CHARACTERIZATION OF LUNAR CRATER EJECTA DEPOSITS USING M-CHI DECOMPOSITIONS OF MINI-RF RADAR DATA. G.W. Patterson, R.K. Raney, J.T.S. Cahill, D.B.J. Bussey, and the Mini-RF Team. Johns Hopkins University Applied Physics Laboratory, Laurel, MD (Wes.Patterson@jhuapl.edu).

Introduction: Impact cratering is the dominant weathering process on the surface of the Moon and is largely the determining factor of material distribution on the lunar surface [1] Radar data provide unique information on both the horizontal and vertical distribution of impact deposits [2]. We introduce a new technique for analysis of polarimetric radar astronomical data, *m-chi*, derived from the classical Stokes parameters. Analysis of the crater Byrgius A demonstrates how *m-chi* can more easily differentiate materials within ejecta deposits and their relative thicknesses.

Background: The Miniature Radio Frequency (Mini-RF) instrument flown on the Lunar Reconnaissance Orbiter (LRO) is a Synthetic Aperture Radar (SAR) with an innovative hybrid dual-polarimetric architecture, transmitting (quasi-) circular polarization, and receiving orthogonal linear polarizations and their relative phase [3]. The four Stokes parameters that characterize the observed backscattered EM field are calculated from the received data. These parameters can be used to derive a variety of child products that include the circular polarization ratio (CPR) and the *m-chi* decomposition. The former provides an indication of surface roughness and the latter provides an indication of the scattering properties of the surface [4].

Analysis: Byrgius A is a 19 km diameter Copernican located in the lunar highlands east of the Orientale Basin and west of Mare Humorum. Visible image data of the region obtained by the Lunar Reconnaissance Orbiter Camera Wide Angle Camera (LROC WAC) [5] at a resolution of 100 m/pixel show optically bright ejecta deposits associated with the crater that extend to radial distances of 100s of km, with near continuous deposits observed to an average radial distance of 70 km (Fig. 1).

Mini-RF CPR information derived from S-band (12.6 cm) data of the region show an increased roughness for Byrgius A and its ejecta deposits relative to the surrounding terrain. This is a commonly observed characteristic of young, fresh craters and indicates that the crater and its ejecta have a higher fraction of cm- to m-scale scatterers at the surface and/or buried to depths of up to ~1 m. As observed with visible image data, the increased roughness associated with the ejecta of Byrgius A appears nearly continuous to a radial distance of ~70 km.

An *m-chi* decomposition of Mini-RF S-band data for Byrgius A suggests that the portion of ejecta that extends radially from ~10 to 70 km appears far less continuous than is suggested in both optical data and CPR information (Fig. 1). The implication is that we are observing properties of the ejecta and lunar background terrain in the top meter of the surface. In other words the thickness of the ejecta in this distance range is on the order of meters or less.

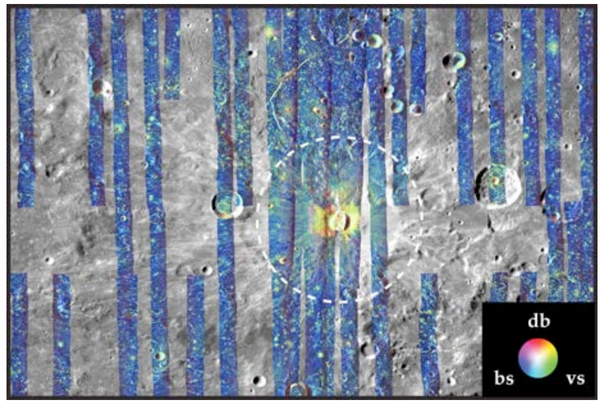

Figure 1. An m-chi decomposition showing the crater Byrgius A (19 km dia.; 24.5°S, 63.7°W) overlain on LROC WAC data (100 m/pixel). The color wheel highlights the m-chi scattering regimes (double bounce, db; single bounce, bs; volume scattering, vs).

Conclusions: The Mini-RF instrument on LRO is among the first polarimetric imaging radars outside of Earth orbit. Stokes information returned from the instrument can be used to create derived products such as CPR and *m-chi* decompositions. Using these products, we examine the crater Byrgius A and demonstrate the ability to differentiate materials within ejecta deposits and their relative thicknesses. This result suggests that the thickness of ejecta at radial distances > a crater radius differ significantly from estimates of ejecta thickness derived from models of ejecta emplacement [6,7].

References: [1] Melosh, H. J. (1989), Oxford Univ. Press, New York; [2] Ghent, R. R. et al. (2008), *Geology*, 36(5), 343-346; [3] Raney, R. K. et al. (2011), *Proc. of the IEEE*, 99(5), 808-823; [4] Raney, R.K. et al. (2012), *JGR,* 117, E00H21; [5] Robinson, M. S. et al. (2010), *Space Sci. Rev.*, 150, 81-124; [6] McGetchin et al. (1973), *EPSL*, 20, 226-236; [7] Pike (1974), *EPSL*, 23, 265-274.