Compositional study of TNOs beyond 2.2 µm in preparation for the JWST

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Introduction: It has been more than 20 years since the discovery of the first trans-Neptunian object (TNO) 1992 QB_1 [1]. In the intervening years, combined visible and near-infrared (VNIR) observations have been a very useful tool in order to study the surface composition of TNOs. We already know that TNOs' surfaces are composed of organics, silicates and water ice [2]. Only the larger TNOs are able to retain large amounts of volatiles [3]. Most of these materials have their fundamental absorption bands at wavelengths longer than 2.5 µm, where IRAC (the InfraRed Array Camera) on the Spitzer Space Telescope has two very broad filters (Fig. 1).

Observations: In this work, we present the analysis of 17 TNOs and centaurs observed with IRAC in the 3.6 µm (*ch1*), seven of them also in the 4.5 µm (*ch2*). We collected a total of ~ 41 hours of observing time. This sample was selected based on the availability of existing Spitzer and Herschel thermal measurements and Hubble near-IR photometry. These requirements were taken into account in order to support our analysis of the IRAC data, and so, significantly enhance the value of our results.

Results: Our analysis will show which combinations of VNIR plus Spitzer/IRAC colors, together with visible albedo, are more diagnostic in order to obtain surface composition. Furthermore, these data will provide a firm footing for studying objects in the trans-Neptunian Belt using the James Webb Space Telescope.

Bibliography: [1] Jewitt, D. and Luu, J., ***Nature*** *362, 730J,* 1993. [2] Barucci, M. A.; Romon, J., and Doressoundiram, A. **AJ** *120:496-500,* 2000. [3] Schaller, E. L. and Brown, M. E., **ApJ** *659:L61-L64,* 2007.

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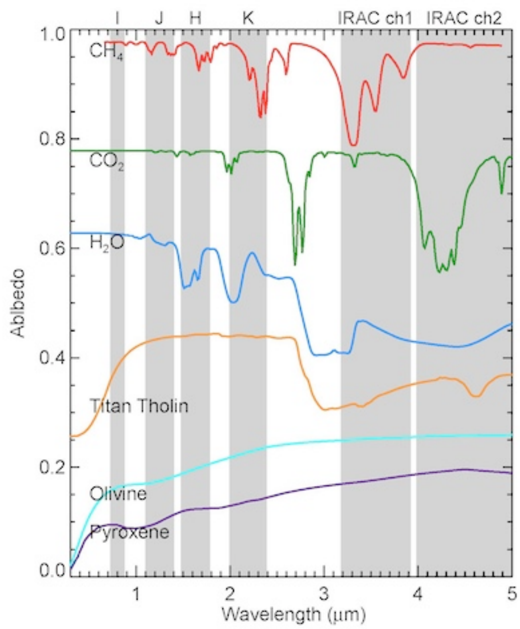

Figure 1: Reflectance of pure materials typically found on the surfaces of TNOs and centaurs. Vertical grey bars are the NIR + IRAC/Spitzer filter bands, as labeled on the top axis. Distinctive behavior for each material can be detected using combinations of these filters. For example: water ice, which is neutral in the visible, strongly dominates the color of the object at IRAC wavelengths, with broad absorptions in the 3.6 and 4.5 µm filters; complex organics (represented here by Titan Tholin) are red in the visible and strongly absorb in 3.6 µm filter, but not in the 4.5 µm filter. The reflectance of amorphous silicates increases from the visible through 4.5 µm, without any significant absorption.

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