TITAN: 13 CM ARECIBO RADAR OBSERVATIONS AND COMPARISONS WITH CASSINI RADAR IMAGERY D. B. Campbell[1], G. J. Black[2], L. M. Carter[3] and M. Nolan[4], [1]Department of Astronomy, Cornell University, Ithaca, NY 14853; campbell@astro.cornell.edu, [2]Department of Astronomy, University of Virginia, Box 3818, Charlottesville, VA 22903, [3]Center for Earth and Planetary Studies, Smithsonian Institution, Box 37012, Washington, DC 20013-7012, [4]Arecibo Observatory, HC3 Box 53995, Arecibo PR 00612

Introduction: Arecibo 13 cm radar observations of Titan probe the scattering properties of its surface at a scale six times longer than the 2.2 cm Cassini radar. While they are at much lower resolution than the Cassini radar images, the 13 cm observations investigate the normal incidence properties of the surface. The properties of any observed specular reflections can be used to derive rms slopes relevant to the 13 cm wavelength and, assuming a homogeneous surface, the Fresnel reflectivity from which the surface dielectric constant can be obtained [1]. The Cassini radar operating in both its scatterometer and altimetry modes [2] is capable of investigation the normal incidence properties of Titan's surface at its 2.2 cm wavelength. However, to date only scatterometer data has been reported on [3].

Observations: We have observed Titan with the Arecibo 13 cm wavelength radar during the last six oppositions of the Saturn system with sufficient sensitivity to allow characterization of its scattering properties as a function of sub-earth longitude. Almost all the observations were of the CW type where a monochromatic circularly polarized signal is transmitted and rotationally Doppler broadened spectra in both senses of receive circular polarization are formed from the received echoes. Using the Arecibo antenna
to both transmit and receive the echo, spectra have been obtained for a total of 65 sub-earth longitudes at latitudes between 13S and 26S. During the opposition
of the Saturn system in February 2008 we expect to obtain spectra for an additional 12 sub-Earth loca
tions at latitudes close to 8S. Due to the relative low declination of the Saturn system at this time, the tracking time for the Arecibo telescope is only about 13 minutes longer than the round-trip light travel time. Consequently, for these observations we will be receiving the Titan echo with both Arecibo (for 13 min) and the 100 m Green Bank Telescope (GBT; for ~2.25 hrs).

To date, the sub-Earth locations for all of the Arecibo observations have been at latitudes between 13S and 26S an area on Titan for which there has been virtually no coverage by the Cassini radar's imaging system. There has been only one common point, a dune field , for which no specular echo was observed at 13 cm with Arecibo indicating considerable 13 cm scale surface roughness at least at this one location [4]. In February, 2008, the track of the sub-Earth location will be at approximately 8S passing along the T8 and T13 swaths of the Cassini radar. The T8 swath, centered on ~8S, crosses large areas of dune fields [5] in Belet and Adiri in the longitude range 185W to 315W while the T13 swath, centered on ~10S, crosses eastern Shangri-La and

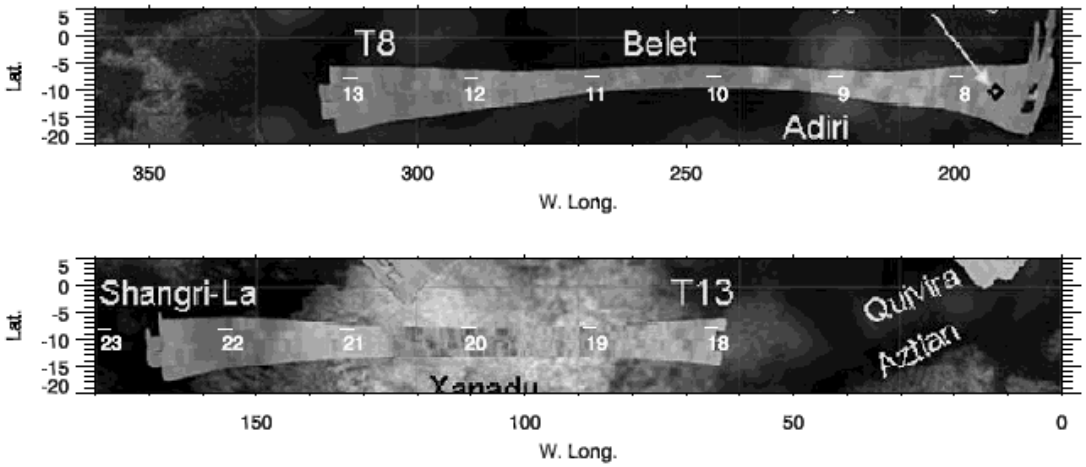

Figure 1: The sub-Earth locations for the February, 2008 Arecibo/GBT observations superposed on the Cassini T8 and T13 radar swaths. The arrow indicates the Huygens landing site.

Xanadu regio in the longitude range 65W to 170W (Fig. 1). The Huygens landing site (10.4S, 192.5W) is at the eastern end of the T8 swath. We are scheduled for 12 observations with the Arecibo 13 cm radar system, 11 of which will have sub-Earth locations on either the T8 or T13 Cassini radar swaths (Fig. 1).

We will report on the primary objective of these observations, the comparison of the properties of the 13 cm radar echoes with the surface terrain type from the Cassini radar imagery. For those locations for which a specular component of the echo is observed, we will be able to estimate the dielectric constant and the rms slope. However, one puzzle arising from the Arecibo observations over the past several years is the declining incidence of specular echoes with the latitude of the sub-Earth location or, possibly, with season. For observations in the latitude range 20S to 26S the incidence of specular echoes was approximately 75%. This fell to ~50% at 13S (in 2006) and to ~25% at 13S for the 2007 observations. This change was particularly noticeable over Xanadu regio so is not necessarily correlated with the increased incidence of "dark" regions in the Cassini ISS imagery north of 13S many of which are associated with dune fields (Lorenz et al, 2006).

References: [1]Campbell, D.B., G.J. Black, L.M. Carter and S.J. Ostro, Science, 302, 431-434, 17 Oct, 2003; [2] Elachi, C. plus 34 co-authors, Science, 308, 970-974, 13 May, 2005; [3]Wye, L. C., H. A. Zebker, S. J. Ostro, R. D. West, R. Grim, R. D. Lorenz and the Cassini Radar Team, Icarus, 188, 367-385, 2007; [4]Campbell, D. B., G. J. Black, L. M. Carter and M. C. Nolan, Abst., LPSC 38, March 2007; [5]Lorenz, R. D. plus 37 co-authors, Science, 312, 724-727, 5 May, 2006.