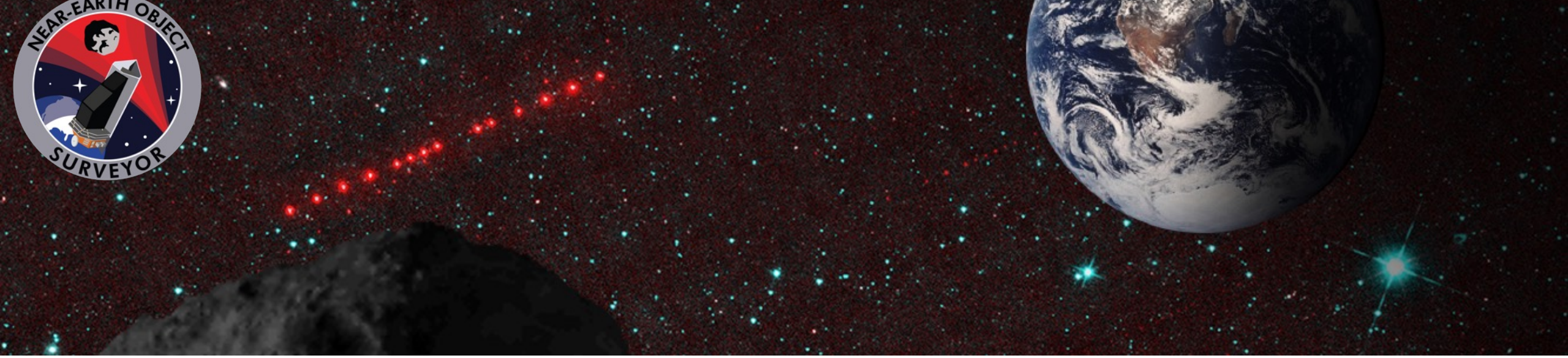


Near-Earth Object (NEO) Surveyor Update

Amy Mainzer
Survey Director

NEO Surveyor: Finding NEOs Before They Find Us

- **NEO Surveyor is a mission designed to find, catalog, and characterize NEOs**

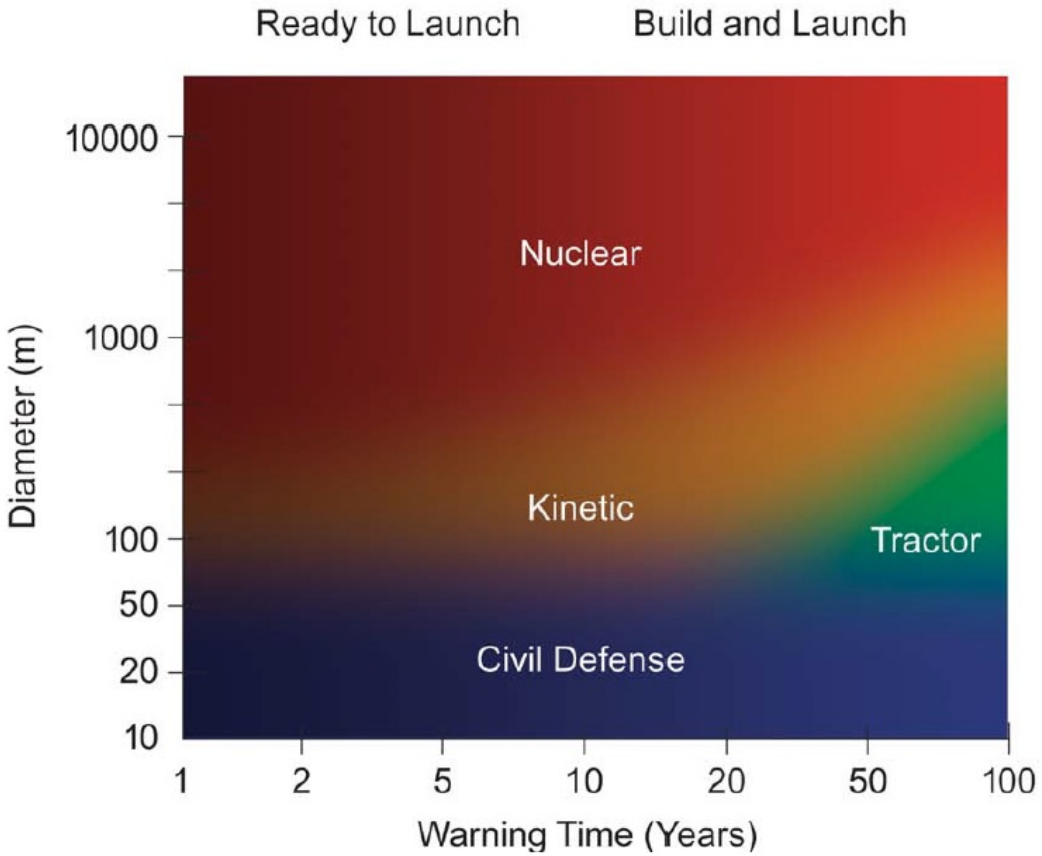
- **It responds to the 2005 George E. Brown law that requires NASA to find more than 90% of NEOs larger than 140 m in diameter**
  - This was supposed to be accomplished by 2020

- **NEO Surveyor is an infrared space telescope with a design and survey strategy optimized for discovering the NEOs that are most likely to impact the Earth**
  - No other science objectives

Near-Earth Asteroids 140 Meters and Larger
Total Population estimated to be ~25,000

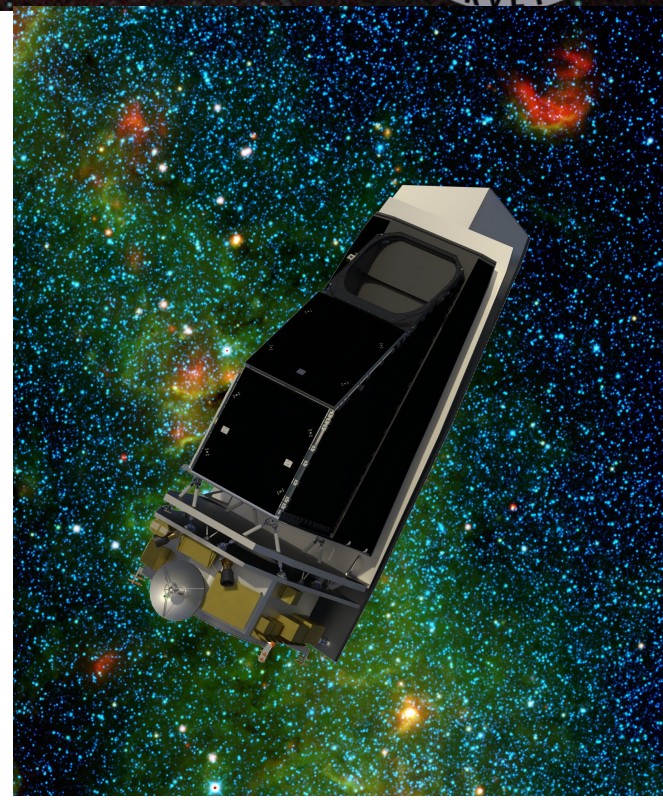
George E Brown
NEO Survey Goal

Mitigation Strategies Work Best When We Have Years to Plan



- Detecting objects well in advance of potential impacts provides maximum time for response & allows widest possible range of mitigation strategies
- We therefore want our surveys to be designed to find objects when they are years to decades from any potential impacts
- From the National Research Council of the National Academies 2010 report “Defending Planet Earth”

NEO Surveyor Project Overview



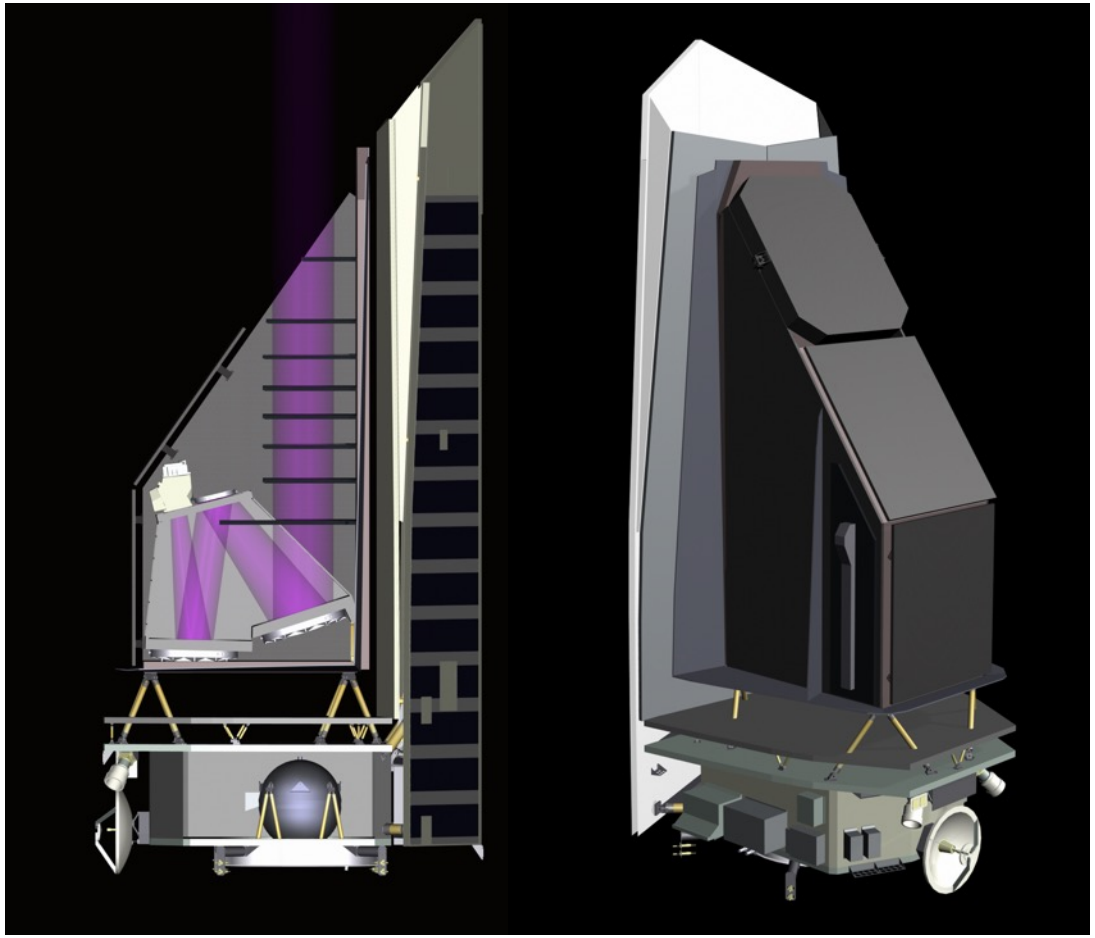
Salient features:

- NEO Surveyor is a planetary defense mission
- Key NASA priority to detect, track, and characterize impact hazards from asteroids and comets
- Will make significant progress toward George E. Brown, Jr. NEO Survey Act (Public Law 109-55, Sec. 321). Responds to National Research Council's report Defending Planet Earth (2010), U.S. National NEO Preparedness Strategy (2018), Planetary Decadal Survey (2022)
- Launch Readiness Date: no later than June 2028
- Program Exec: Andrea Riley. Program Scientist: Mike Kelley. Mission Manager: Solveig Irvine
- Survey Director: Amy Mainzer (UA). JPL Project Manager: Tom Hoffman

Science requirements:

- Identify at least 2/3 of potentially hazardous asteroids >140 m in effective spherical diameter within 5-year baseline mission (Goal: ≥90% completeness within 10-12 years)
- Collect and verify sufficient observations in order to calculate the frequency of impacts from asteroids >50 m in effective spherical diameter & comets
- Collect and verify sufficient observations in order to derive physical and orbital characteristics of specific objects of interest

Mission Architecture



Observatory will survey from halo orbit at L1 for 5 years with 12-year goal. Launch Sept 2027.

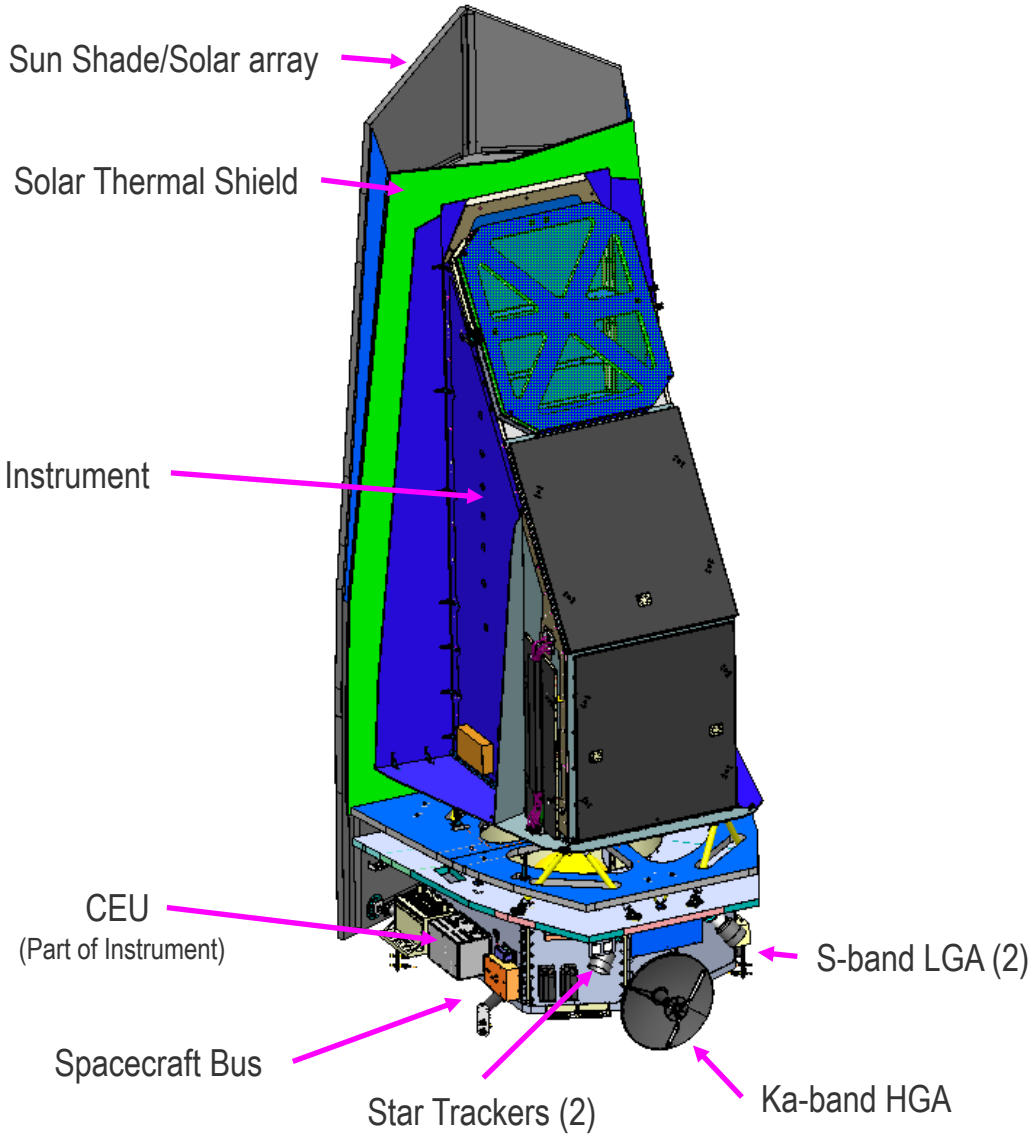
Instrument is passively cooled

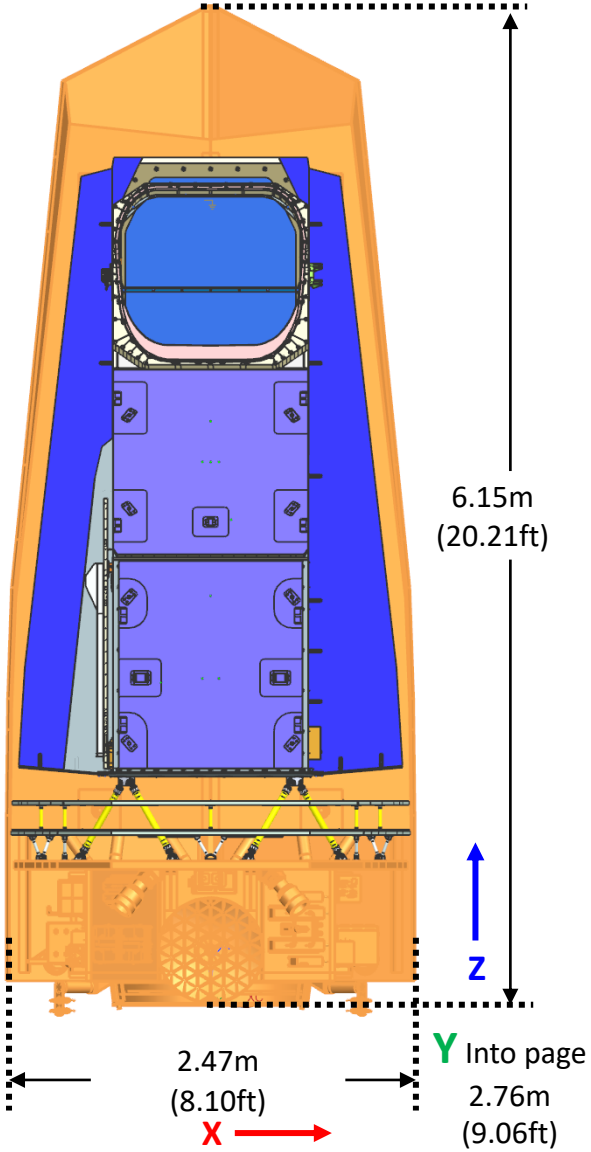
- 50-cm telescope
- 2 IR channels imaging simultaneously
- 4-5.2 um and 6-10 um
- Field of view 11 sq deg
- Sensitivity:
  - <110/280 uJy 5-sigma in 3min @ 8um @ 120/45 deg from Sun
  - <65/120 uJy 5-sigma in 3min @4.6um @120/45 deg from Sun

Spacecraft is based on Ball BCP2000 heritage

- 3-axis stabilized spacecraft
- Ejectable cover is the only deployment

Project / Flight System Key Attributes

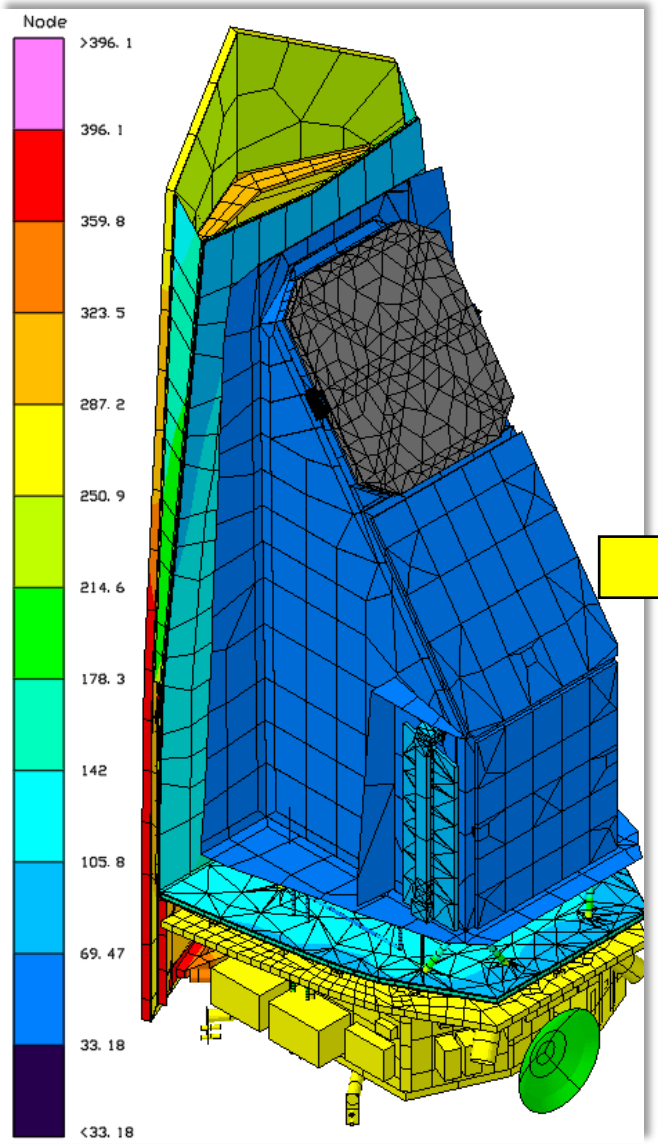


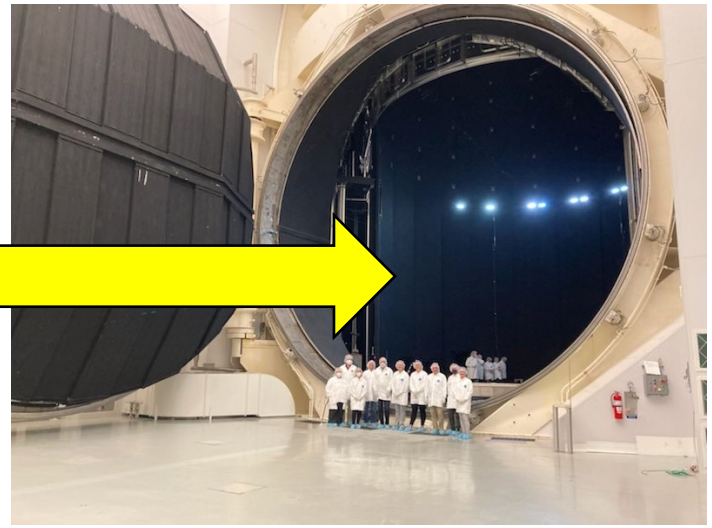


Key Attributes

- Type 2 - Class C mission
- Launch Readiness Date (LRD): 13 September 2027
- Orbit: Sun-Earth L1 halo orbit
- 5-year life (12-year goal)
- Dual band simultaneous imaging
- Passively-cooled system
- Observatory allocated dry mass 1680 kg
- Propellant 133 kg
- Power consumption 1000 Watts (CBE)
- Daily data download 793 Gbits (CBE) @ 150Mb/s

Project Status & Next Milestones



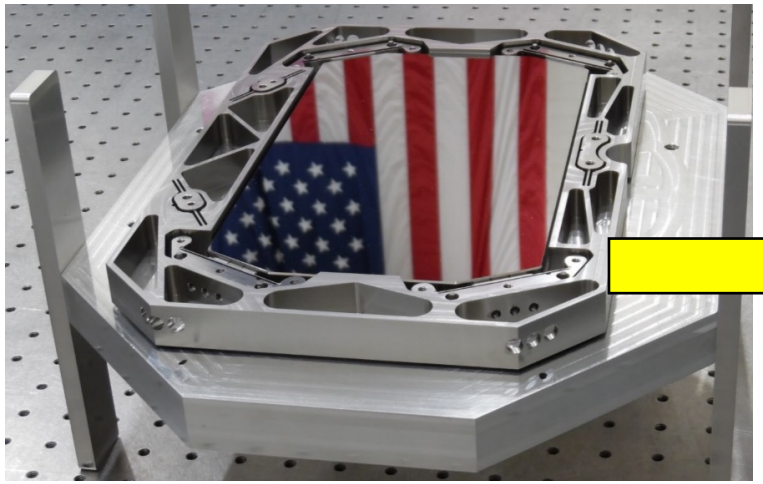


- NEOS was confirmed to enter Phase C on November 29, 2022
- External Thermal Balance Test scheduled in Chamber A at JSC with 15K shroud
- LASP brought on as mission operations partner
- Instrument Critical Design Review (CDR) Part 1 November 2023 (non-integration & test part)
- Instrument CDR Part 2 Spring 24 (I&T instrument)
- Project CDR Feb 2025

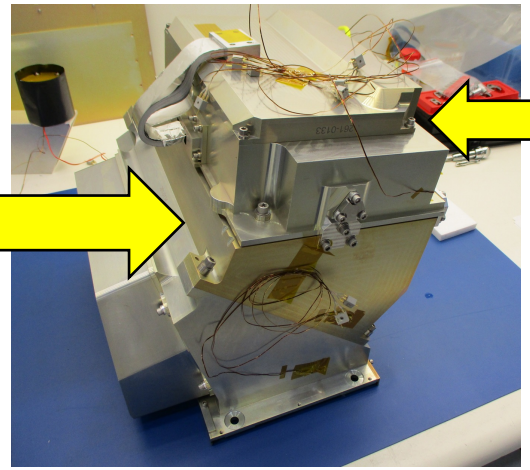
Progress to Date

- Developed detailed reference population model of NEOs & background objects for use with survey simulation tool
- 8 out of 8 flight + flight spare focal planes selected for mid-wave infrared NC1 channel (4.0-5.2 um)
- 8 out of 8 flight + flight spare focal planes selected for long-wave infrared NC2 channel (6-10 um)
- Telescope mirror material purchased
- Beamsplitter qual units completed

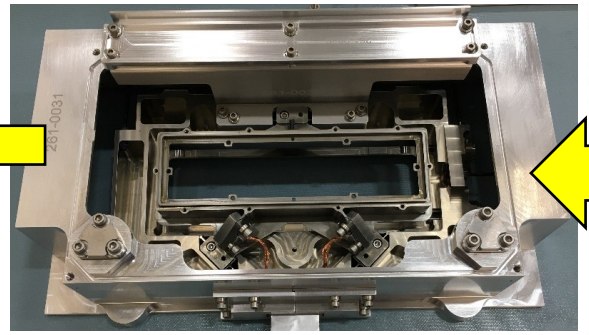
Hardware Progress



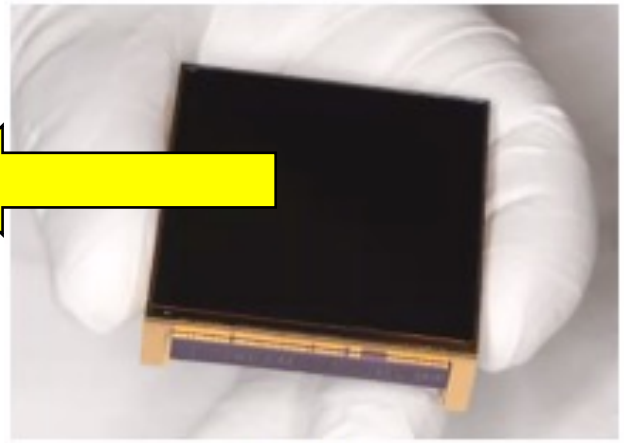
Qual unit beamsplitter



Camera enclosure assembly engineering dev unit

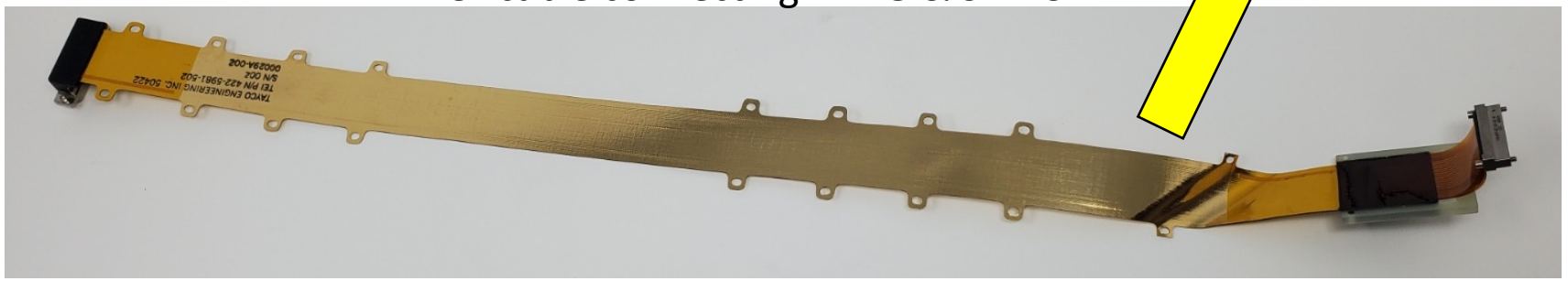


Focal plane module housing

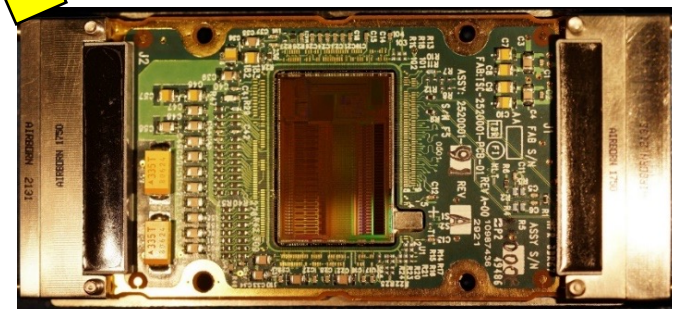


H2RG
(2K×2K, 18 µm pitch)

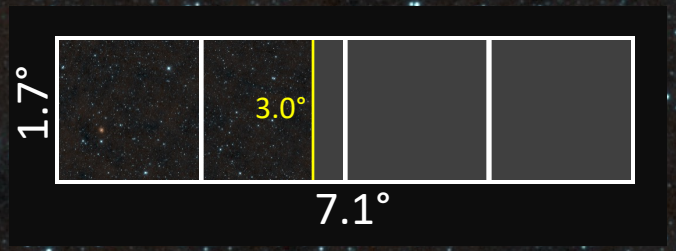
Flex cable connecting H2RG & SIDECAR



SIDECAR control ASIC



The Challenge: 3.0° x 1.7° FOV (λ ~ 65°, β ~ 10°), 2 NEOS Surveyor bands (data derived from WISE W2 and W3)



Artifact

Galaxy

Galaxy

Artifact

Galaxy Cluster

Interstellar Dust/Star-Forming Region

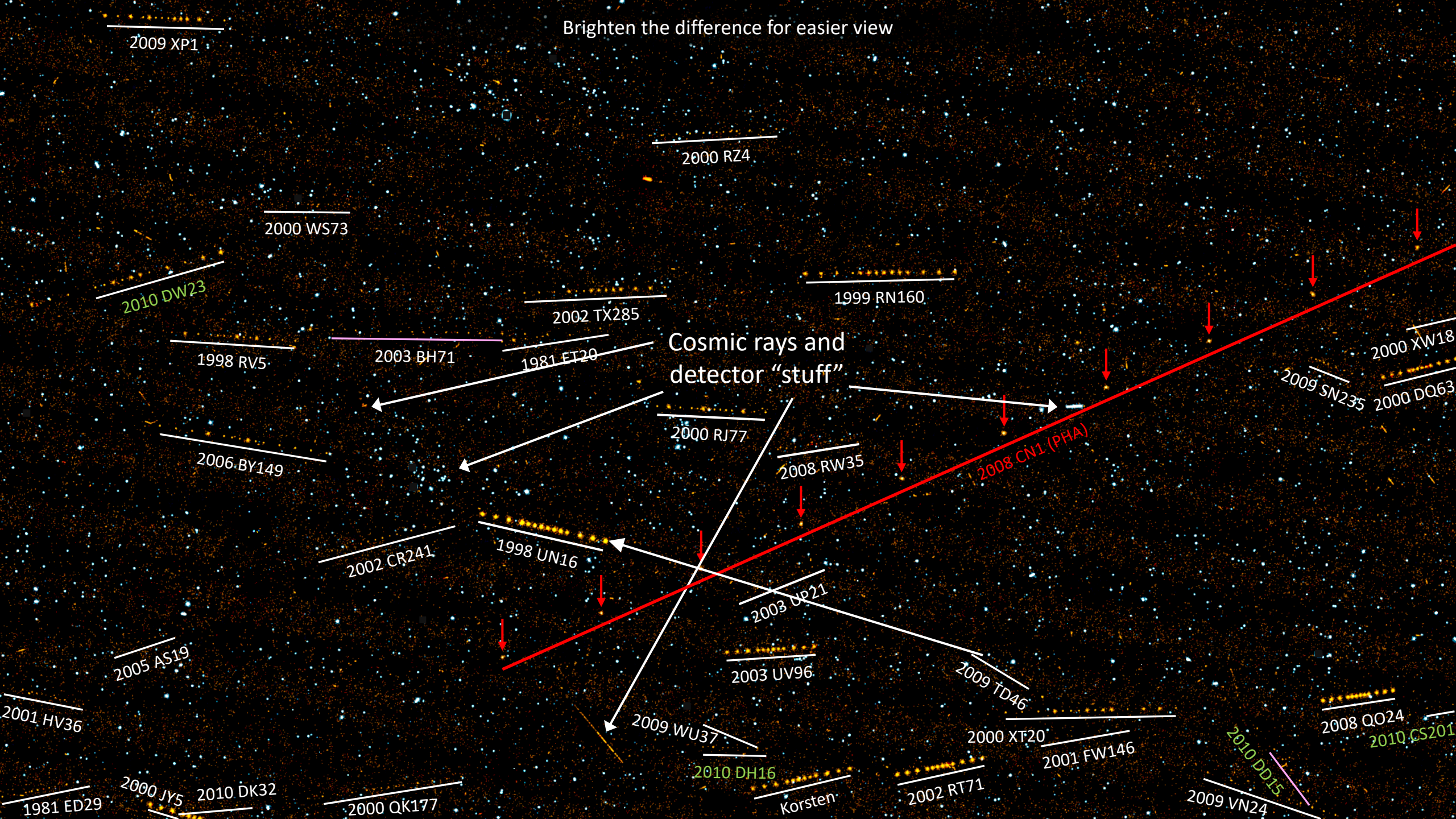
Planetary Nebula

Galaxy

Galaxy

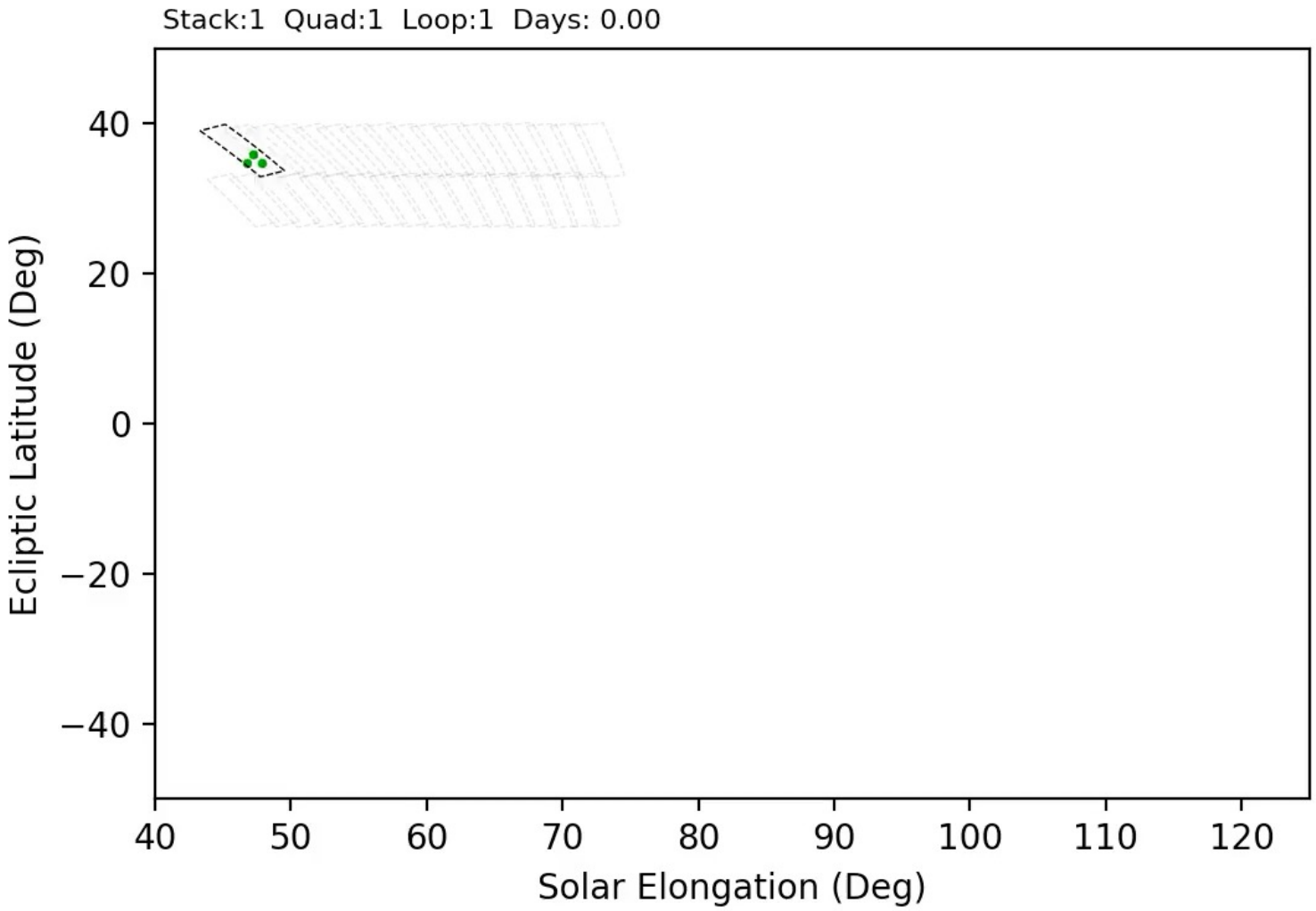
Where are the asteroids?

Figure courtesy Mike Ressler


Brighten the difference for easier view
2009 XP1
2000 RZ4
2000 WS73
2010 DW23
1999 RN160
2002 TX285
1998 RV5
2003 BH71
1981 ET20
Cosmic rays and detector "stuff"
2000 XW18
2009 SN235
2000 DQ63
2000 RJ77
2006 BY149
2008 RW35
2008 CN1 (PHA)
2002 CR241
1998 UN16
2003 QP21
2005 AS19
2003 UV96
2009 TD46
2001 HV36
2009 WU37
2000 XT20
2008 QO24
2010 CS201
2001 FW146
2010 DD15
2010 DH16
1981 ED29
2000 JY5
2010 DK32
2000 QK177
Korsten
2002 RT71
2009 VN24

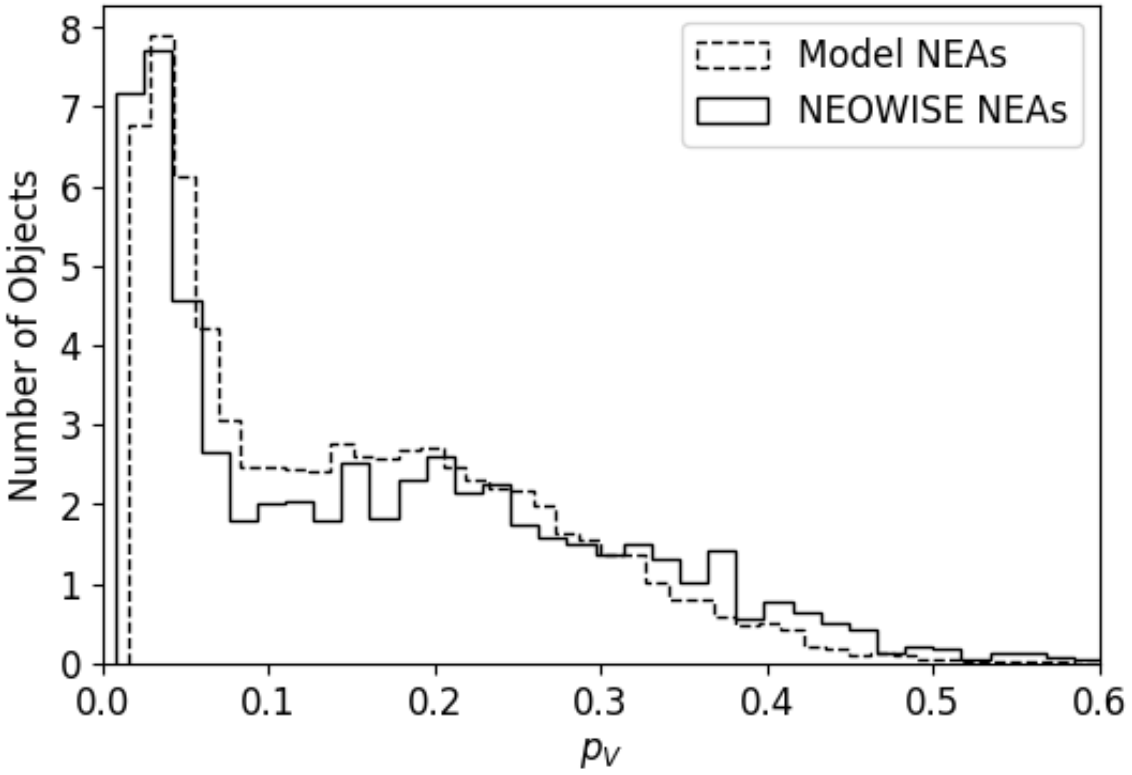
Demonstration of Survey Plan

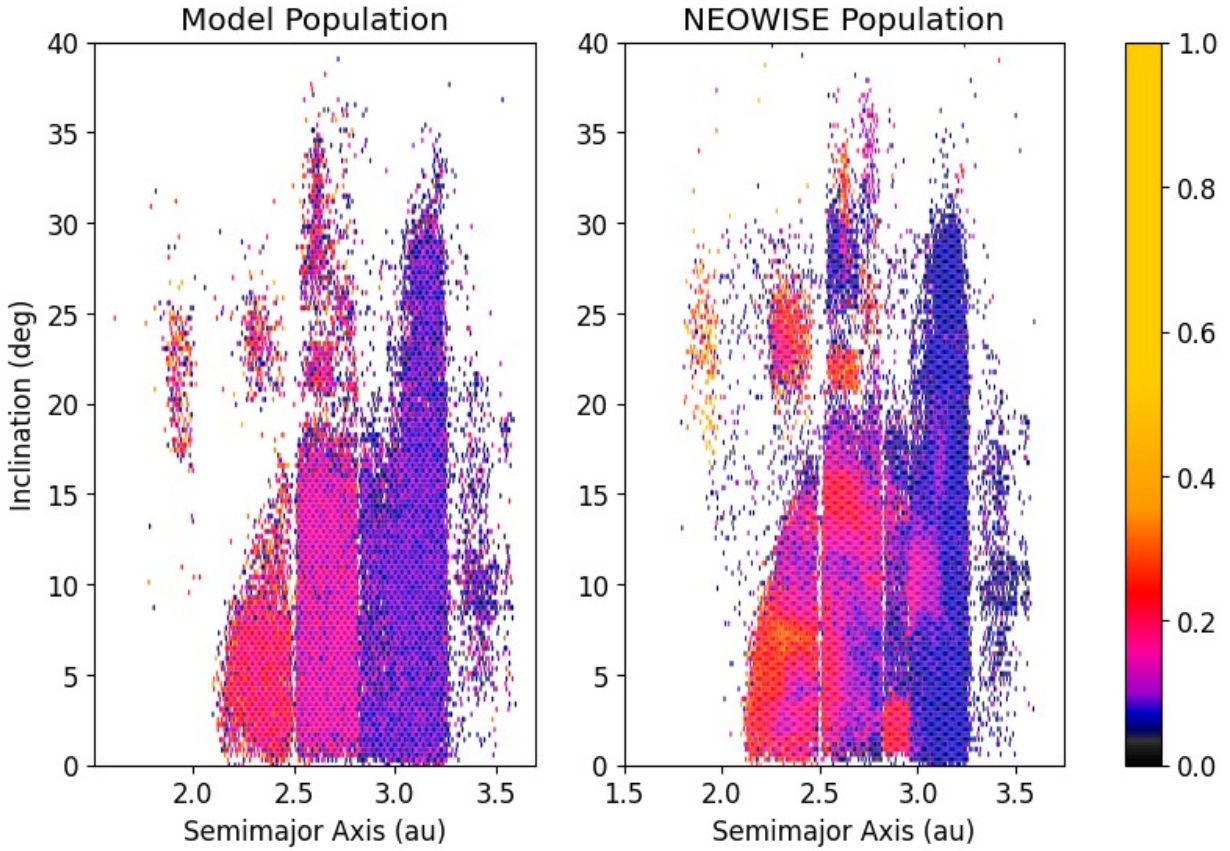
- NSS code used to generate this product



Software Progress

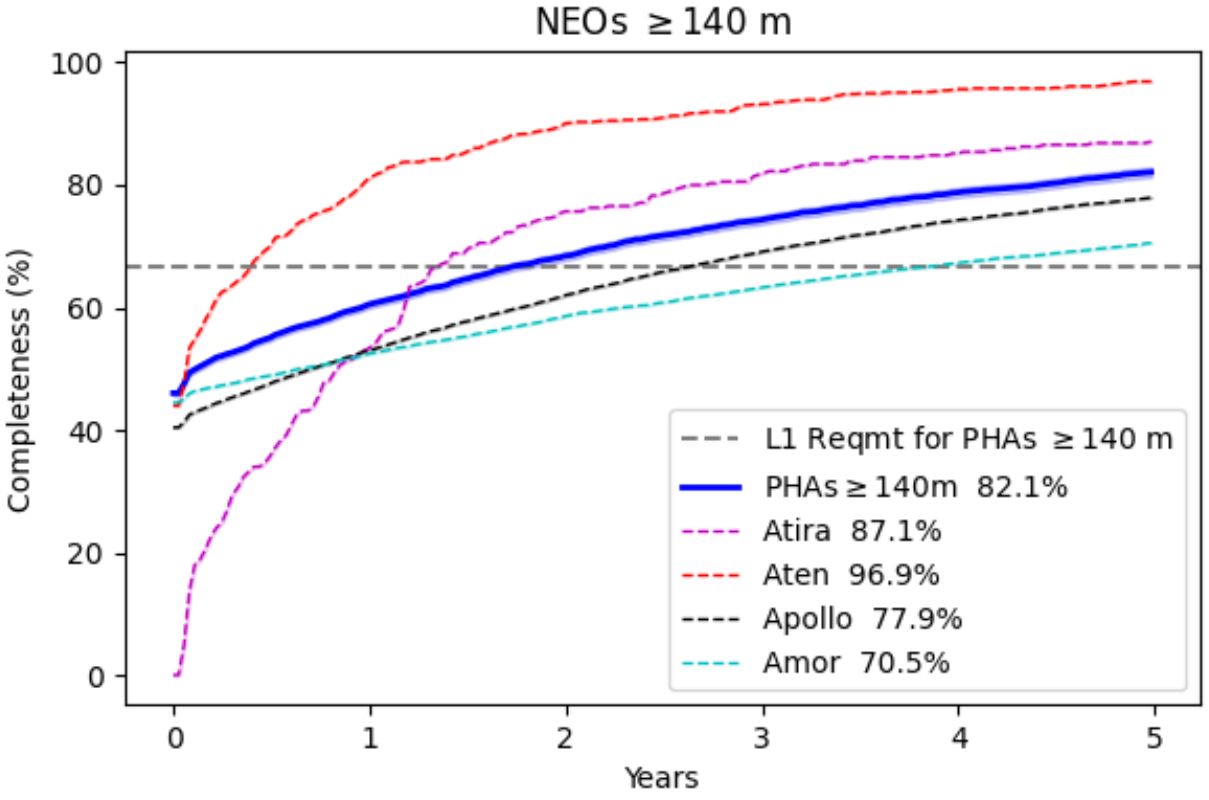
- Reference population model containing NEOs & background objects complete
- Survey simulations run using reference population model & representation of observatory properties + survey plan

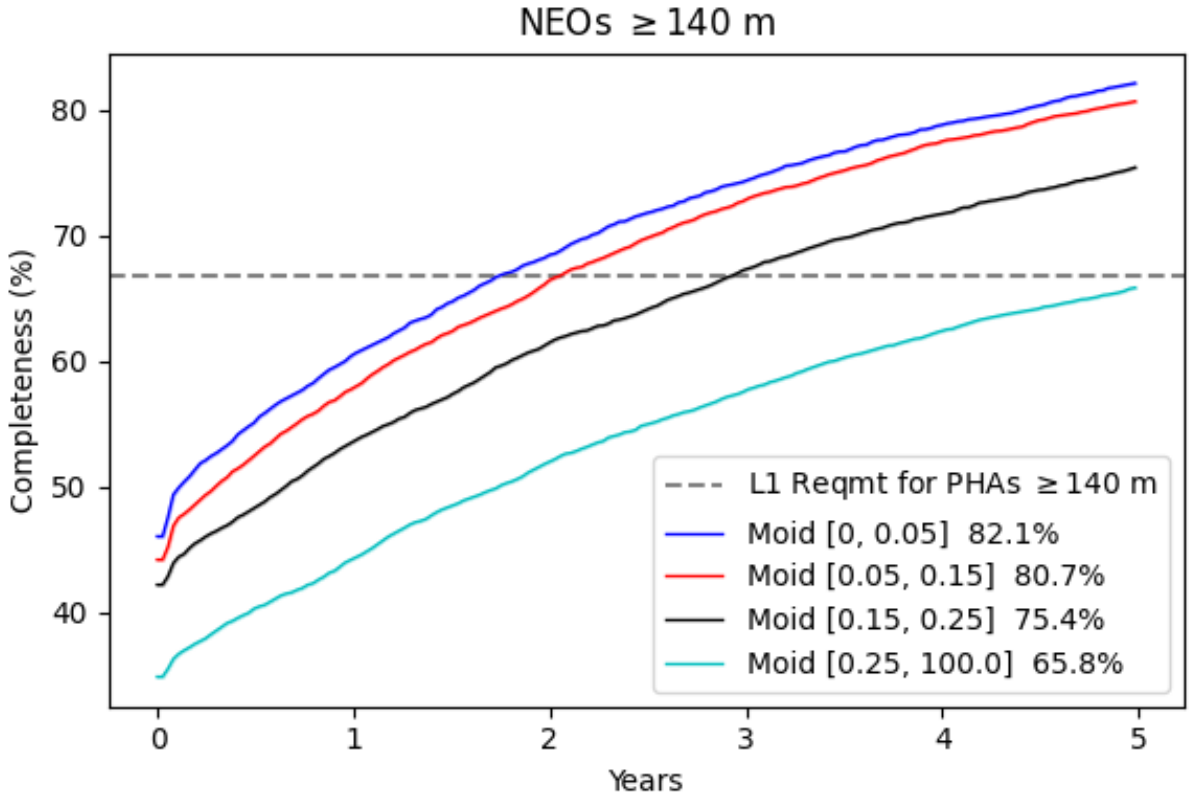




Survey Completeness vs. MOID & vs. Object Type

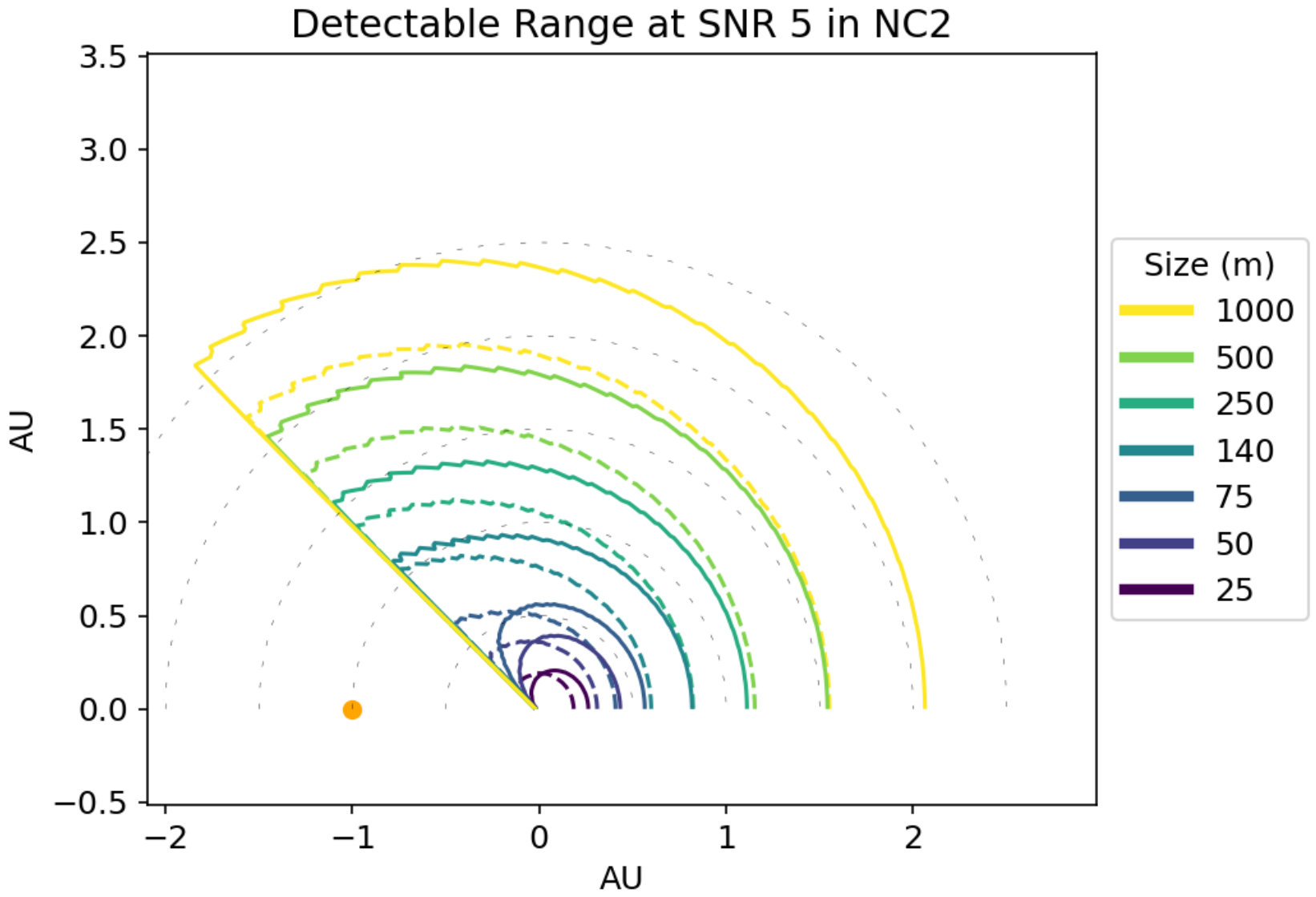
- NEOS will meet its baseline objectives within its 5-year nominal mission.
- It will reach >90% survey completeness for potentially hazardous asteroids >140 m in 10-12 years.
  - Survey is particularly effective at finding PHAs (MOID < 0.05 au), Atens, and Atiras.



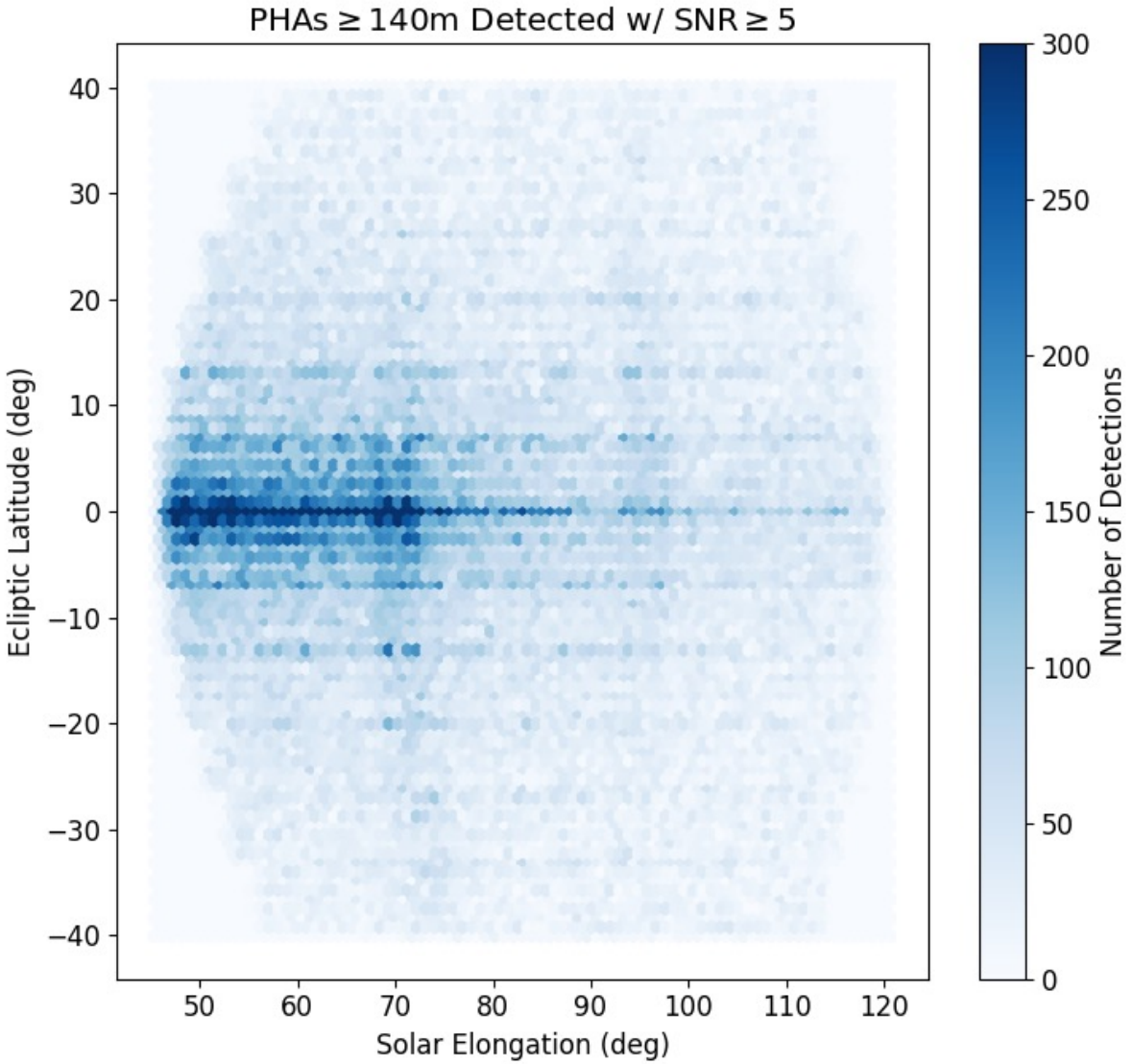


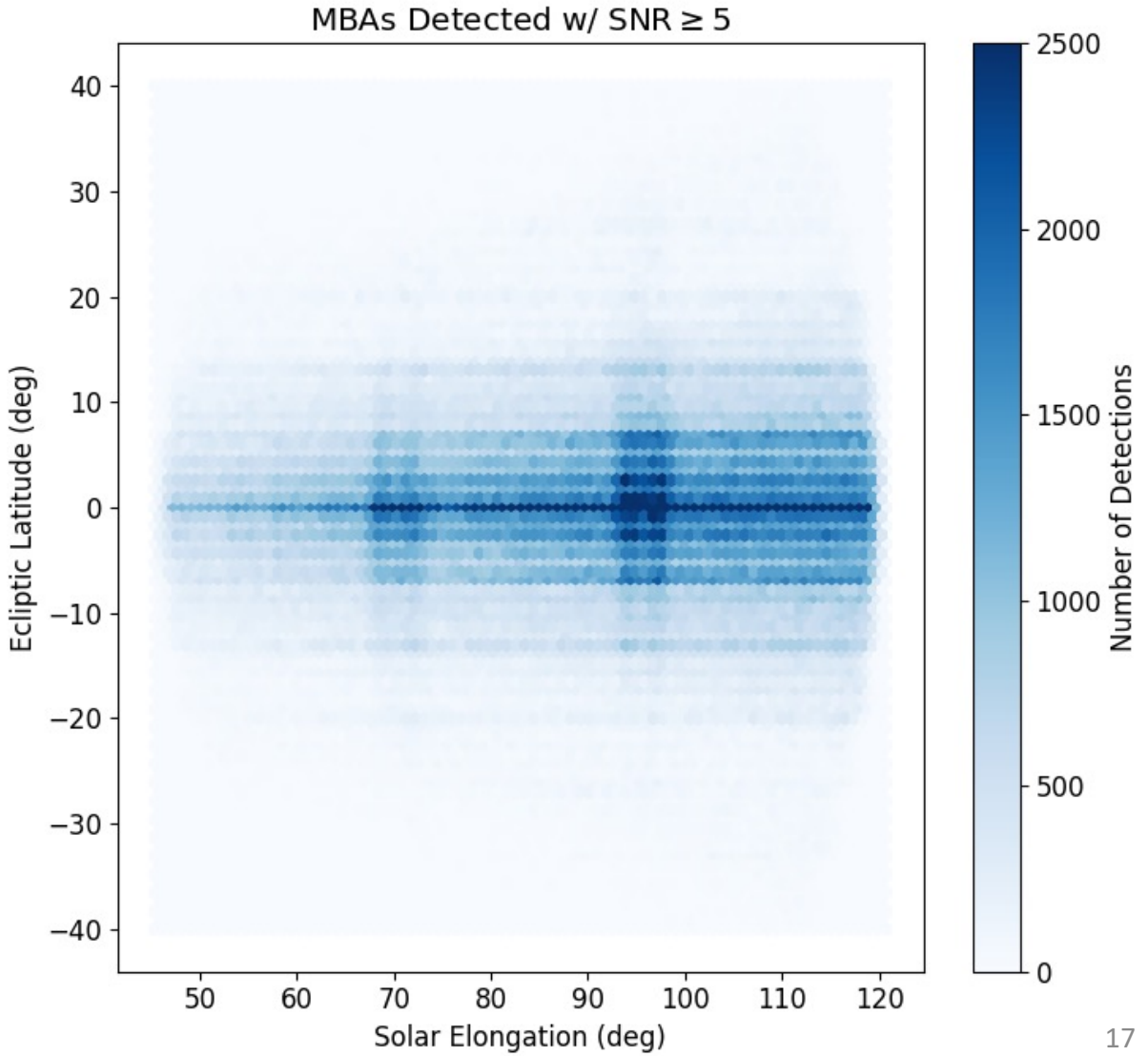
NEO Detectability vs. Distance for NEATM vs. FRM

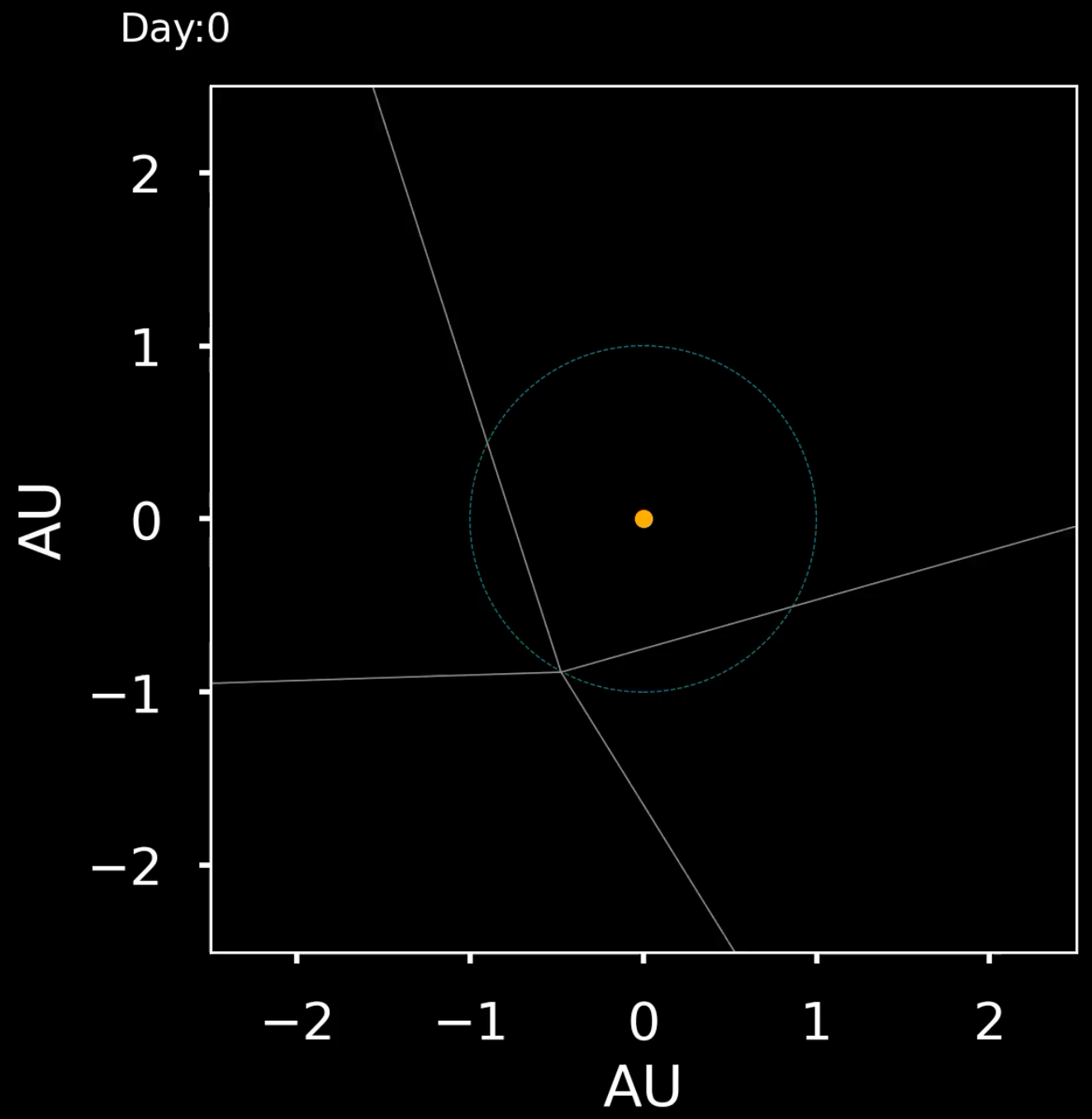
- Solid lines are Near-Earth Asteroid Thermal model (NEATM)
- Dashed lines Fast Rotating Model (FRM), which is probably more appropriate for small, fast-rotating NEAs below the spin barrier



Source Locations on Sky



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