TIGHT AND CONTACT TNO BINARIES WITH STELLLAR OCCULTATIONS. Buie, M.W.[1], Keller, J.[2], Leiva, R.[1]
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Introduction: Trans-Neptunian binary systems from direct imaging are resolution-limited to those separated by more than ~1000 km. Stellar occultations provide a way to characterize the unexplored parameter space of size v/s separation of binaries: the tighter systems down to contact binaries. Models of the early Solar System evolution and the contact binary nature of the small trans-Neptunian object 2014 MU69 by stellar occultations inform us that binaries are prevalent among TNOs. The rate of these binaries among different dynamical classes provides a sensitive way to constrain such models.

We will show some results from the 5 successful campaigns in the last year with the Research and Education Collaborative Occultation Network (RECON), more than 60 telescopes spread along 2000 km. RECON is designed to study the binary TNO population. These results involved the known binary Varda/Illmare, the plutino (523764) 2014 WC510, the small Centaur 2014 YY49, the tenuous atmosphere of Pluto and the extreme TNO 2015 TG387.

The known binaries among trans-Neptunian (TNO) and Centaur objects can be grouped in two main populations: large TNOs with small satellites and equal-size binaries, showing different formation paths. The amount of binaries among different dynamical classes of TNOs is a strong constraint for models of formation of planetesimals in the early Solar System and their early dynamical evolution.

The separation of these known systems is larger than ~1000 km, limited by the resolving capabilities of HST and ground-based AO imaging. These precludes the chance to study the tighter systems, including contact binaries, key for understanding the conditions of planetesimal formation and the planetary migration during the early Solar System.

Stellar occultation provide a way to characterize the unexplored parameter space of size v/s separation of binaries: the tighter systems down to contact binaries. The contact binary nature of the Cold Classical TNO 2014 MU69 was revealed by stellar occultations in anticipation of the New Horizons encounter showing the capabilities of the technique to study small TNOs.

The Research and Education Collaborative Occultation Network (RECON) is composed of more than 60 telescopes working as a single instrument. The network spreads more than 2000 km with stations separated by about 50 km. This design allows to study small TNOs and the tight binary systems down to contact binaries, surpassing the capabilities of direct imaging techniques.

The adoption of the Gaia DR2 astrometric catalog and an increase of astrometric data for faint TNOs from Pan-STARRS has proved to be vital for an increase in occultation opportunities observable with RECON and, consequently, on successful campaigns.

Five successful campaigns in the last year include:

- The known binary Varda/Illmare
- The tenuous atmosphere of Pluto
- The small Centaur object 2014 YY49
- The extreme TNO 2015 TG387
- The plutino (523764) 2014 WC510

With the latest results, RECON as well is probing small objects providing accurate size, shape and albedos which will be useful for cross calibration of thermal measurements and the size distribution of TNOs.

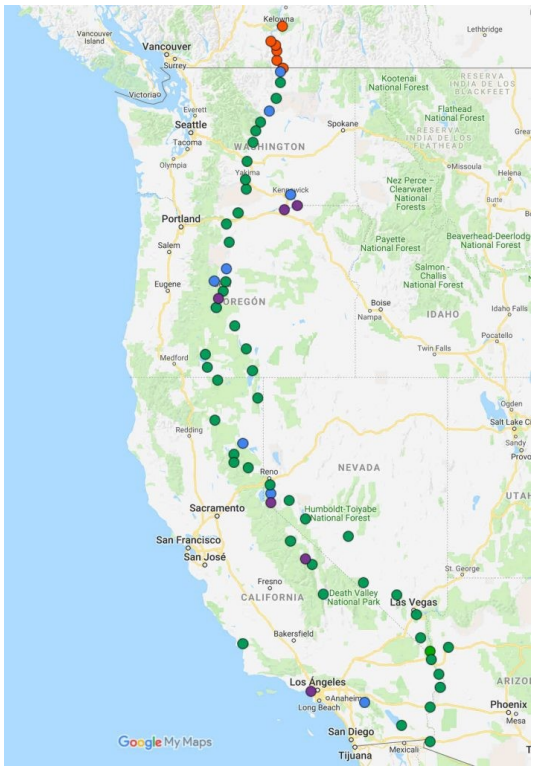

Figure 1. The ~2000 km footprint of the RECON experiment with the recent Canadian extension CanCON.

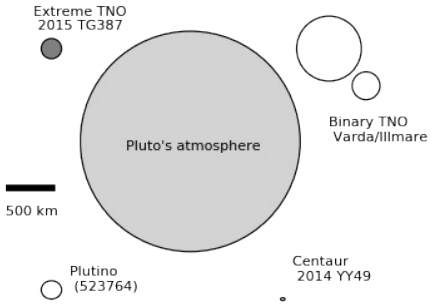

Figure 2. Diversity of TNOs and Centaurs with positive occultation results from RECON in the past year.

Results: Five successful stellar occultation campaigns in the last year include the recently discovered extreme TNO 2015 TG378 which shows an object of 100 km and a typical TNO albedo of 21% [2]. The occultation by the small plutino object (523764) 2014 WC510 shows a slightly elongated object of 200 km and a dark albedo of 6% with a conspicuous secondary event.

Conclusions: An increased rate of successful occultation campaigns with RECON shows the capabilities of its unique design. RECON allows to study the vastly unexplored small population of TNOs and Centaurs (<100 km) to reveal the nature of the tighter binary systems and its fraction among the different dynamical populations, not possible with other ground-based techniques.

Occultations by the known binary Varda/Illmare and the tenuous atmosphere of Pluto shows as well the capabilities of the extensive RECON network to study larger objects as part of larger collaborations.

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References: [1] Buie, M.W. and Keller. J. (2016), AJ 151, 3. [2] Buie, M.W. et al. (2019). AJ (submitted).