

## **Responses to Reviews – MS I10258**

### **Shepard et al., Radar observations of E-class asteroids...**

#### **Reviewer #1 (Campbell)**

**Comment:** The terms “expected” and “unexpected” are not explained, which is fine in the context of a short paper, but these could be deleted for clarity. The terms “same sense circular” and “opposite-sense circular polarization” are more descriptive of the actual observations.

**Response:** We used the terminology suggested and placed the ‘unexpected’ and ‘expected’ terms in parentheses after each more descriptive term.

**Comment:** The references to circular polarization ratio values (smooth versus rough or deep-scattering surfaces) are limited to asteroid papers. There are recent papers on Mars (Harmon 7th Mars abstract) and Moon echoes (D. Campbell et al., Nature) with similarly high 12.6-cm values.

**Response:** Yes, of course. We also added a terrestrial radar paper.

**Comment:** The discussion of why MBA’s have lower CPR is short, and needs at least a note that the “thicker regolith” is taken to have fewer wavelength-scale surface and volume rocks.

**Response:** Noted and corrected.

**Comment:** Pages 5 and 7: The discussion of “second highest” for Nysa (pg. 5) and “surpassing Nysa” (pg. 7) is awkward. Perhaps just mention their values in the text then point out their rank order in the discussion.

**Response:** Within each asteroid analysis, we want to note that these are very high values. Since we can only do this by comparing with other MBAs, we would like to leave this as is.

**Comment:** Page 6. The rationale for  $C=0.5$  being “geometric scattering” is not clear. This term seems like it would be linked with quasi-specular reflections rather than diffuse. Perhaps just a reference or short description.

**Response:** Yes – this is a quasispecular scattering law. But by setting  $C=0.5$ , we’ve turned it into what is essentially a diffuse scattering law. The reference is Mitchell et al (one sentence earlier) and we’ve removed the ‘geometric scattering’ note and explained the purpose.

**Comment:** “Nevertheless, both are significantly”, could be clearer, e.g.: “Nevertheless, both values of  $\mu_{sc}$  are significantly higher than observed for any other main-belt asteroid, suggesting a geologic mechanism common to E-class MBAs and NEAs”.

**Response:** Fixed.

**Comment:** The idea of long-preserved crystal structures forming the detailed topography of an asteroid seems speculative, though perhaps this is developed in detail in the Science submission. The authors should discuss, briefly, the possibility for densely spaced, wavelength-scale blocks (such as seen by the Hayabusa mission) as another source of highly depolarized scattering.

**Response:** The hypothesis was developed more in the Benner et al. Science paper. We have added other possibilities discussed in that paper. The polarization ratio of Itokawa is relatively low (0.27), but this is for the entire asteroid and we do not know how it varies over the surface.

**Comment:** The discussion of radar albedo needs to be sharpened. While the SC echoes are high, there is a substantial part of the diffuse echo present in the OC return (the 2nd-to-last sentence is awkward on this). The higher radar albedo could be due to some combination of higher bulk density and/or an increased population of surface and near-surface rocks (relative to a thick-regolith case with few rocks).

**Response:** We changed this discussion to make it clearer.

## **Reviewer #2 (Gaffey)**

**Comment:** My one potential concern is focused on the as-yet-unpublished work of Benner et al. (2007, submitted to Science), which the present manuscript draws upon significantly. My concern is that the E-type NEOs described as having high polarization ratios are most likely identified using the Bus and Binzel taxonomic classification. Those classifications are not very robust because of a lack of albedo information and the E-type NEO sample might actually include a significant diversity.

**Response:** All of the E-type NEOs in the Benner et al. paper are E-type in the Tholen taxonomy. The Bus/Binzel taxonomy does not have an E-type, but puts the M/E/X types into the X-class. In the Benner et al paper, those X-class asteroids with albedo information are labeled E-class if appropriate, and those without are left as X-types. In a few cases, several of the X-types have high radar polarization ratios and are suspected to be Tholen E-class.