The Colour Distribution Of The Low Inclination Trans-Neptunian Objects

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The low-inclination component of the classical Kuiper Belt is thought to be the only population of trans-Neptunian bodies that formed in-situ (Parker et al., 2010). This population, often referred to as the cold classical objects, exhibits a ~30% observed binary fraction, much higher than for other trans-Neptunian objects (TNOs; Noll et al., 2008). The majority of cold classicals belong to the Very Red (VR) class of the bimodal TNO compositional taxonomy (Fraser and Brown, 2012). Though recently, a population of Less Red (LR) members has been identified, exhibiting a 100% binary fraction (Fraser et al., 2017). These so-called blue binaries are thought to be survivors of a push-out process that occurred during a smooth phase of Neptune’s outward migration.

Here we report 20 new (g-r) and (r-J) colours of cold classical objects gathered as part of the Colours of the Outer Solar System Origins Survey (Col-OSSOS; Schwamb et al., 2019), bringing the total sample of cold classicals with measured colours to 21 with simultaneous optical and NIR colours, and 103 cold classical TNOs with optical colours alone. In this sample, 29 objects have been identified as binary (Parker, A., personal communication).

Cold classical colours span the full range of optical-NIR colours exhibited by the dynamically excited TNO populations, though they strongly favour red objects; the VR:LR ratio is ~12 compared to ~3 for the excited TNOs. Moreover, the VR cold classicals have a redder colour distribution than the VR excited TNOs, with the former exhibiting a mean (g-r)~0.95 and the latter, a mean (g-r)~0.8.

The optical colour distribution of binary cold classicals is significantly different than that of the single (or unresolved) cold classical systems (see Figure 1), with the binary sample exhibiting a tail of lower spectral slopes than is found in the sample of singles. The Kolmogorov-Smirnov test comparing the optical colour distributions of the single and binary samples says that there is a only a 0.3% chance the two samples share the same colour distribution. The Col-OSSOS sample on its own shows a similar result, with a 2% probability of the null hypothesis. This argues for a different
origin of some or all of the binary cold classicals over the unresolved or single objects population, and is compatible with the hypothesis that the blue binaries are contaminants having been pushed out from regions closer to the Sun.

Figure 1: cumulative optical colour distributions of the single (or unresolved; solid) and binary (dashed) cold classical TNOs. The vertical line demarks the division between less red and very red compositional classes. Spectral slope is reported in percent reddening per 100 nm normalized in the V-band.