MULTI-WAVELENGTH OBSERVATIONS OF 2100 RA-SHALOM: RADAR AND LIGHTCURVES. M. K. Shepard[1], B. E. Clark-Joseph[2], L. A. M. Benner[3], J. D. Giorgini[3], P. Kusnirak[4], J-L. Margot[5], M. C. Nolan[6], S. J. Ostro[3], P. Pravec[4], L. Sarounova[4], D. K. Yeomans[3], [1]Bloomsburg University (Dept. of Geography and Geosciences, Bloomsburg, PA 17815, mshepard@bloomu.edu), [2]Ithaca College, Ithaca, NY, [3]Jet Propulsion Laboratory, Pasadena, CA, [4]Ondrejov Observatory, Czech Republic, [5]University of California Los Angeles, Los Angeles, CA, [6]National Astronomy and Ionosphere Center, Arecibo, PR.

Introduction: We conducted a multi-wavelength campaign to study the near-Earth asteroid (NEA) 2100 Ra-Shalom during its August 2003 encounter. Rotationally resolved observations were acquired at Arecibo (12.6 cm radar), the IRTF (0.8-2.5 μm and 3 μm), McDonald Observatory (0.48-0.92 μm), Palomar Observatory (8-15 μm), and Ondrejov Observatory (optical lightcurves). Our objectives were to determine Ra-Shalom's size and shape, and the composition and physical state of its near-surface material.

Preliminary results from radar and lightcurve measurements will be presented here. Visible, infrared, and thermal results will be presented by Clark et al. (this volume).

Why Ra-Shalom is Interesting: Ra-Shalom is one of the largest Aten-family NEAs. Thermal radiometry analyses indicate a high surface thermal inertia and suggest the absence of fine regolith [1,2]. Its classification is controversial; C [1,3], S[2], and Xc [4] classifications have all been suggested. Earlier radar analyses of Ra-Shalom indicated a near-circular hull and heterogeneous surface roughness [5,6]. Finally, Ra-Shalom requires only a modest Δv for spacecraft encounters and has been suggested as a candidate target for an asteroid mission [7].

Data: We observed Ra-Shalom at Arecibo observatory (2380 MHz, 12.6cm wavelength) on 2003 Aug 22-26. Given Ra-Shalom's 19.8h period [8], this provided full rotational coverage. We obtained 24 dual-polarization continuous wave (CW) observations and 81 delay-doppler (imaging) observations. Optical data for lightcurves were obtained at Ondrejov observatory on 2003 Sept. 1,3,5,6,14, and 15 at a solar phase angle of ~40°.

Analysis: Table I shows preliminary results of 2003 CW measurements along with measurements acquired in three previous encounters. All are consistent with the exception of those measured in 1981. The low SNR of that encounter and pointing errors are probable reasons for its discrepencies.

The optical data were not sufficient to generate an independent lightcurve, but were consistent in period and shape with previously derived lightcurves [8].

Table I. CW Radar Properties for All Encounters

Year	**2003**	**2000**	**1984** [6]	**1981** [5]
Total SNR	545	137	74	13
BW (Hz)	$4.0^{+0.3}_{-0.1}$	$3.6^{+0.1}_{-0.2}$	$3.5^{+0.1}_{-0.2}$	4-8
D_{max} (km)	≥2.8	≥2.5	≥2.5	≥2.9
AR	≤1.2	≤1.4	≤1.2	----
μ_c	0.25±0.01	0.24±0.01	0.31±0.02	0.14±0.02
σ_{oc} (km^2)	1.5 ± 0.5	1.2 ± 0.4	1.1 ± 0.4	0.5 ± 0.1

SNR is total signal-to-noise, BW is echo bandwidth estimated from a two-standard-deviations of noise crossing threshold, D_{max} is the maximum diameter of the pole-on silhouette based on echo bandwidth, AR is aspect ratio based on the maximum and minimum bandwidths over one full rotation, μ_c is the polarization ratio, and σ_{oc} is the OC radar cross-section.

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