A possible divot in the Kuiper belt's scattered-object size distribution

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The formation and evolution history of the Solar System, while not directly accessible, has measurable signatures in the present-day size distributions of the Trans-Neptunian Object (TNO) populations. The form of the size distribution is modelled as a power law with number going as size to some characteristic slope. Recent works have shown that a single power law does not match the observations across all sizes; the power law breaks to a different form [1, 2, 3]. The large- size objects record the accretion history, while the small-size objects record the collision history. The changes of size-distribution shape and slope as one moves from 'large' to 'medium' to 'small' KBOs are the signature needed to constrain the formation and collision history of the Solar System.

The scattering TNOs are those TNOs undergoing strong (scattering) interactions Neptune. The scattering objects can come to pericentre in the giant planet region. This close-in pericentre passage allows for the observation of smaller objects, and thus for the constraint of the small-size end of the size distribution.

Our recent analysis of the Canada France Ecliptic Plane Survey's (CFEPS) scattering objects revealed an exciting potential form for the scattering object size distribution – a divot (see Figure). Our divot (a sharp drop in the number of objects per unit size which then returns at a potentially different slope) matches our observations well and can simultaneously explain observed features in other inclined (so-called "hot") Kuiper Belt populations. In this scenario all of the hot populations would share the same source and have been implanted in the outer solar system through scattering processes. If confirmed, our divot would represent a new exciting paradigm for the formation history of the Kuiper Belt.

Here we present the results of an extension of our previous work to include a new, deeper, Kuiper Belt survey. By the addition of two new faint scattering objects from this survey which, in tandem with the full characterizations of the survey's biases (acting like non- detections limits), we better constrain the form of the scattering object size distribution.

References: [1] Shankman, C. et al. (2013), ApJ 764, L2 [2] Fraser & Kavelaars (2008) Icar 198, 452 [3] Bernstein et al. (2004) AJ 128, 1364