**MULTI-WAVELENGTH OBSERVATIONS OF ASTEROID 2100 RA-SHALOM: VISIBLE, INFRARED, AND THERMAL SPECTROSCOPY RESULTS.** Beth Ellen Clark[1], M. Shepard[2], S.J Bus[3], F. Vilas[4], A.S. Rivkin[5], L. Lim[6], S. Lederer[4], K. Jarvis[4], S. Shah[1], and T. McConnochie[7], [1]Ithaca College, Department of Physics, Ithaca NY 14850, bclark@ithaca.edu, [2]Bloomsburg University, [3]University of Hawaii, [4]JSC, [5]MIT, [6]Goddard, [7]Cornell University.

## Introduction

The August 2003 apparition of asteroid 2100 Ra-Shalom brought together a collaboration of observers with the goal of obtaining rotationally resolved multi-wavelength spectra at each of 5 facilities: infrared spectra at the NASA Infrared Telescope Facility (Clark and Shepard), radar images at Arecibo (Shepard and Clark), thermal infrared spectra at Palomar (Lim, McConnochie and Bell), visible spectra at McDonald Observatory (Vilas, Lederer and Jarvis), and visible lightcurves at Ondrojev Observatory (Pravec). The radar data was to be used to develop a high spatial resolution physical model to be used in conjunction with spectral data to investigate compositional and textural properties on the near surface of Ra Shalom as a function of rotation phase. This was the first coordinated multi-wavelength investigation of any Aten asteroid.

There are many reasons to study near-Earth asteroid (NEA) 2100 Ra-Shalom: 1) It has a controversial classification (is it a C- or K-type object)? 2) There would be interesting dynamical ramifications if Ra-Shalom is a K-type because most K-types come from the Eos family and there are no known dynamical pathways from Eos to the Aten population (Bottke et al. 2002). 3) The best available spectra obtained previously may indicate a heterogeneous surface (most asteroids appear to be fairly homogeneous). 4) Ra-Shalom thermal observations obtained previously indicated a lack of regolith, minimizing the worry of space weathering effects in the spectra (Harris et al. 1998). 5) Radar observations obtained previously hinted at interesting surface structures. 6) Ra-Shalom is one of the largest Aten objects. And 7) Ra-Shalom is on a short list of proposed NEAs for spacecraft encounters and possible sample returns (Sears and Scheeres 2001).

Preliminary results from the visible, infrared, and thermal spectroscopy measurements will be presented here. Radar and lightcurve results will be presented in the paper by Shepard et al. (this volume).

## Results

Rotationally resolved visible wavelength spectra from 0.45 to 0.95 microns were obtained at McDonald Observatory August 22-25, 2003 from longitude 46 to 284. These spectra show variations within a night from one longitude to another at the level of about 6%. These spectra can be approximately correlated with rotationally resolved infrared spectral measurements obtained at the NASA IRTF on August 16 and August 18, 2003 from longitude 12 to 349. Infrared spectra from 0.8 to 2.5 microns show variations from one longitude to another at the level of up to 7%. Three-micron observations were also obtained at the IRTF on August 16, 2003. These spectra were averaged over longitudes 45 to 85 to increase signal-to-noise. No longitudinal variations could be observed, however the thermal component of the observations allowed for a calculation of the object's albedo at 9 to 15%. Thermal IR spectra from 8 to 15 microns were obtained at Palomar Observatory on August 22 and 23 from longitude 40 to 200. These measurements were also co-added to increase signal-to-noise so no longitude variations were observed. The measurements indicate no departure from black-body thermal emission, indicating no observable mineral emission features, and constraining the asteroids regolith thickness to be at least as thick as is required to randomize mineral signatures (this thickness is unknown at the present time).

## References

[1] Bottke et al. (2002) *Icarus* 156, 399-433; [2] Harris et al. (1998) *Icarus* 135, 441-450; [3] Sears and Scheeres (2001).

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