to acquire high-quality SAR images in S & X bands at both baseline and zoom spatial resolutions. Initial analysis of images amd backscatter data indicate that Mini-RF is a fully functional imaging SAR, capable of providing new and unique information about lunar surface properties. Current Mini-RF activities primarily fall into two categories:- 1. LCROSS support, and 2. Non-polar imaging.

LCROSS Support. During the commissioning portion of the LRO mission,whilst the spacecraft was in an elliptical orbit, Mini-RF acquired data in support of the LCROSS mission [4]. Mini-RF acquired primarily S-band zoom data of potential LCROSS target sites (Figure 1). These were one of the data sets used by the LCROSS team to select their final target site inside Cabeus crater. Mini-RF continues to support LCROSS by acquiring post-impact data of the target site.

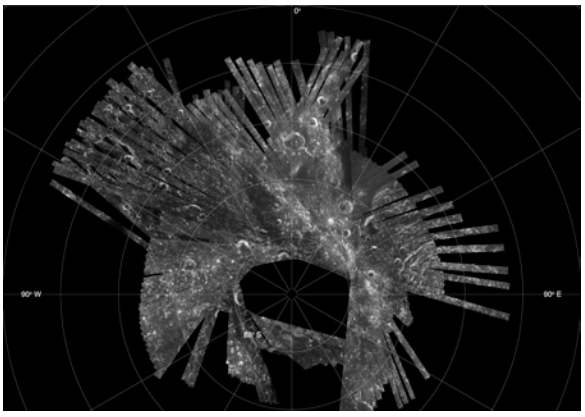

Figure 1. S-zoom mosaic of the south polar region acquired in support of LCROSS targeting.

Non-Polar Imaging. Mini-RF has been taking advantage of excees downlink capacity to acquire nighttime imaging of non-polar targets. The Mini-RF target database includes the Constellation potential landing site listand areas of scientific and exploration interest. As of November 21st 2009 Mini-RF had acquired more than 175 non-polar passes. The coverage map for these data is shown in Figure 2. Some examples of the data collected are shown in Figures 3 & 4.

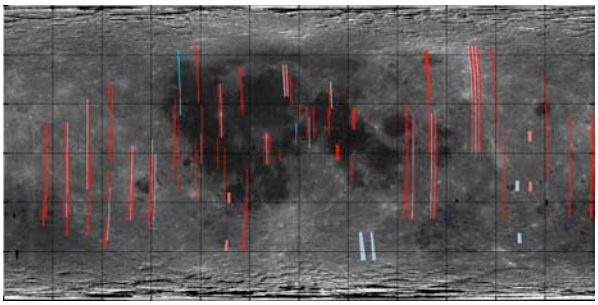

Figure 2. Non-polar coverage map as of November 21st 2009.

Figure 3. SAR image showing a portion of Kopff crater. Ejecta from a small interior crater can be seen to drape out side the rim of Kopff.

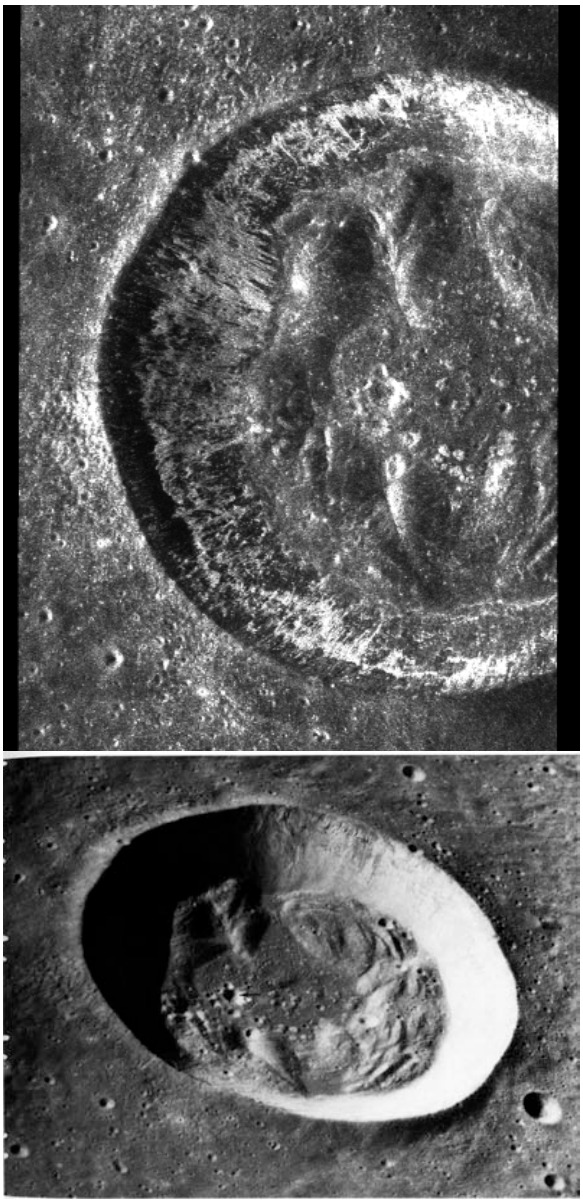

Figure 4. Top: Mini-RF SAR image of the 16 km diameter Bessel crater. Bottom. Apollo 15 oblique pan frame of Bessel. Synergistic analysis of optical and SAR data will enhance our understanding of lunar surface processes.

Conclusions: Mini-RF is acquiring good quality data of the radar backscatter properties of the lunar surface. These data will help Mini-RF address it's level 1s, particularly when synergistaically analyzed with other LRO data sets [5].

References: [1] Spudis P.D. et al., (2009) *Current Science*, V96 #4, 533-539. [2] Chin G., et al., (2007) *Space Sci Rev.* 129, 391-419. [3] Raney R.K. (2007) *IEEE trans. Geosci. Rem. Se.,* 45, 3397-3404. [4] Neish C.D. et al., (2010) *LPSC* XLI. [5] Lawrence S. et al., (2010) *LPSC* XLI.