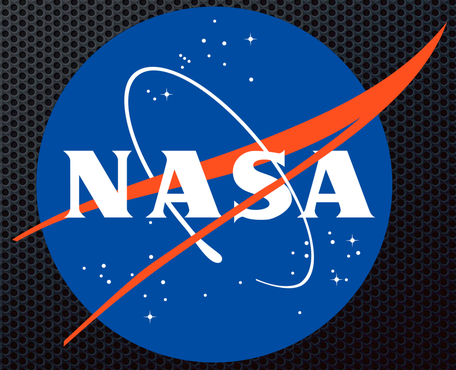
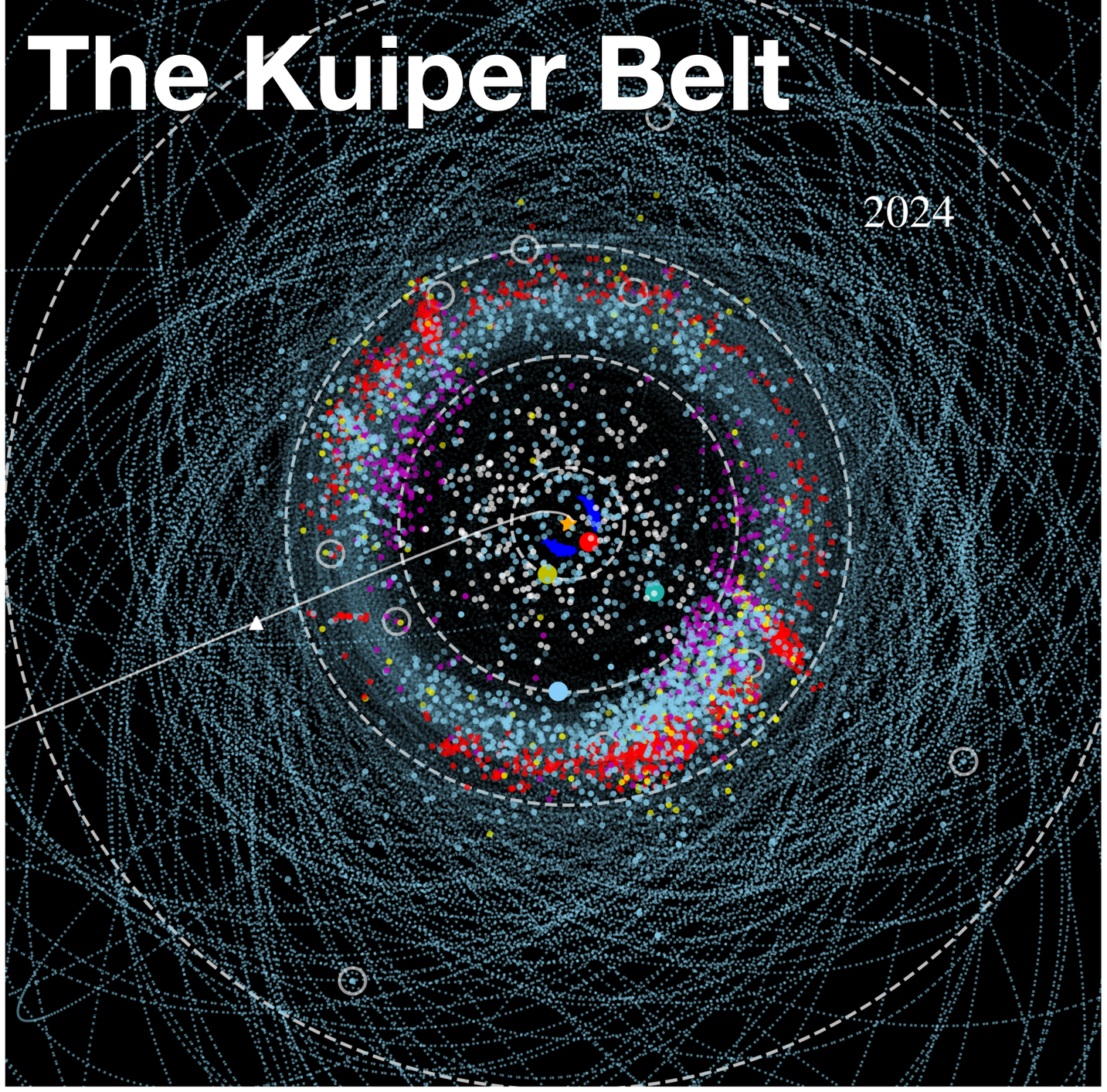
The New Horizons Distant KBO Search: Summary and Future Prospects

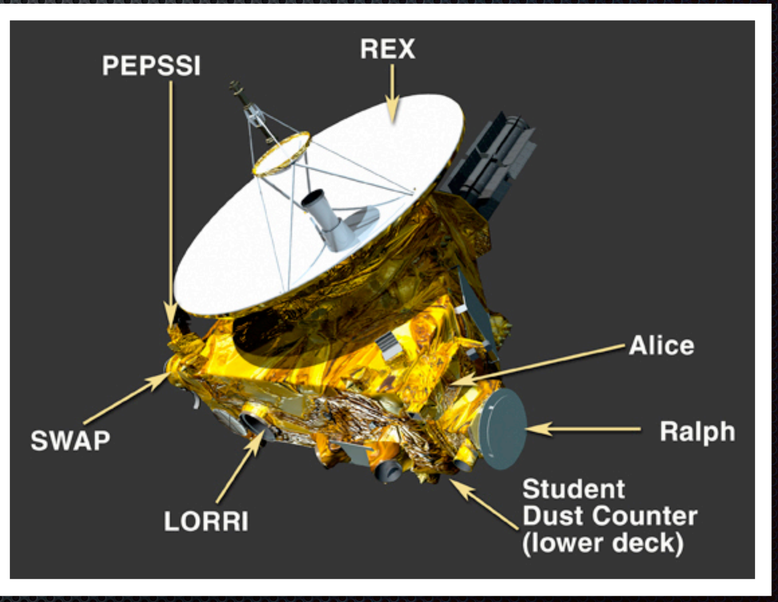
Wesley Fraser, Alan Stern, Simon Porter, Fumi Yoshida, Takashi Ito, Tsuyoshi Terai, Anne Verbiscer, Susan Benecchi, JJ Kavelaars, Lowell Peltier, Ko Arimatsu, David Gerdes, Mark Buie, John Spencer, Hsing Wen Lin



The Kuiper Belt



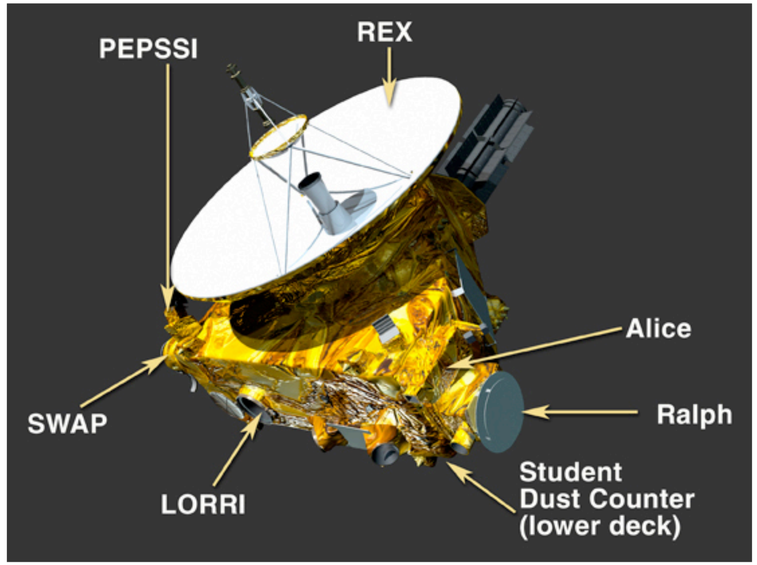
New Horizons



The Kuiper Belt

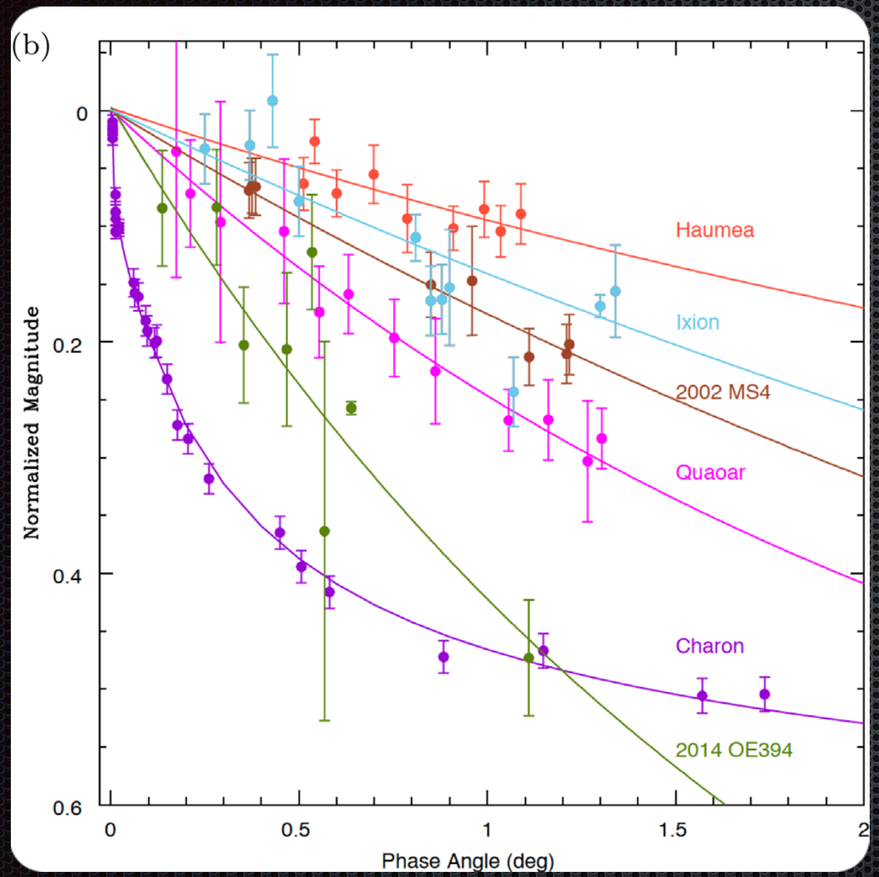
2024

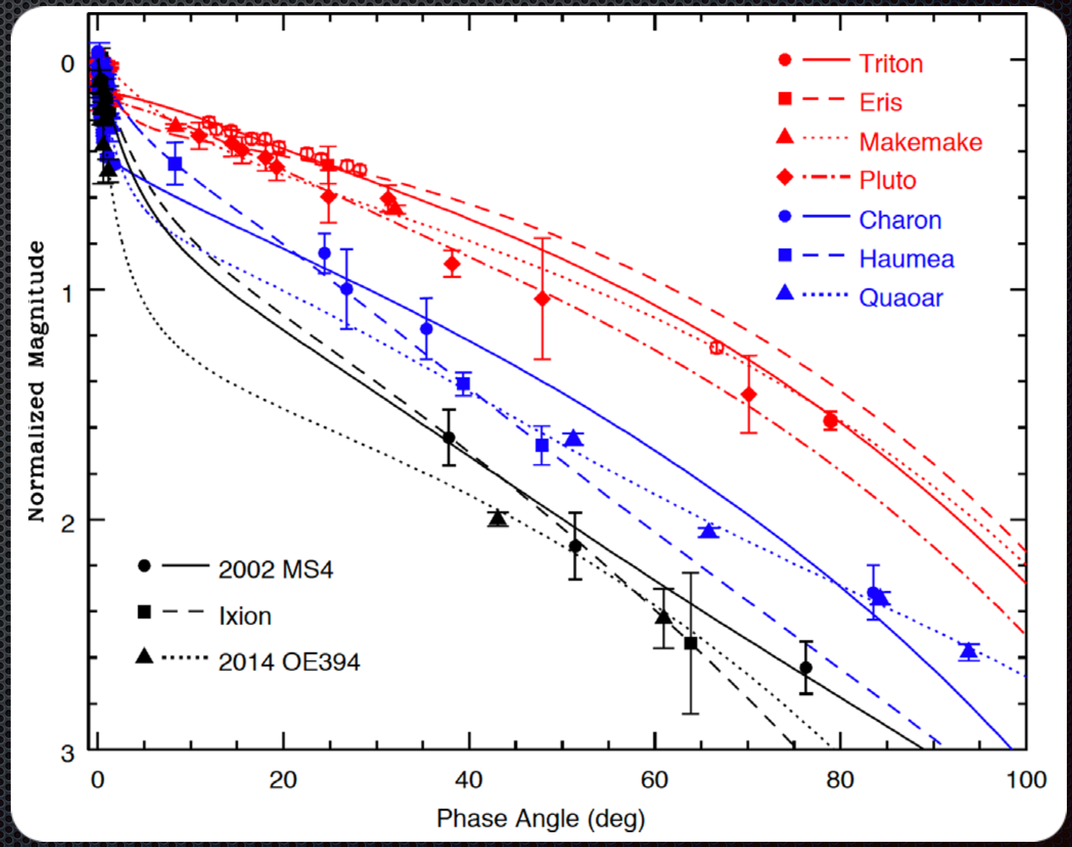
New Horizons



High Phase-Angle Observations

Verbiscer et al. (2022)



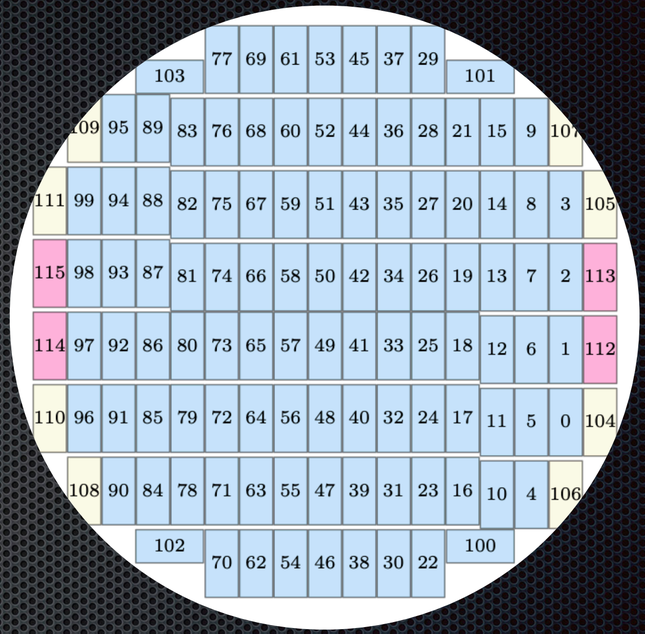


Phase Angle = Observer-Sun-Target Angle

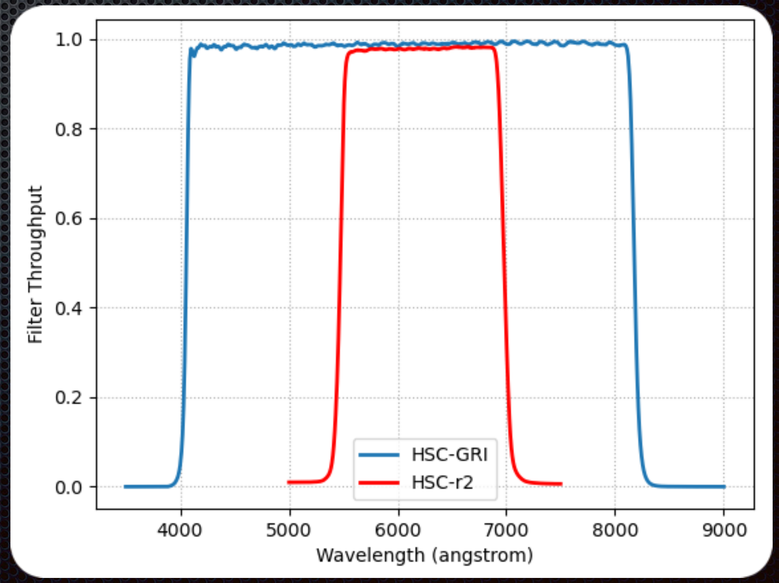
The Search For Distant KBOs

- started in 2020
- 34 half nights to date
- magnitude limit r~26.5
- 5-7 new LORRI targets (2023-2027 observations)
- 240 new KBOs

Hyper Suprime-Cam



GRI Filter

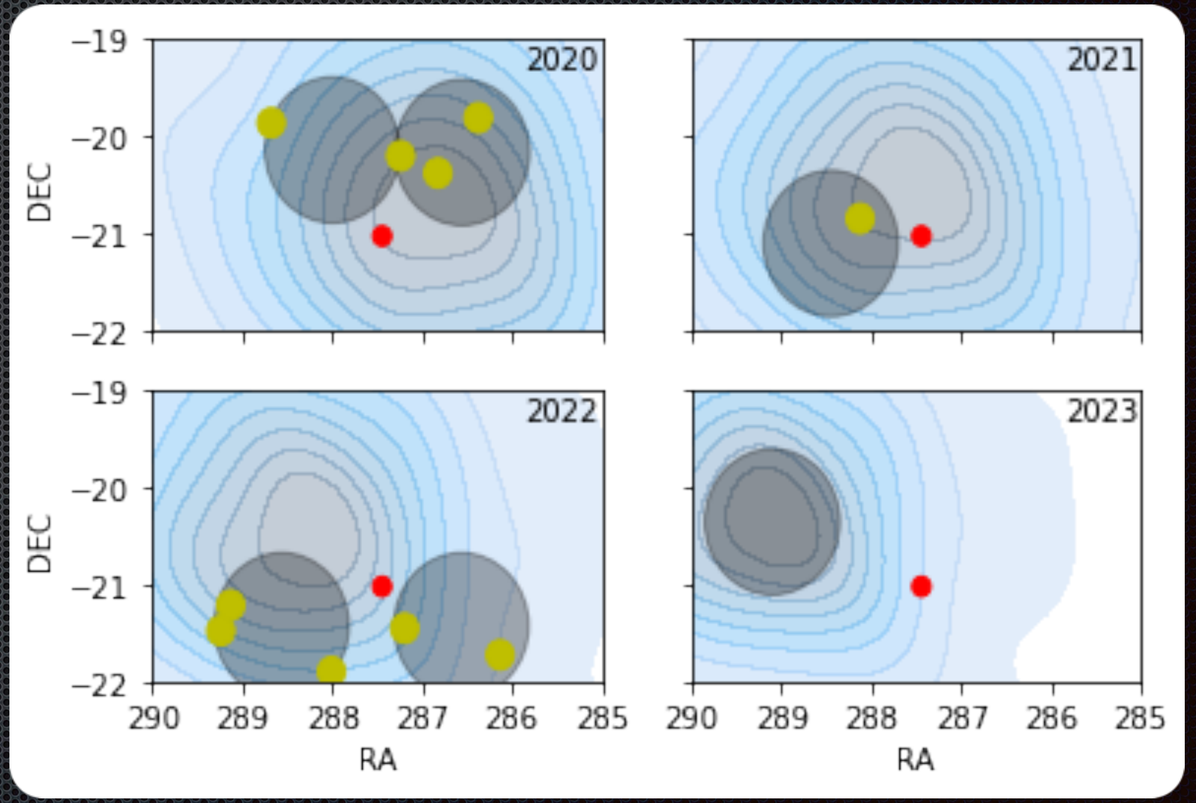


The Search For Distant KBOs

The process:

1. Observation Planning
2. Reductions + Subtractions using LSST pipeline
3. Shift-and-stack search
4. Machine Learning Source Rejection

Observation Planning



The Search For Distant KBOs

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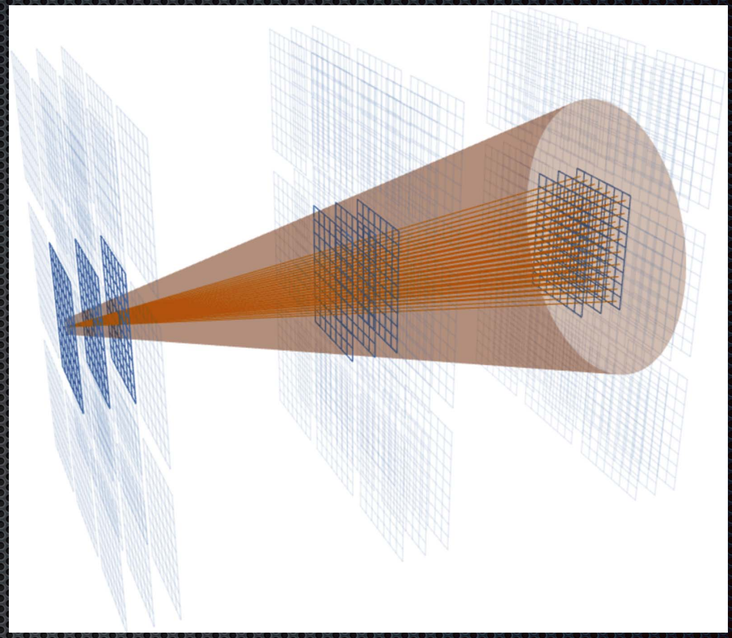
Shift-and-stack



KBMod (Whidden et al. 2019)

1.5 "/hr 2.0 "/hr 2.5 "/hr 3.0 "/hr

The Search For Distant KBOs

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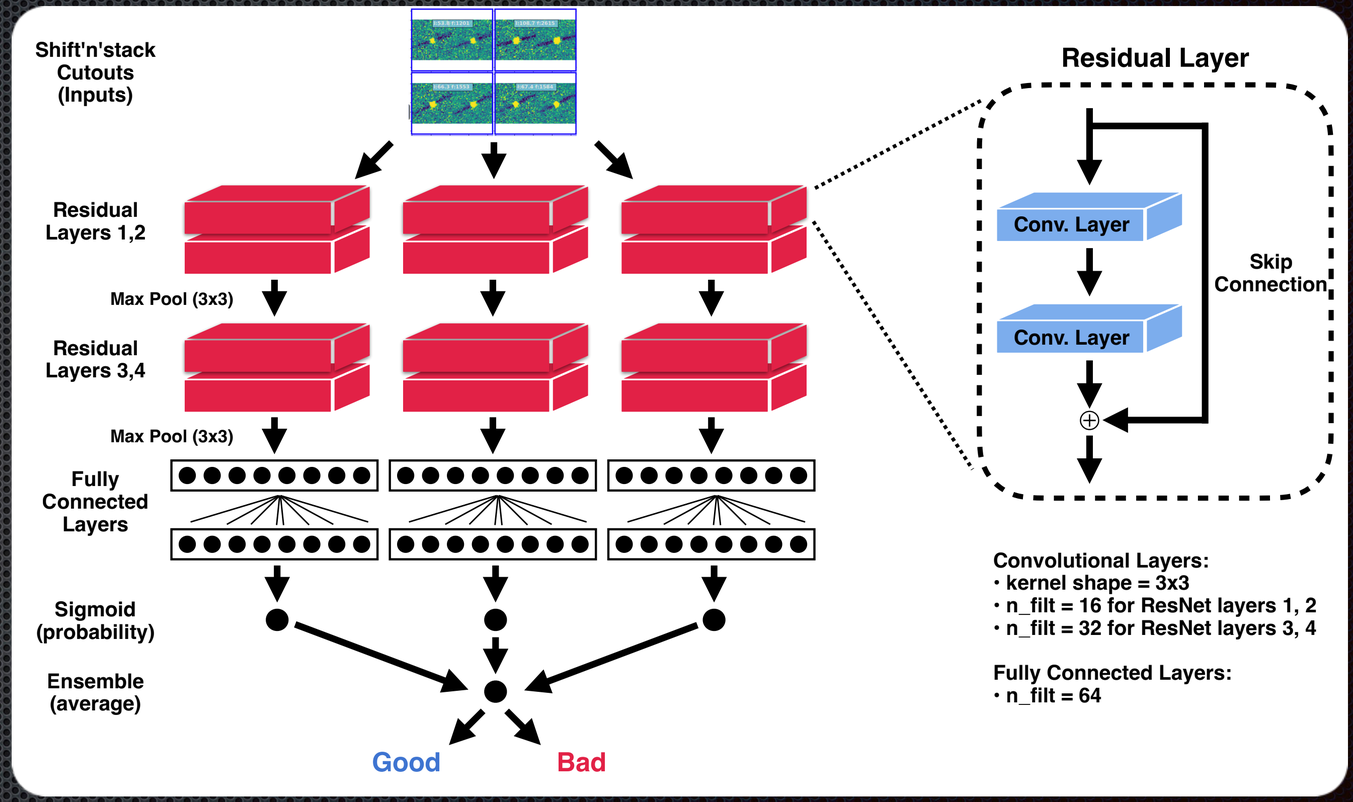
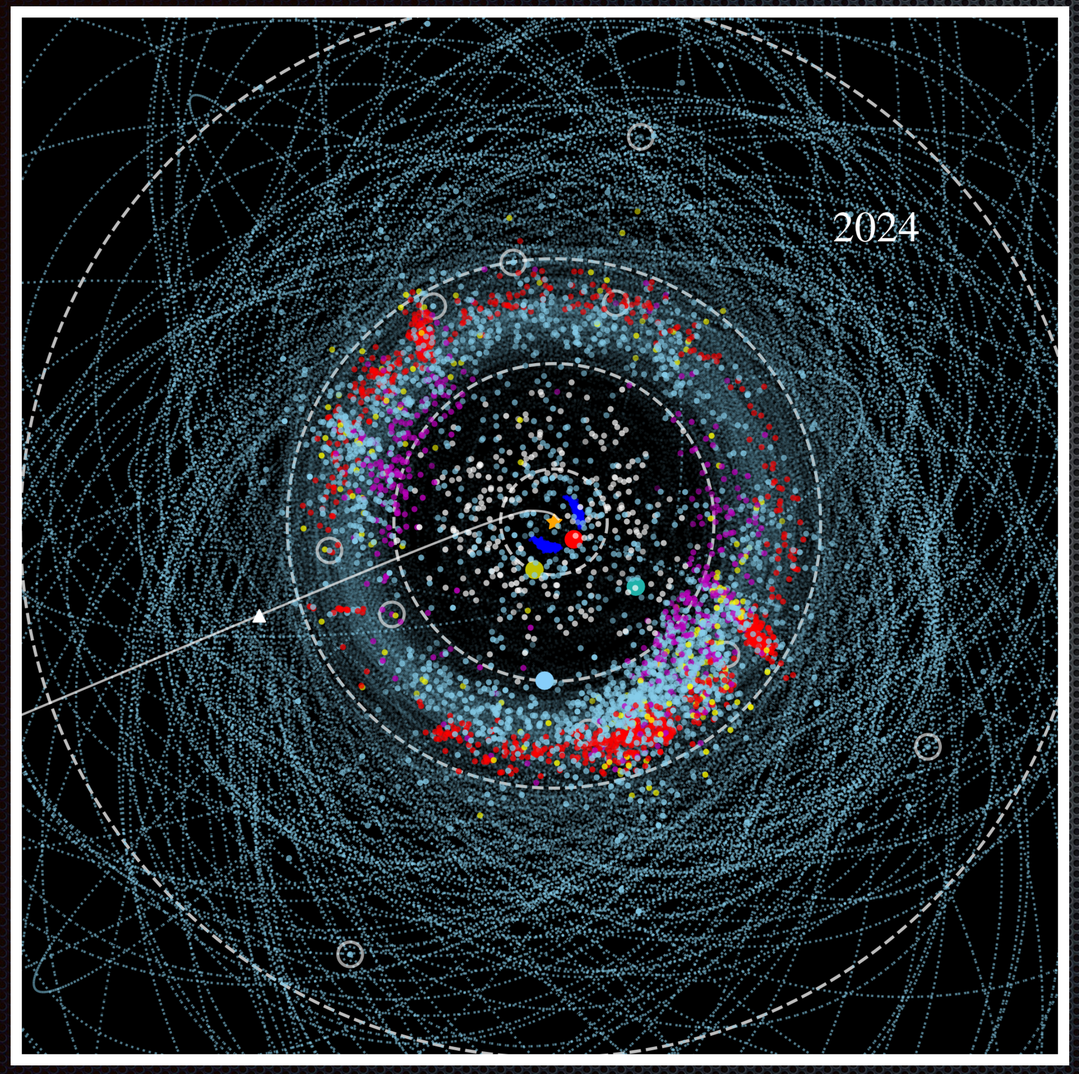
Machine Learning Source Rejection

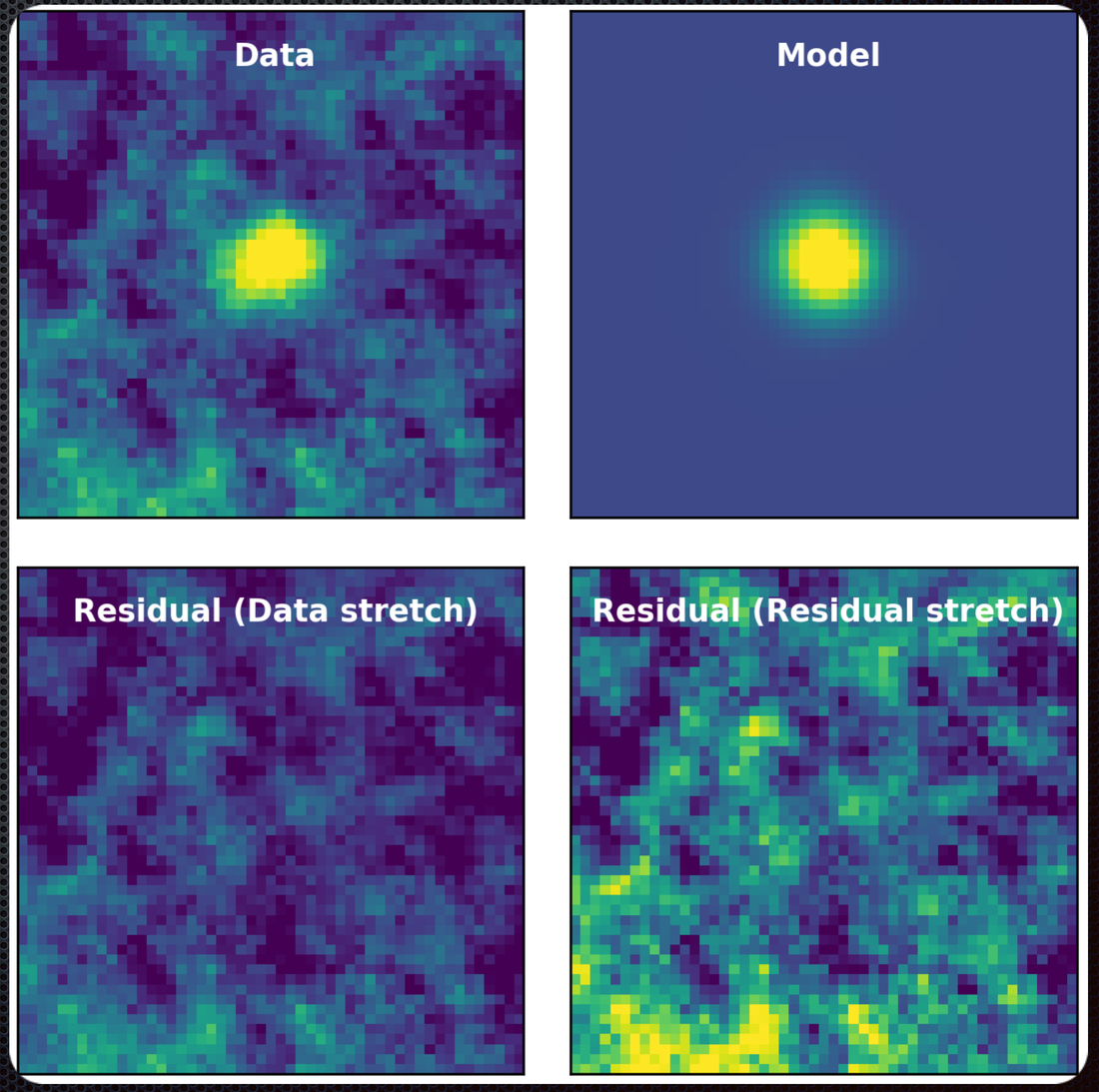


Also See P25 by Yoshida-San:

A Deep Analysis for New Horizons' TNO Search Images

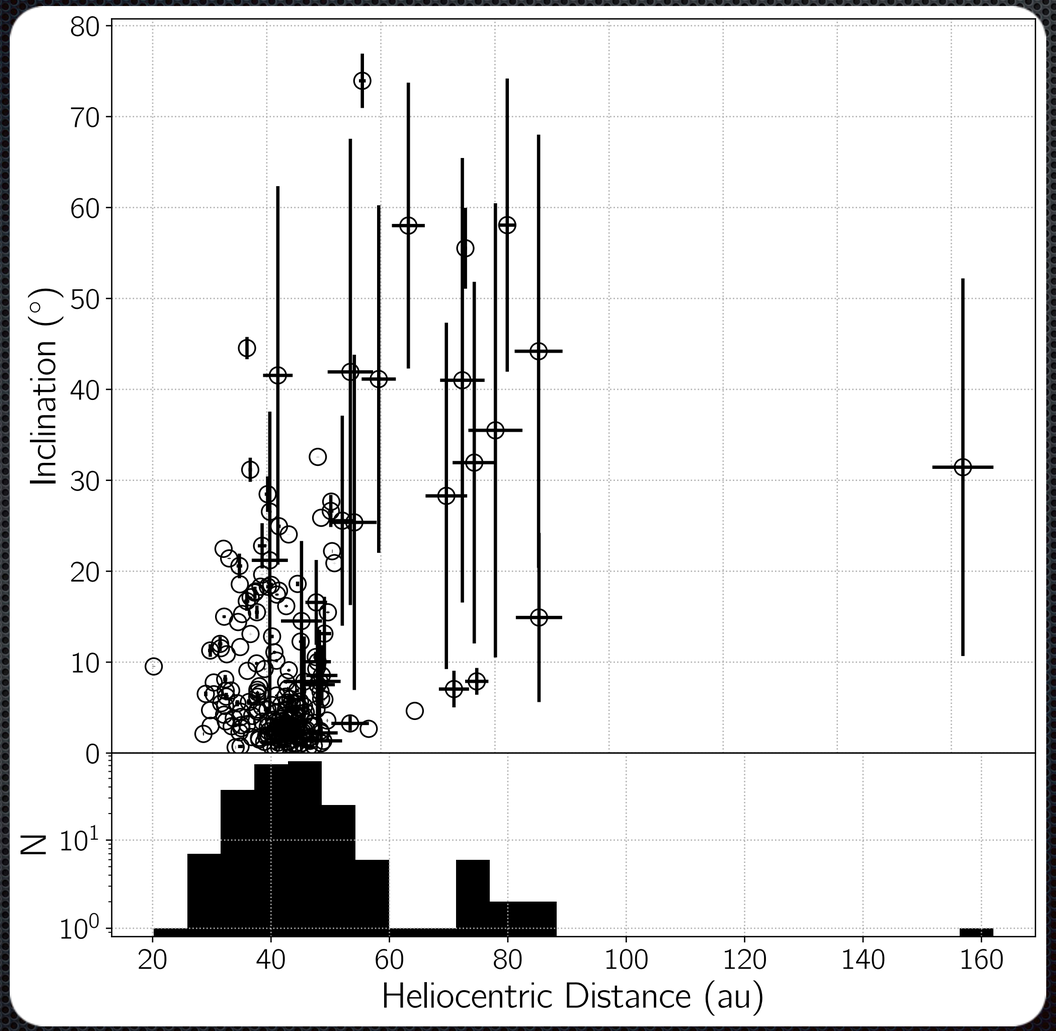
LORRI Observations of 2020 KS11



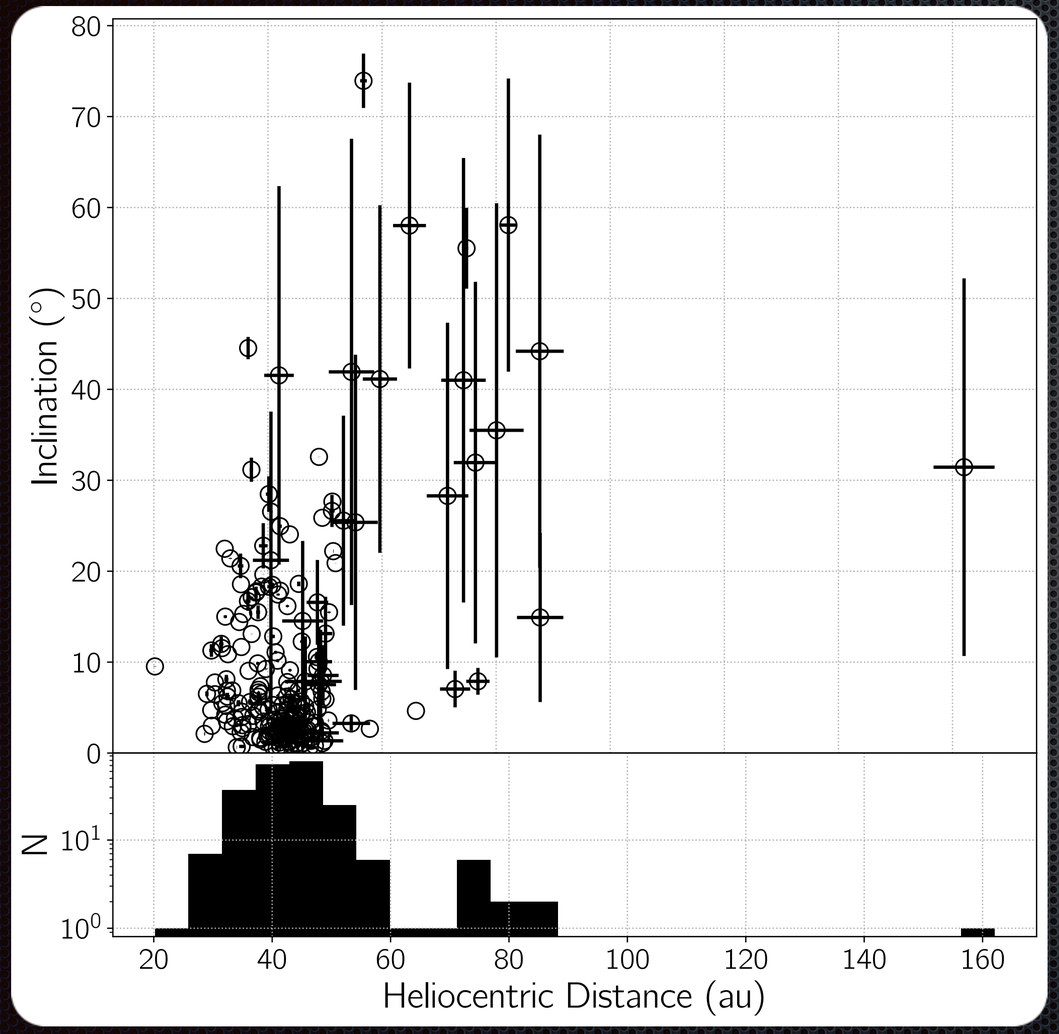


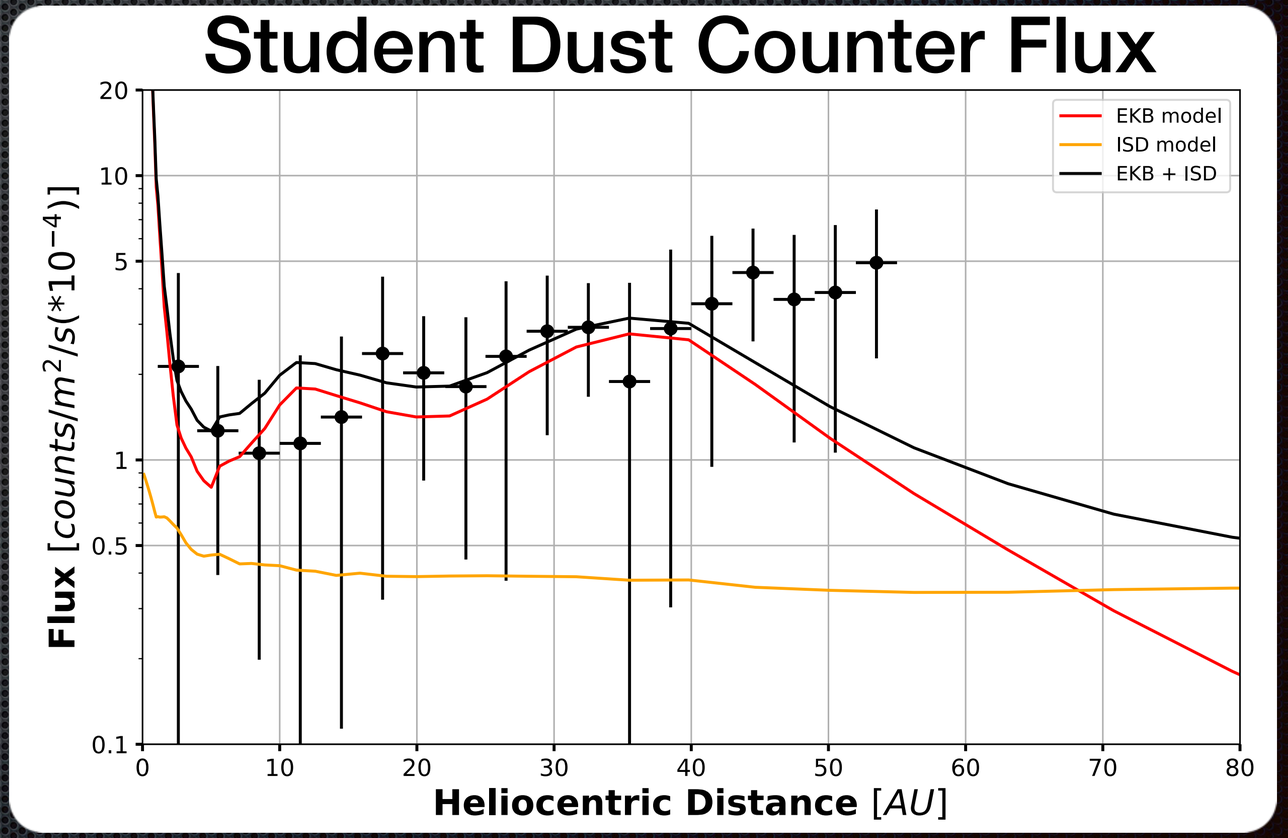
Courtesy of Simon Porter

240 Newly Discovered KBOs



240 Newly Discovered KBOs





Doner et al. Accepted to PSJ

2024 Plan

1. 9 half nights purchased for 2024A and 2024B
   - June 2x half nights
   - July 5x half nights
   - August and Sept to be scheduled
2. Full re-search of the data
   - improved subtraction with LSST v25
   - retrain the neural network
   - possible 20% increase in sample

The Recipe For Moving Object Success

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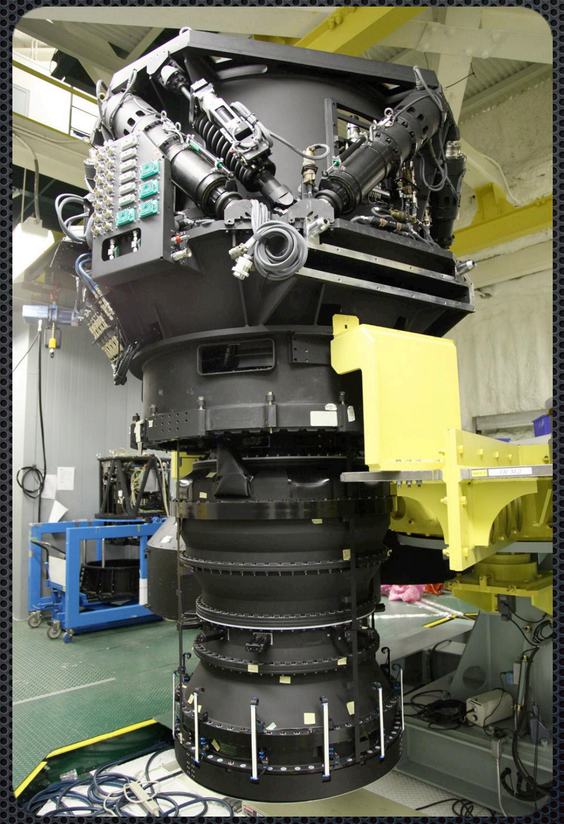

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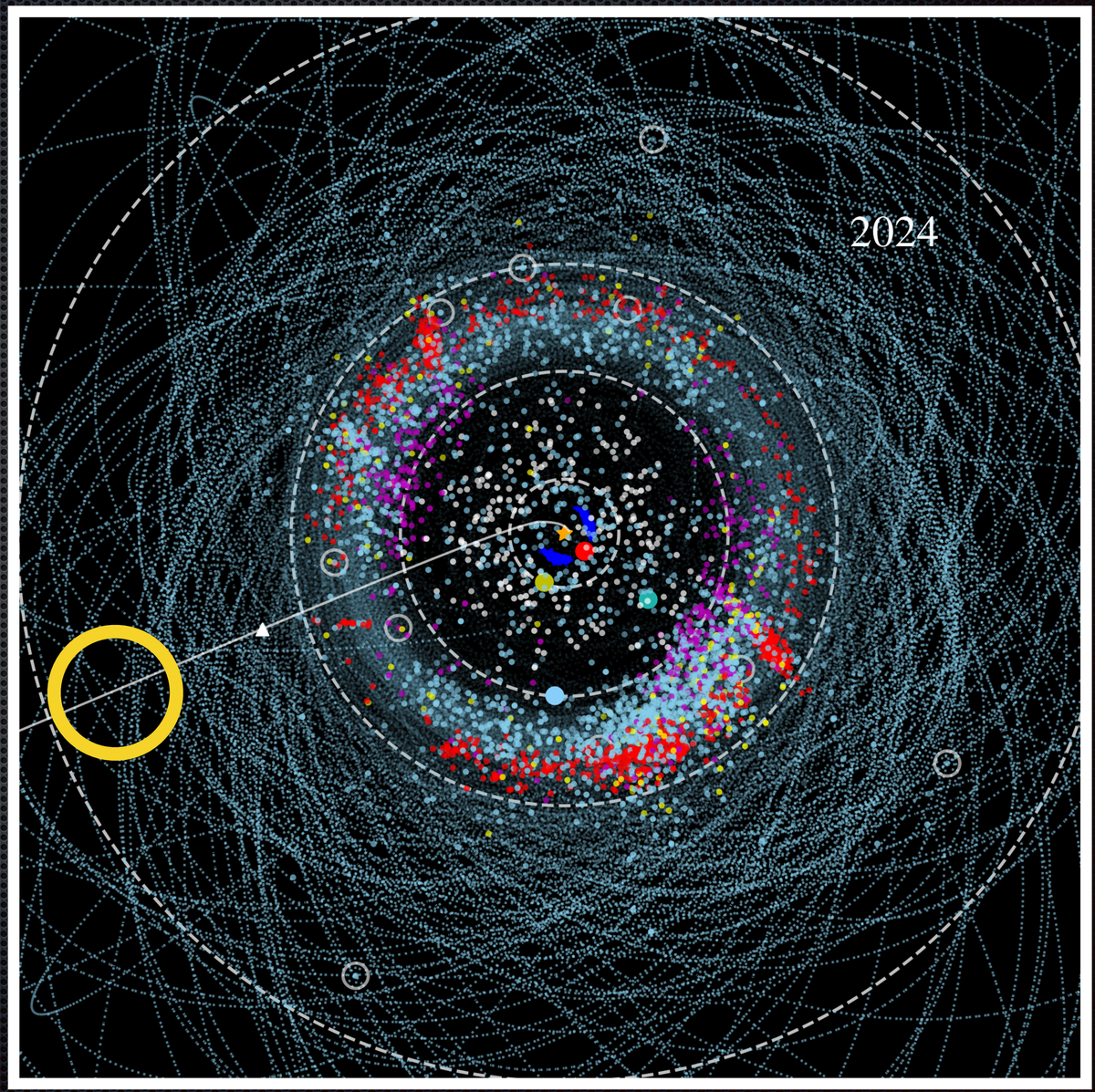
Big Aperture on great site **Wide Field** **Half Night Flexibility**

Future Attempts to Find A Flyby Target

- With NASA we are exploring options to find a new target for close flyby
  - LSST ➜ m~28
  - Roman/Euclid ➜ m~29



Summary

- On-going Subaru search started in 2020
- 240 new discovered Kuiper Belt Objects

  ➡ 5x more distant objects than expected
- 5-7 new targets for LORRI imaging

  ➡ High eccentricity target 2020 KS11 observed in Dec 2023

スバルさん、本当にありがとう