

# Understanding the diverse trans-Neptunian Solar System by direct exploration with an interstellar probe

**Michele T. Bannister** (1), Bryan J. Holler (2), and 17 coauthors

(1) Astrophysics Research Centre, Queen's University Belfast, Belfast BT7 1NN, United Kingdom (m.bannister@qub.ac.uk)

(2) Space Telescope Science Institute, Baltimore, MD, USA (bholler@stsci.edu)

## Abstract

Interest in future exploration of the trans-Neptunian region has never been higher among the planetary science community and the general public, spurred by the scientific returns from the wildly successful *New Horizons* mission. The trans-Neptunian objects (TNOs) are key to understanding the past history and the present geology of our solar system. There are compelling scientific arguments for expanding our knowledge of this extremely diverse population of minor bodies through flybys of a wide range of sizes of TNOs, including dwarf planets and binary TNOs. The state of knowledge can now be summarised for fifteen major TNOs, together with overviews of key smaller populations. Planning for future missions by international agencies has begun to shift towards combined missions to Centaurs, the ice giant planets, and TNOs, which benefits both scientific opportunities and logistics. Gravity assists from ice giants can be used for travel to distant TNOs, while at the same time returning valuable science on the ice giants and their ring and satellite systems. Trajectories to high-priority distant targets also include close approach opportunities to multiple TNOs en route, in addition to remote observations of nearby TNOs. The available target list and thus the scientific dividends of a future mission to the trans-Neptunian region will be hugely enhanced by the tens of thousands of new TNO discoveries anticipated from the Large Synoptic Survey Telescope (LSST) in the 2020s. To optimally understand this bounty of new worlds, exploration missions of the 2020s and beyond will all be grand tours, visiting a myriad of objects.

## Acknowledgements

MTB appreciates support from UK STFC grant ST/P0003094/1.