JUNO MICROWAVE RADIOMETER OBSERVATIONS OF GANYMEDE'S ICE SHELL. S. Brown[1], S. J. Bolton[2], S. Misra[1], S. Levin[1], Z. Zhang[3], J. Lunine[4], D. Stevenson[3], M. Siegler[5], A. Martinez[5], L. Bonnefoy[4]

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On 7 June 2021, Juno had a close flyby of Jupiter's moon Ganymede, flying within 1000 km of the surface. During the flyby, Juno's Microwave Radiometer (MWR) observed Ganymede obtaining several swaths across Ganymede using Juno's spin to partially map Ganymede's ice shell in six channels ranging from 600 MHz to 22 GHz. The radiance at these frequencies originates from successively deeper layers of the sub-surface from the highest to lowest frequency. The MWR observations cover a latitude range from 20S to 60N and an east longitude range from -120 to 60 degrees, roughly centered on the Perrine region. The local solar time varies from around noon to mid-night over the longitude range. Ground-based interferometry at mm-cm wavelengths have helped characterize icy satellite surfaces with previous unresolved microwave and radar maps providing the basis for Ganymede models indicating surface temperature variations that correlate with surface albedo (Butler 2012). Previous observations at millimeter wavelengths probed the shallow sub-surface (~cm depths), and provided information on thermal properties such as emissivity and thermal inertia, show strong hemispheric differences in surface albedos, with large regions of warmer, darker terrain as well as cooler, ice-rich regions (de Kleer et al 2021). Previous full disk cm-wave observations have been hindered by the presence of Jupiter's thermal and synchrotron emission. We present resolved brightness temperature maps and associated spectra of Ganymede with a spatial resolution of up to ~140 km (approximately $1/40^{th}$ of Ganymede's diameter). The maps and spectra are sensitive to prominent localized thermal features in addition to the various types of terrain seen in visible and infrared images of Ganymede. Comparing the microwave spectra with maps of Ganymede reveal spectral differences corresponding to different types of terrain visible on Ganymede including bright and dark geological features. Juno's wide range of wavelengths probe various depths providing information on porosity, water ice purity, thermal inertial and dielectric constants of the various ice regions as well as linear features thought to be associated with tectonic activity. Significant variation in the Juno MWR spectra with location suggest sub-surface ice properties are not uniform with location. The dark regions tend to exhibit the warmest microwave spectra and brighter regions are observed to have a lower brightness temperature (up to half the blackbody temperature). The coldest microwave feature observed by MWR is the Tros crater and the immediate surrounding region. We will highlight these variations and infer possible thermo-physical properties of the sub-surface ice based on radiative transfer modeling. These observations provide new constraints on the subsurface properties and complement future radar sounding observations from the JUICE mission.

References:

[1] Butler B. 2012 *ALMA Memo* 594

[2] de Kleer et al. 2021 Ganymede's surface properties from millimeter and infrared thermal emission, Planet. Sci. J., 2.