Unusual Neutral Colored/BrightIR Surfaces in the Kuiper Belt

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Unusual Neutral Colored/BrightIR Surfaces in the Kuiper Belt. M. E. Schwamb[1], W. C. Fraser[2,3], R. E. Pike[4], L. E. Buchanan[1], M. Marsset[5], M. T. Bannister[6] , J. J. Kavelaars[2,3], S. D. Benecchi[7], M. J. Lehner[8], S.-Y. Wang[8], N. Peixinho[9], T. Secull[10], K. Volk[7], M. Alexandersen[4], Y.-T. Chen[8], B. Gladman[11], S. D. J. Gwyn[2], and J.-M. Petit[12], [1]Astrophysics Research Centre, Queen's University Belfast, [2]Herzberg Astronomy and Astrophysics Research Centre, [3]Department of Physics and Astronomy, University of Victoria, [4]Center for Astrophysics — Harvard & Smithsonian, [5]European Southern Observatory, [6]School of Physical and Chemical Sciences — Te Kura Matū University of Canterbury, [7]Planetary Science Institute, [8]Institute of Astronomy and Astrophysics, Academia Sinica, [9]Instituto de Astrofísica e Ciências do Espaço, Universidade de Coimbra, [10]Gemini Observatory/NSF's NOIRLab [11]Department of Physics and Astronomy, University of British Columbia, [12]Institut UTINAM UMR6213, CNRS, Univ. Bourgogne Franche-Comté.

Introduction: Excluding the Haumea collisional family [1] and asteroid-like 2004 EW95 [2] , Kuiper belt object (KBO) surfaces are divided into two broad categories: spectrally featureless surfaces and the volatile rich dwarf planets. Unlike the Pluto-sized dwarf planets, most KBOs are either too small or hot to retain their primordial abundance of volatile ices [3]. Generally, the volatile-depleted surfaces of these volatile-rich bodies are poorly understood, with involatile water-ice being only confidently identified on the surface of a few objects. Other than a linear spectral slope, the optical spectra of non-dwarf planet KBOs (< 200 km; apparent r magnitude > 22 mag) are featureless. For these small KBOs, obtaining ground-based spectra is very difficult and time consuming; we must rely on what broadband photometric colors reveal. By studying these small bodies, we can probe the dynamical history and compositional structure of the early Solar System. The small KBO color-orbit distribution holds the key to determining the migration modes, distances, and timescales experienced by Neptune [4][5].

Col-OSSOS: Colours of the Outer Solar System Origins Survey (Col-OSSOS) [6, 7, 8] is exploring the true frequency of KBO surface colors and types, subdivided by dynamical classification. Col-OSSOS has obtained near simultaneous near-infrared and optical photometry and measured (g-r) and (r-J) colors for 102 KBOs (see Figure 1) found in a brightness limited survey with a well-measured detection efficiency [6,7,8]. By utilizing the 8-m Gemini North telescope and carefully accounting for light curve variations as best as we can, we obtain with Col-OSSOS color measurement uncertainties of +/- 0.03 mag for nearly all of our sample.

We clearly identify two compositional classes of dynamically excited KBO population at a boundary of (g-r) = ~0.75: the neutral and red classes [6,7]. Recent analysis from [8] using a new projection of the optical-NIR colors, finds the surfaces colors of the entire Kuiper belt can be reproduced by two classes: the BrightIR and FaintIR surfaces. The BrightIR class spans the full range of optical colors while following a reddening line in the (g-r)/(r-J) color space. FaintIR surfaces are more constrained in (g-r) color space and are fainter in the J-band compared to the BrightIR class.

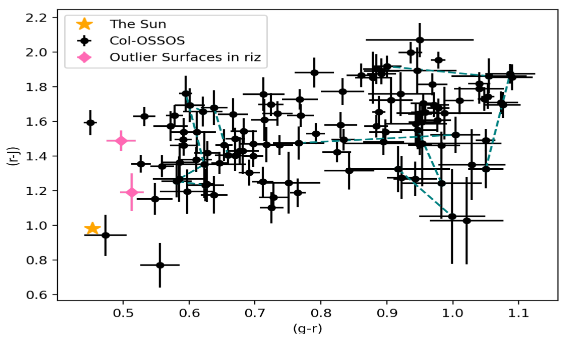

Figure 1: Col-OSSOS colors. Repeat measurements are linked by teal dashed lines. Our 2 outlier surfaces in grizJ photometry are plotted in pink.

Unusual Surfaces in the Neutral/BrightIR Class: Combining grJ photometry from Col-OSSOS with near simultaneous griz photometry taken in a second epoch with Gemini, we find at least two neutral/ BrightIR KBOs with surface colors that are unique compared to what has been previously measured for all small KBOs. Converting the measured KBOs' colors to spectral reflectance, we see features beyond a straight linear slope from r-band to the infrared making these surfaces outliers within the small KBO population. We find evidence for wide spectral features in the 0.5-0.8 micron region.

We will present our photometry and the reflectance spectrum for our two outlier KBOs. We will compare these unique surfaces to asteroids, small KBOs, and asteroid-like KBO 2004 EW95. We will present our analysis of potential surface compositions (including the possibility of hydrated minerals) that could match our photometry and reproduce the observed features in the optical reflectance, and we discuss the implications for the composition of the excited Kuiper belt.

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