Radar images of the Moon at 6-meter Wavelength

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We present recently obtained range-Doppler images of the Moon using 6 meter wavelength. For this study, we used the Jicamarca Radio Observatory 49.92 MHz radar. The observations were performed using circular polarization on transmit and two orthogonal linear polarizations on receive, allowing scattering images to be obtained with the polarization matched to the transmitted wave (polarized), and at a polarization orthogonal to the transmitted wave (depolarized). The long wavelength is severely affected by ionospheric propagation, including variable phase delay and change of polarization state of the wave. To mitigate these issues, we use the subradar point of the Moon as a calibration point, with "known" polarization and range migration characteristics. Due to the long wavelength that penetrates efficiently into the subsurface of the Moon, the radar images are especially useful for studies of subsurface composition. Two antenna interferometry on receive was used to remove the Doppler North-South ambiguity. The images have approximately 10 km resolution in range 20 km resolution in Doppler, allowing many large scale features, including maria, terrae, and impact craters to be identified. Strong depolarized return is observed from relatively new larger impact craters with large breccia and shallow regolith. Terrae regions with less lossy surface material also appear brighter in both depolarized and polarized images. A large region in the area near the Mare Orientale impact basin has overall higher than mean radar backscatter in both polarized and depolaried returns, indicating higher than average presence of relatively newly formed large breccia in this region. Mare regions are characterized by lower polarized and depolarized return, indicating that there is higher loss of the radio wave allowing less subsurface scattering to reach back. We also report low polarized and depolarized backscatter from an old impact basin in the Schiller-Schickard region, and also North of the Mare Imbrium region – both regions that have an optical appearance of Terrae composition, but a radar signature of a basaltic composition.