Potentially Hazardous Asteroids and Small Near-Earth Objects in the Taurid Resonant Swarm

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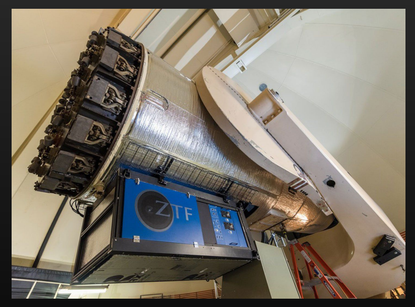
The Taurid Resonant Swarm

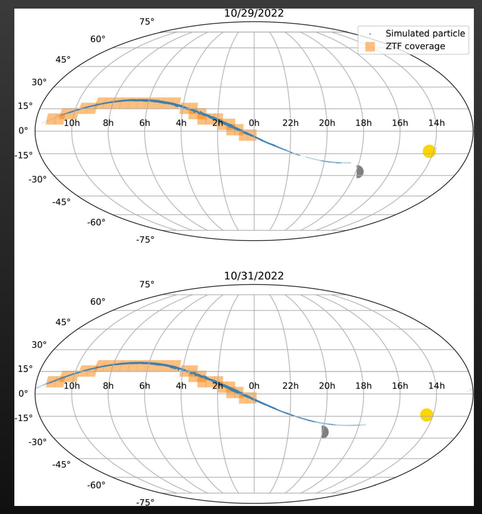
- Materials from 2P/Encke or its progenitor trapped within the 7:2 orbital resonance with Jupiter (Asher & Clube 1993)
- Confirmed by enhanced Taurid fireball activities in certain years (e.g. Asher & Izumi 1998, Olech et al. 2017, Spurný et al. 2017)
- Extension to larger, multi-meter-class asteroids has not been unambiguously detected

The 2022 ZTF Campaign

- The Earth passed close to the center of the Taurid swarm in 2022
- Guided by the simulation by Clark et al. (2019), we used the 1.2-m Zwicky Transient Facility (ZTF) to search for macroscopic bodies within the Taurid Resonant Swarm
- A total of 33 pointings were observed on 2022 October 29 and 31, covering 1600 deg^2 down to V~20



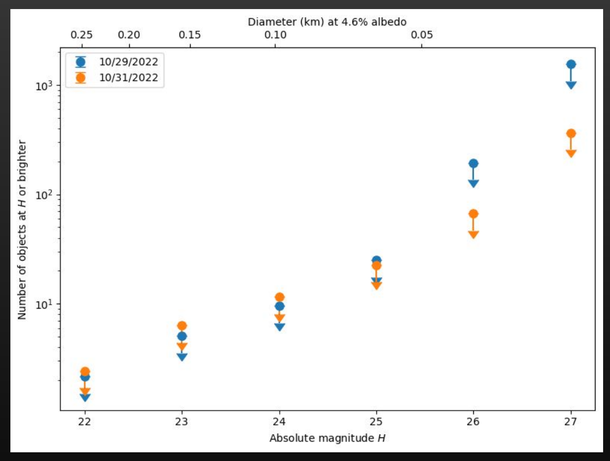
The ZTF dome and telescope at Palomar Observatory, California



Search footprint of the survey (shaded orange squares) and simulated Taurid swarm asteroids (blue dots). Yellow and gray circles marked the Sun and the Moon

Analysis and Results

- We searched for both streaked (fast-moving) and slow-moving objects in the ZTF data
- No objects matching the predicted motion of Taurid Resonant Swarm objects were found
- We derived an upper limit of 9-14 objects of H≤24 within the swarm, scaling to ≲50 Tunguska-sized objects or ≲1000 Chelyabinsk-sized objects



Constraints on the number of objects at different H threshold placed by our ZTF campaign

Concluding Remarks

- With no more than 9-14 objects of H≤24 within the swarm,the progenitor that produced the Encke-Taurid Complex might be ~10 km in size, consistent with the expectations from the state-of-the-art planetary dynamical models
- Our search does not rule out an appreciable risk from Chelyabinsk-sized objects in the swarm

Our paper is published in PSJ!

(Li et al. 2025, PSJ, 6, 94)