HIGH RESOLUTION LUNAR RADAR STUDIES—PRELIMINARY RESULTS; N.J.S. Stacy and D.B. Campbell, National Astronomy and Ionospheric Center and Dept. of Astronomy, Cornell University, Ithaca, New York 14853; P.G. Ford, Center for Space Research, MIT, Cambridge, MA 02139.

High resolution 12.6cm radar data for several sites on the Lunar surface were acquired in 1990 using the S-Band radar system at Arecibo Observatory. The raw data collected for each site covers an area approximately 100km–300km by 400km and is processed into images of relative backscatter cross section. The sites were observed with different spatial resolutions varying from 50m to 220m. All observations transmitted a circularly polarized signal and received both senses of circular polarization containing the polarized and depolarized components of the backscattered signal. These polarization components correspond to the opposite sense of circular polarization to the transmitted signal (that polarization sense expected from a single reflection with a plane interface) and the orthogonal circular polarization respectively. The backscattered signal has contributions from quasi-specular and diffuse scattering. The first, due to reflection from small facets, contributes to the polarized signal and the second, due to wavelength size surface and near surface structures, contributes to both received polarizations [1]. The relative power in the two polarizations provides useful information on properties of the surface, in particular wavelength scale surface roughness which is usually attributed to large angular rocks and boulders (blocks).

One aim of the observations is to study the polarization properties of impact craters on the Lunar surface. The area around the crater Plato (100km, 52°N, 9°W) was observed at an incidence angle of 56° at the lower spatial resolution of ~200m in June 1990 (Figure 1). Plato is situated between Mare Imbrium to the south and Mare Frigoris to the north and is characterized by mare materials filling the crater floor and truncating the ejecta deposits to the south. Examples of a young impact crater, evident by its radar bright halo in both the polarized and depolarized images indicating that blocky ejecta is still present [2], and an older impact crater with no radar bright halo are shown in the figure. In this region the ratio of the depolarized to polarized backscatter cross sections varies from ~0.07 for impact craters without radar bright halos to ~0.20 for the younger craters with radar bright halos. This variation in polarization ratio could possibly be used to characterize the impact crater age.

The crater Plato has a radar dark halo which was previously noted in 70cm observations [3]. In the 12.6cm observations this halo extends ~2.5 crater radii to the north and east and has lower average backscatter cross section than the crater floor and surrounding mare in both the polarized and depolarized images. Small craters (<2km diameter) in the halo have lower relative radar signatures (contrast) than small craters on both the flooded Plato crater floor and nearby mare. This apparent lack of radar bright small craters in the halo indicates that these small impacts do not generate a crater with significantly increased radar wavelength scale surface roughness. These small impacts may only stir up the already pulverized halo material as suggested by Thompson et. al. [4] resulting in their backscatter cross section being similar to the local surrounds. Several larger craters in the ejecta deposit region are radar bright indicating that the impact event for these craters...

may have penetrated the halo deposit to excavate blocky subsurface material. Analysis of the radar characteristics of the small craters in the halo could potentially be used to place limits on the depth of the Plato radar dark halo deposit.


Figure 1: Averaged 12.6cm radar images of the polarized (left) and depolarized (right) relative backscatter cross section of the 100km diameter crater Plato (52°N, 9°W) and surrounding terrain. The incidence angle is 56° in the center of the image, north is to the top and illumination is from the south-southeast. Crater A has a radar bright halo in both polarizations indicating that it is younger than crater B.