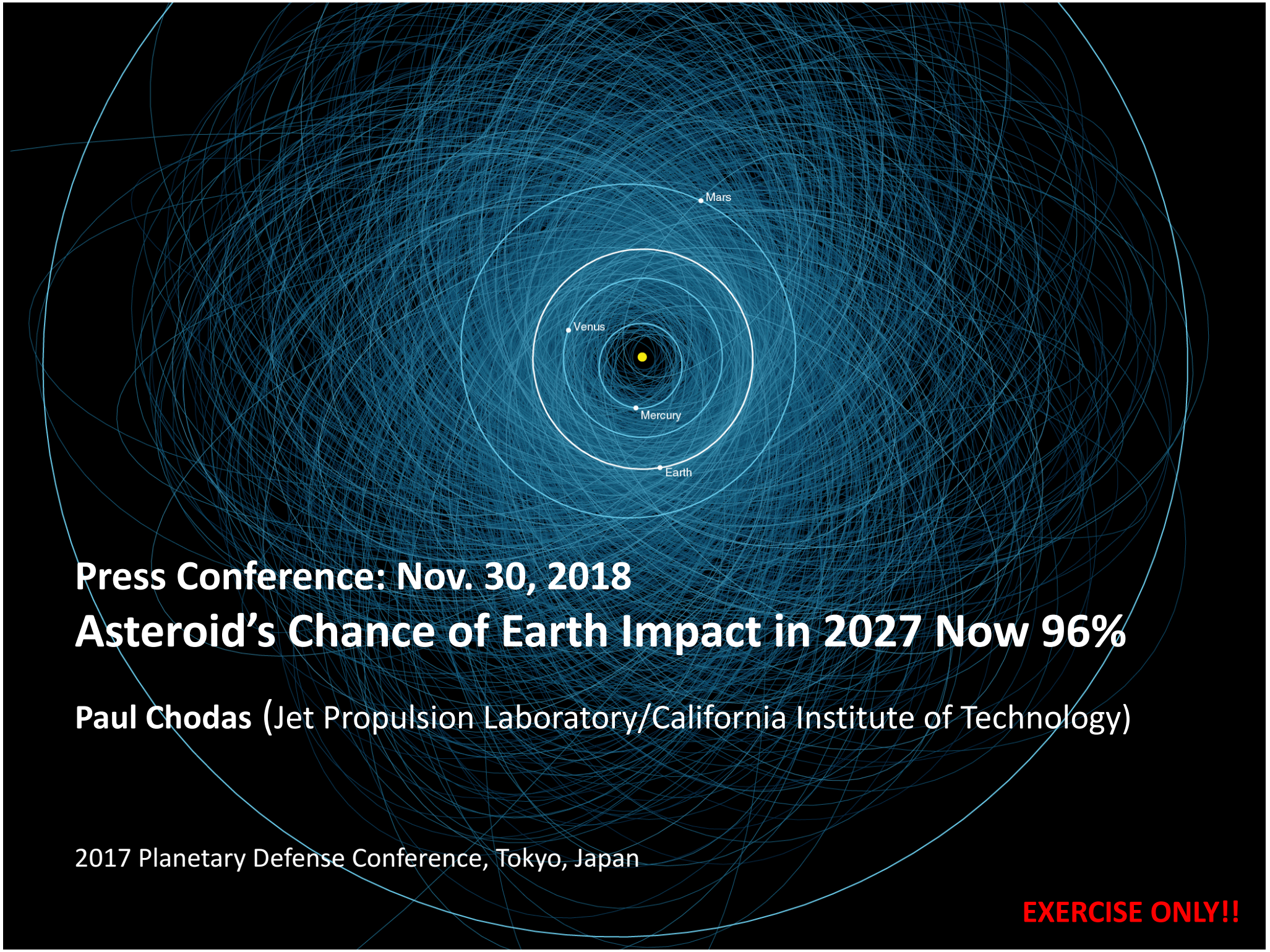


Press Conference: Nov. 30, 2018

Asteroid's Chance of Earth Impact in 2027 Now 96%

Paul Chodas (Jet Propulsion Laboratory/California Institute of Technology)

2017 Planetary Defense Conference, Tokyo, Japan

EXERCISE ONLY!!

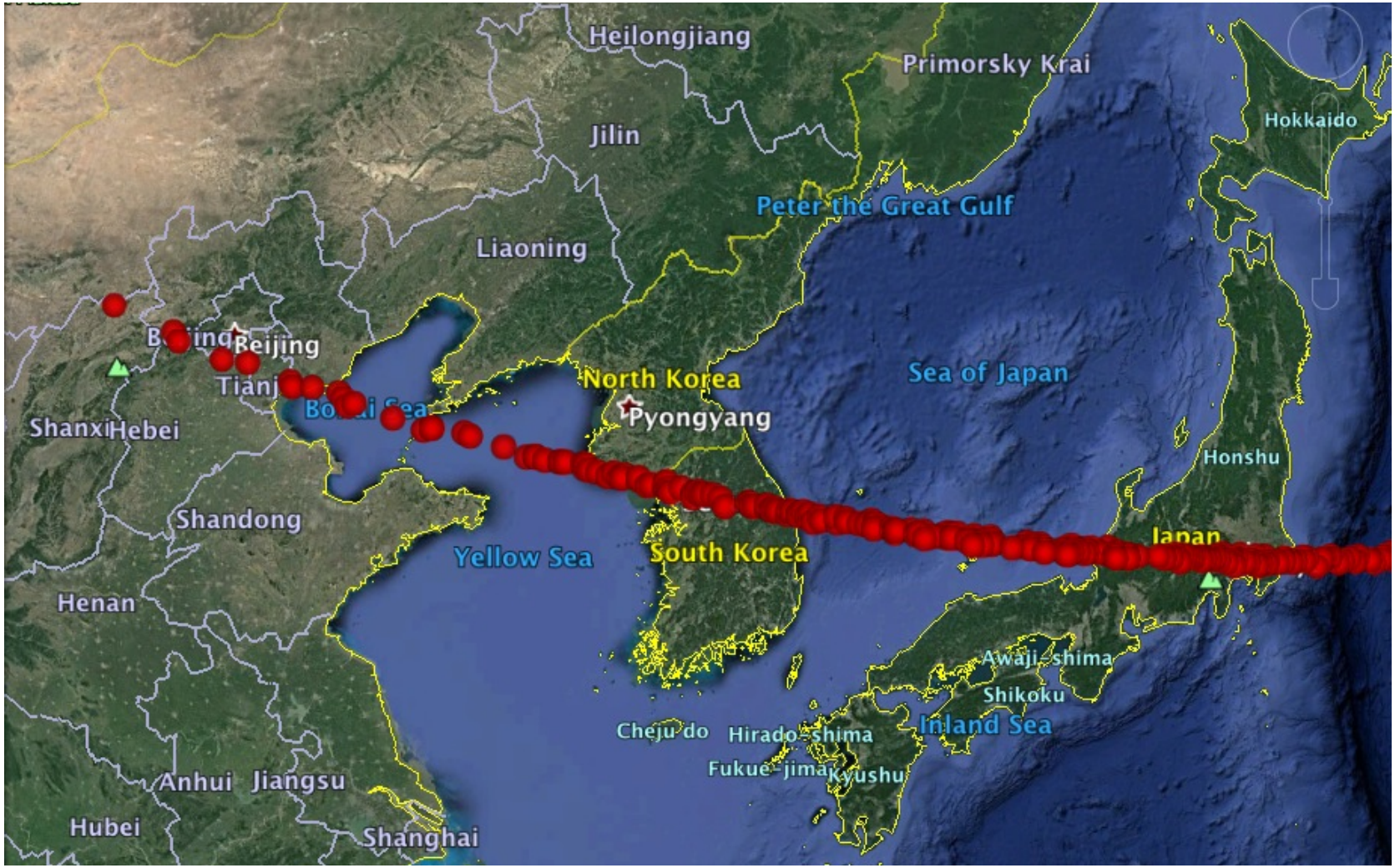
Chance of Impact in 2027 is Now 96%

Jet Propulsion Laboratory
California Institute of Technology

- Based on new tracking observations taken this week, IAWN has confirmed that asteroid 2017 PDC is on a course that almost certainly will impact the Earth on July 21, 2027, less than 9 years from now
- The asteroid brightened just enough to be detected by the NASA's Hubble Space Telescope (HST) and the National Astronomical Observatory of Japan's large 8-meter Subaru Telescope
- The new measurements did not eliminate the possibility of impact, as had been hoped; IAWN now estimates the impact probability at 96%
- Prior to this week the asteroid was unobservable for 11 months, during which time the impact probability was 26%; after this week the asteroid is again too faint to be observed for another 11 months
- The possible impact locations are confined to a region stretching from China, across North and South Korea, Japan, and into the Pacific
- For more info: **https://cneos.jpl.nasa.gov/pd/cs/pdc17/day2.html**

EXERCISE ONLY!!

Possible Impact Locations for 2017 PDC



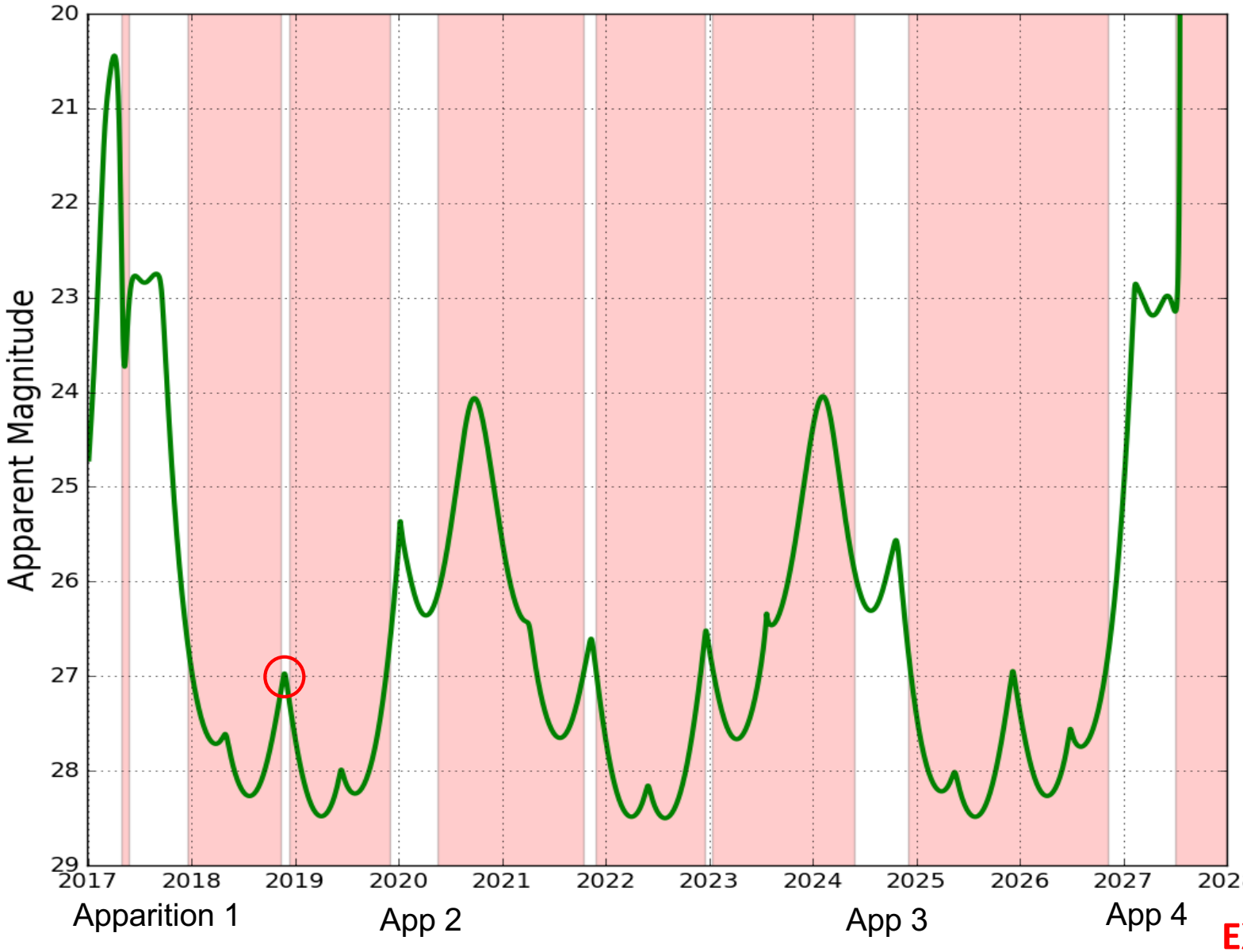
Nations most at risk from the effects of a land impact or airburst:
China, North and South Korea, and Japan

EXERCISE ONLY!!

When Is 2017 PDC Visible from Earth?

Jet Propulsion Laboratory
California Institute of Technology

Not visible during shaded times (AppMag > 26.8 or solar elongation < 45 deg)



Telescope Category:

1 m

2 m

4 m

8 m

HST

EXERCISE ONLY!!

Position of 2017 PDC Relative to Earth and Sun

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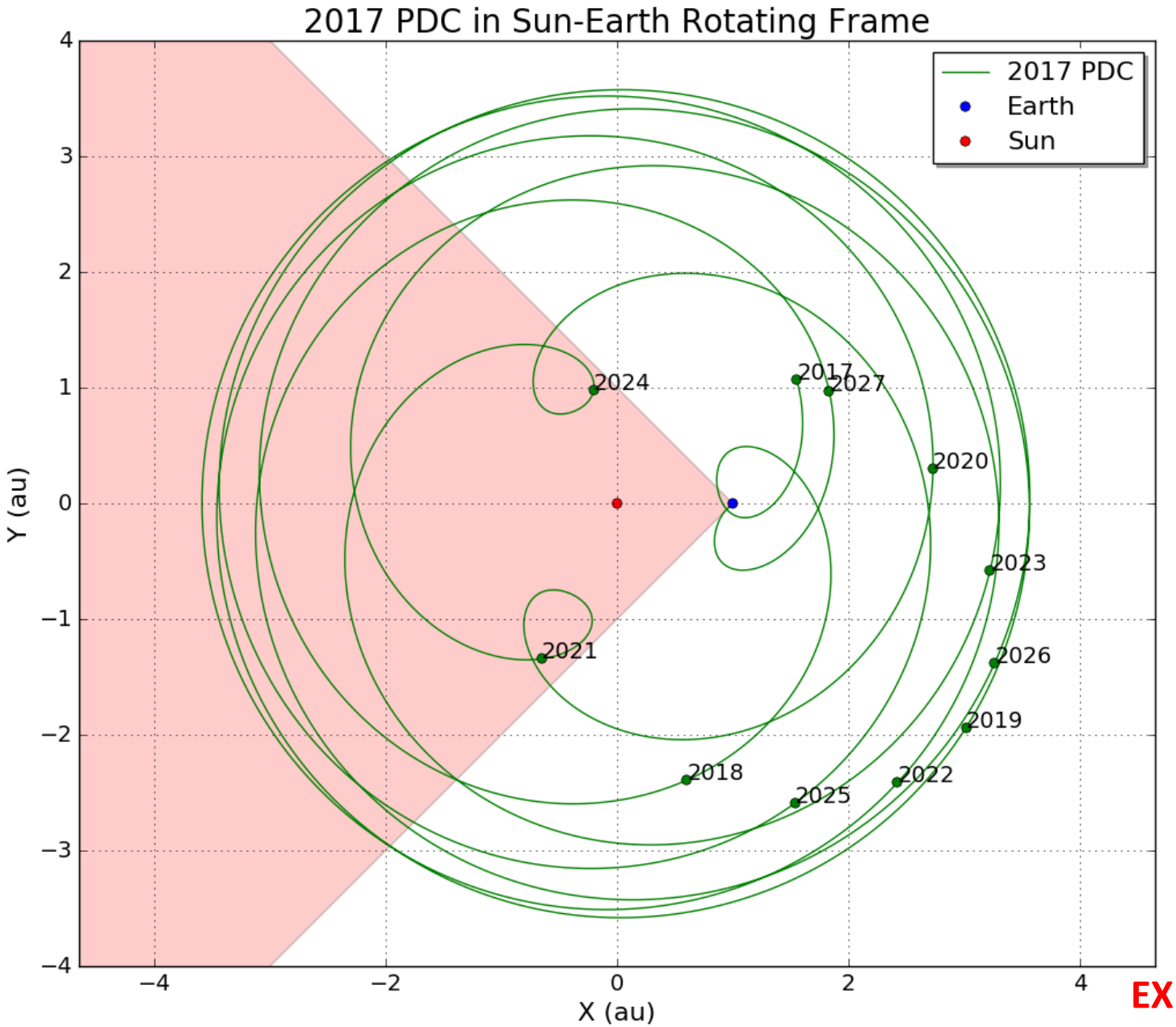
California Institute of Technology



EXERCISE ONLY!!

Update on Physical Properties of 2017 PDC

Jet Propulsion Laboratory
California Institute of Technology

- IAWN updated its size estimate for 2017 PDC based on NEOWISE observations; the new size estimate is 200 to 280 meters
  - Indicates a relatively low albedo of roughly 4% to 8%
- Spectral measurements made in May and June 2017 indicate that 2017 PDC is a C-type asteroid
- Further refinements to the taxonomy will be available soon from the recently launched James Webb Space Telescope (JWST)
- Back in April 2017, radar astronomers had already put an upper bound of 300 meters on the size estimate based on non-detection at 0.13 au
- Photometry and light-curve measurements were also made in April through June 2017, but they were ambiguous and a definitive rotation period was not established; non-priniciple-axis (NPA) rotation is indicated

EXERCISE ONLY!!

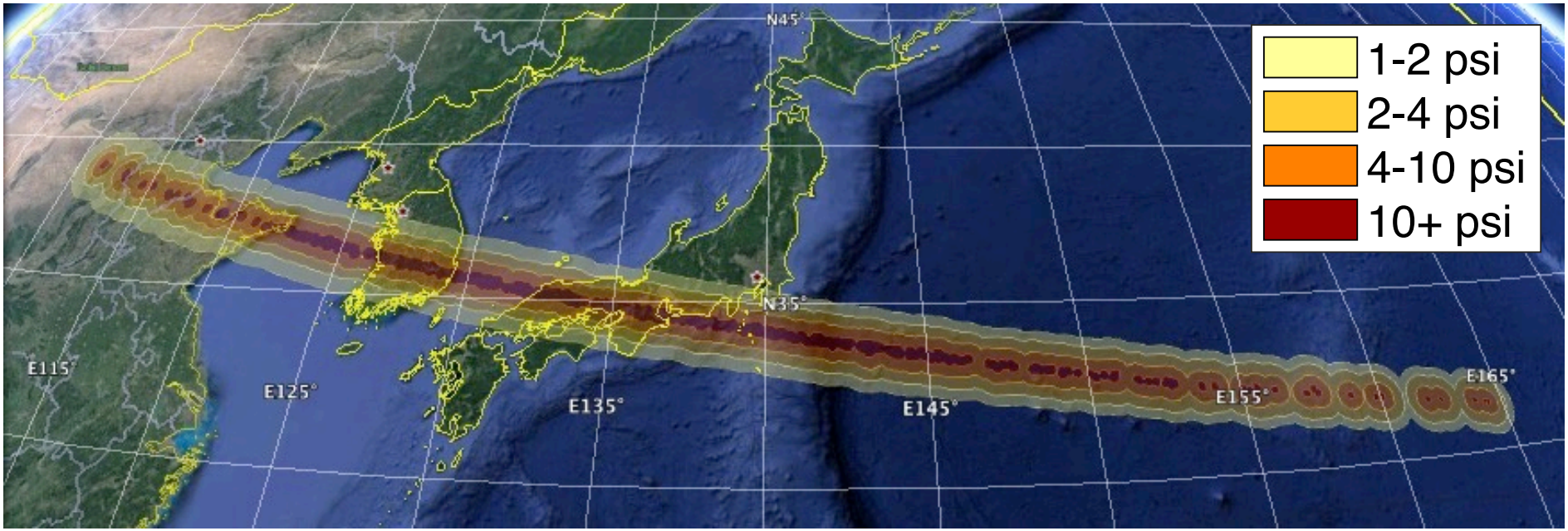
Impact Risk Assessment Summary

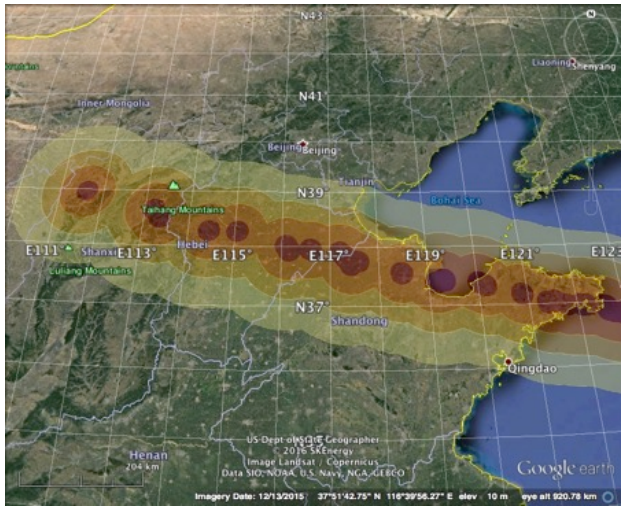
- Simulated 1000 impact cases for each swath point, sampling from uncertainty distributions of size (diameter or H-mag/albedo), density, and strength according to the given knowledge about the asteroid for each inject option.
- Local population affected by blast overpressure and/or tsunami is computed for each sampled impact case.
  - For blast overpressure, different fractions of the population are counted as affected depending on the blast overpressure level: 10% of people within the 1-2 psi zone, 30% within the 2-4 psi zone, 60% within the 4-10 psi zone, and 100% within the 10+ psi zone.
  - For tsunami, fractions of the inundated population are counted as casualties depending on flood depth (averaging to about 10% of the inundated population).
  - The maximum affected population from blast or tsunami is taken as the affected population for each sampled impact case.

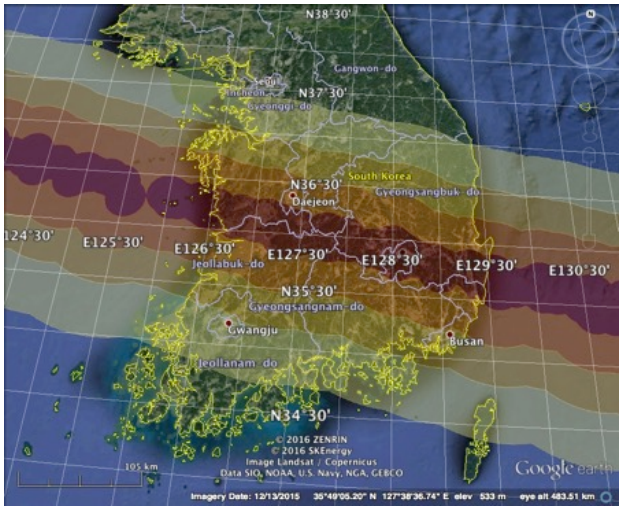
Result Plot Summary

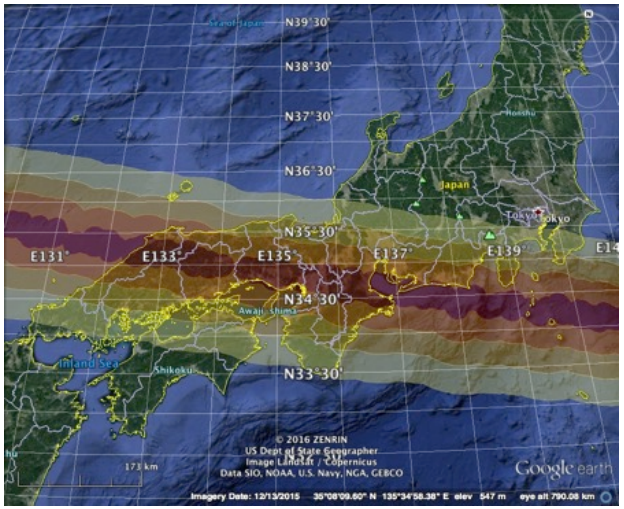
- Blast Damage Zone Plots
  - Google Earth plots showing blast overpressure zones along the swath (1-2 psi, 2-4 psi, 4-10 psi, and 10+ psi).
- Mean Affected Population Plots
  - Color map of mean affected population for each swath point.
  - Points are plotted at the mean impact coordinates for each swath point (which varies for each realization depending on where it bursts along the trajectory).
  - Points are sized by the mean 1-psi damage area.
  - For small/tight footprints, also included an alternate version of this plot that small points (rather than sizing them to the 1-psi region).
- Damage Level Probabilities
  - Histograms showing the probability of various damage levels.

Blast Damage Zones



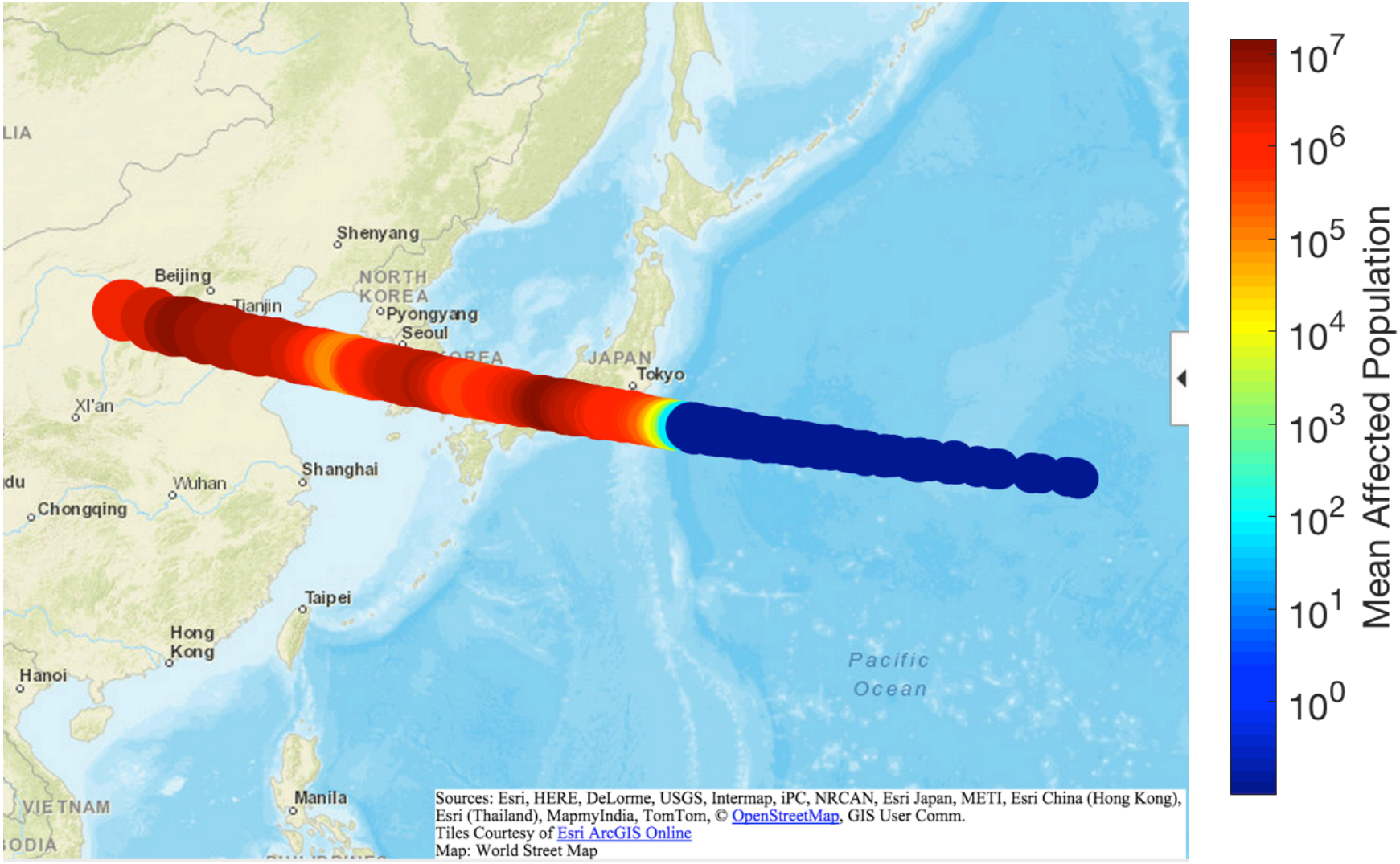






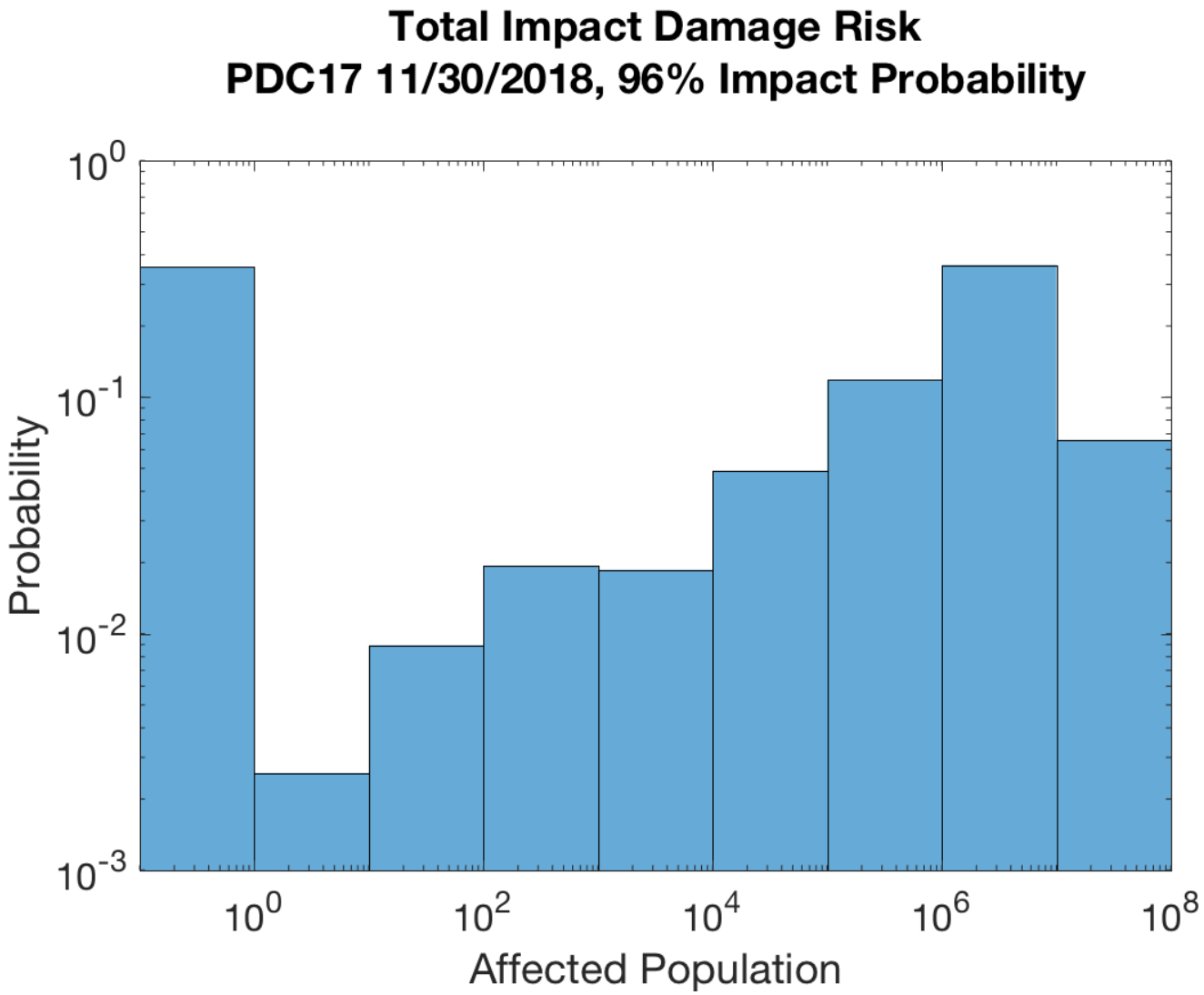
EXERCISE ONLY!!

Mean Affected Population



EXERCISE ONLY!!

Damage Level Probabilities



EXERCISE ONLY!!

Space Mission Plans

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California Institute of Technology

- Over the last 18 months, the Space Missions Planning Advisory Group (SMPAG) has been very active in advising for and coordinating an international program of space missions to 2017 PDC
- Several types of space missions are under development:
  - Early fast flyby characterization: launch in Oct. 2019, flyby May 2020
  - Rendezvous characterization and observer spacecraft: launch in June 2020, arrival in May 2023 (2 spacecraft)
  - Kinetic Impactor Eastwards (KI-E): launch in March 2020, deflection Feb. 2024 (6 spacecraft)
  - Kinetic Impactor Westwards (KI-W): launch in July 2023, deflection Feb. 2024 (6 spacecraft)

EXERCISE ONLY!!

CNEOS NEO Deflection App (NDA)

https://cneos.jpl.nasa.gov/nda/nda.html

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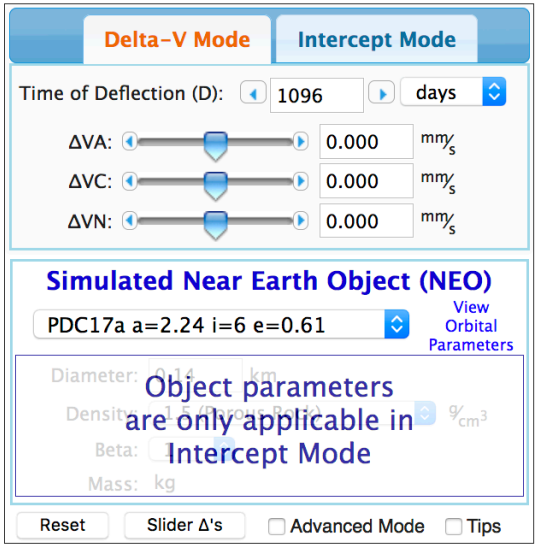
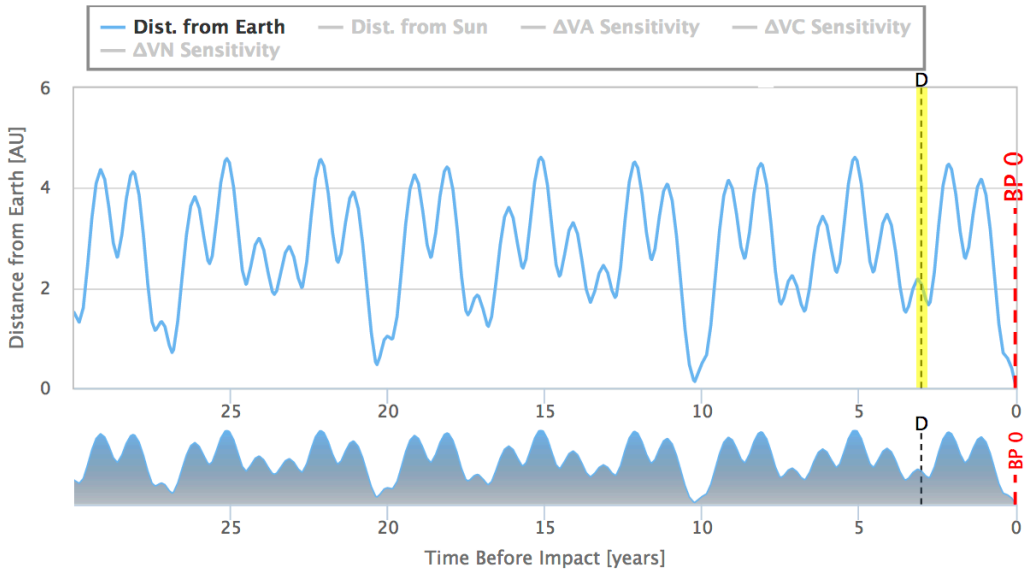
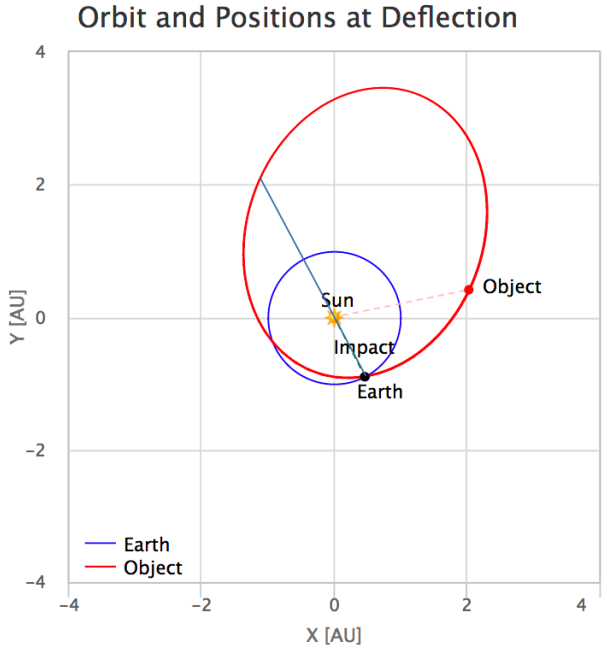




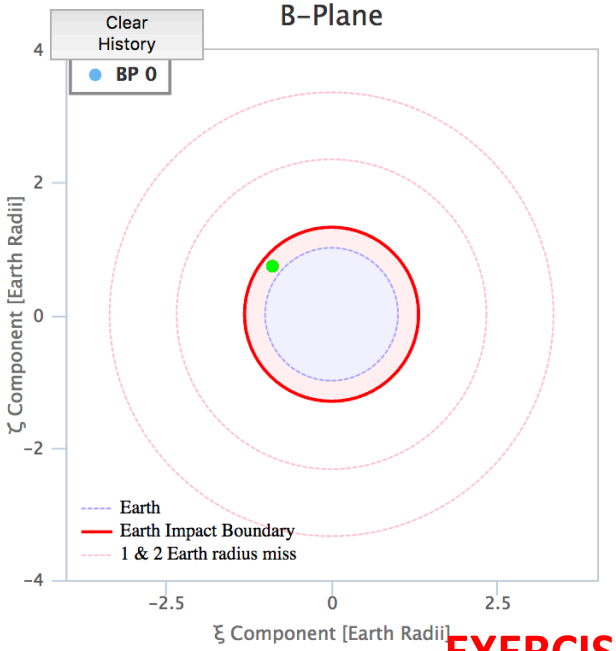


Orbit Changes
ΔVA: 0.000 mm/s
ΔVC: 0.000 mm/s
ΔVN: 0.000 mm/s
Total ΔV: 0.000 mm/s
Period at D: 1225.064 d
Δ Period: 0.0000 s

B-Plane Values
ζ (zeta): 0.737 R_e
ξ (xi): −0.880 R_e
B magnitude: 1.148 R_e
Capture Rad.: 1.310 R_e
Perigee Dist.: 0.845 R_e
IMPACT
V_∞: 13.212 km/s

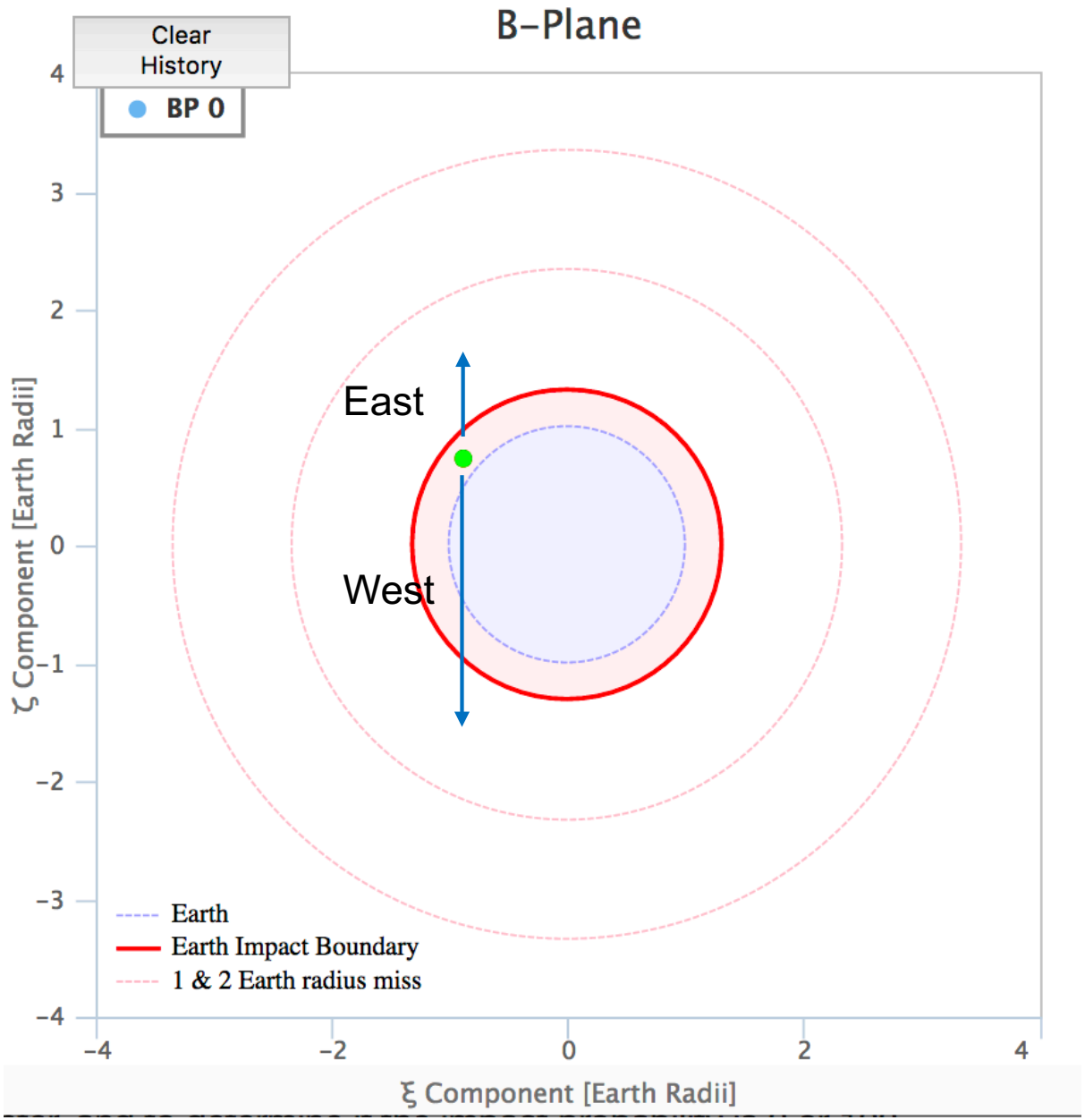
* R_e = Earth Radii

Save Current Session
Restore Session
Deflection Map



EXERCISE ONLY!!

Updated 2017 PDC Trajectory in B-Plane



EXERCISE ONLY!!

2017 PDC: B-Plane in NDA

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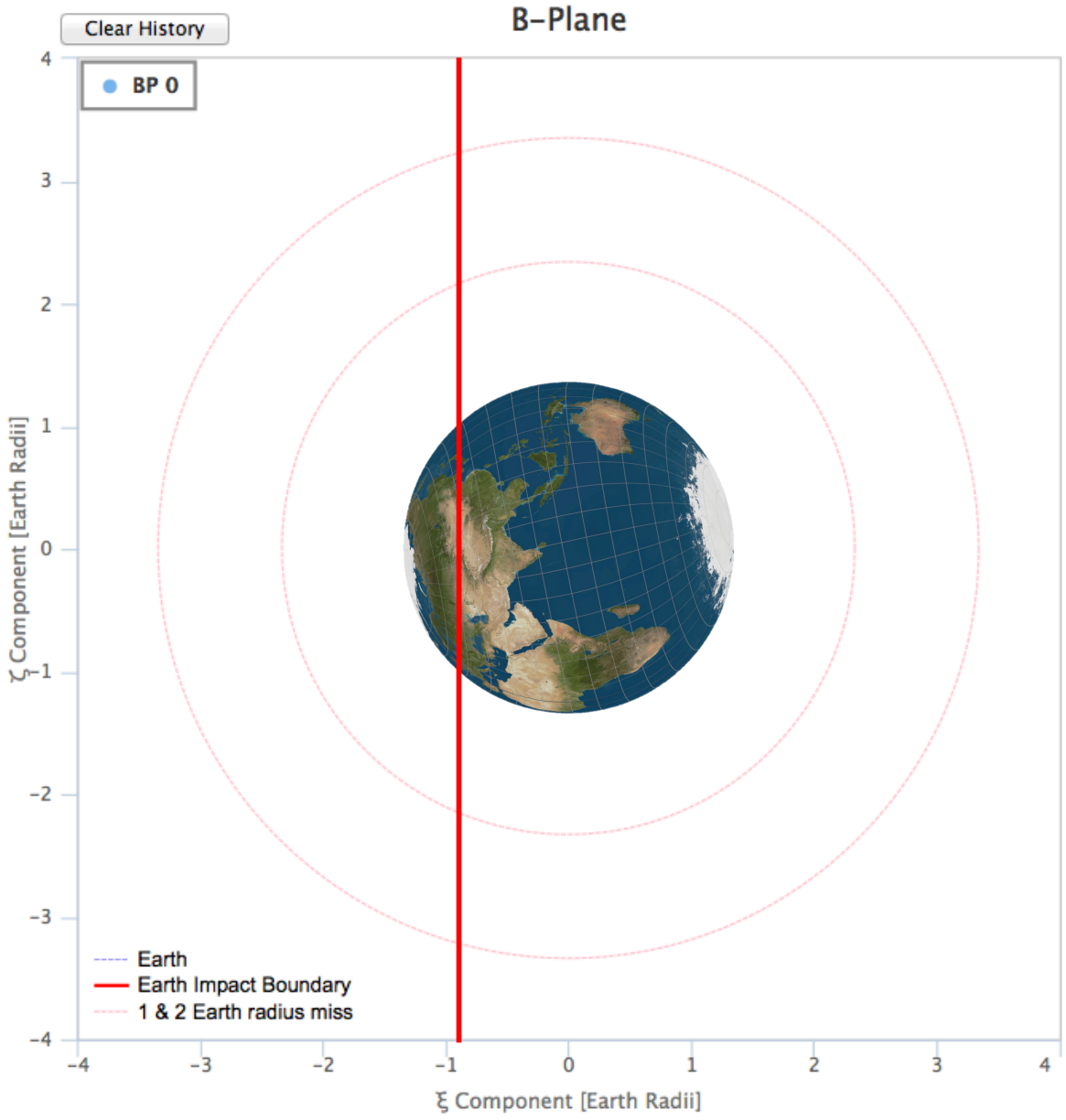
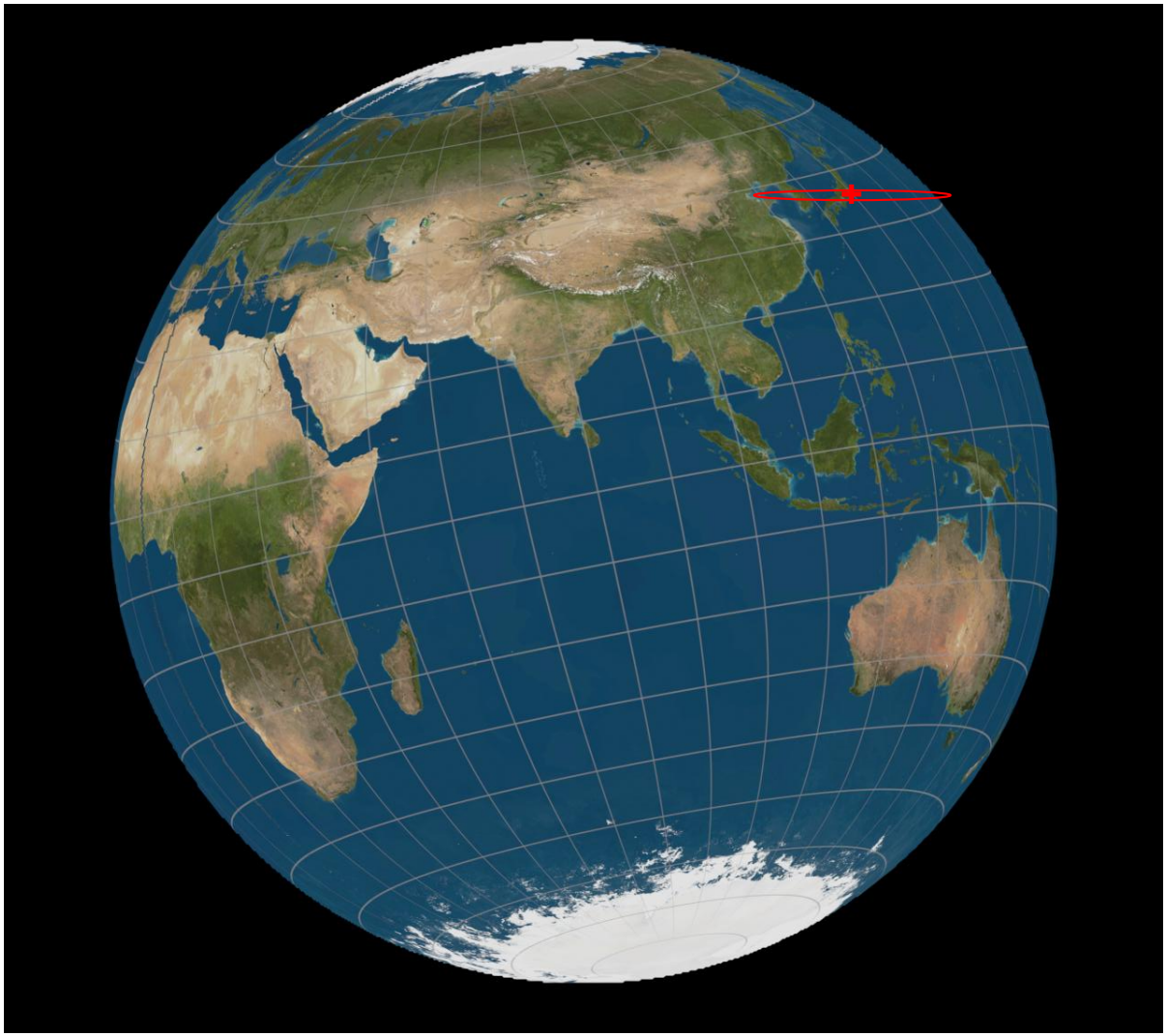


EXERCISE ONLY!!

Impact Footprint in the B-Plane

Chord length in b-plane: 12,330 km



Easier direction for Kinetic Impactors

Difficult direction for Kinetic Impactors

EXERCISE ONLY!!

Required vs. Achievable Deflection

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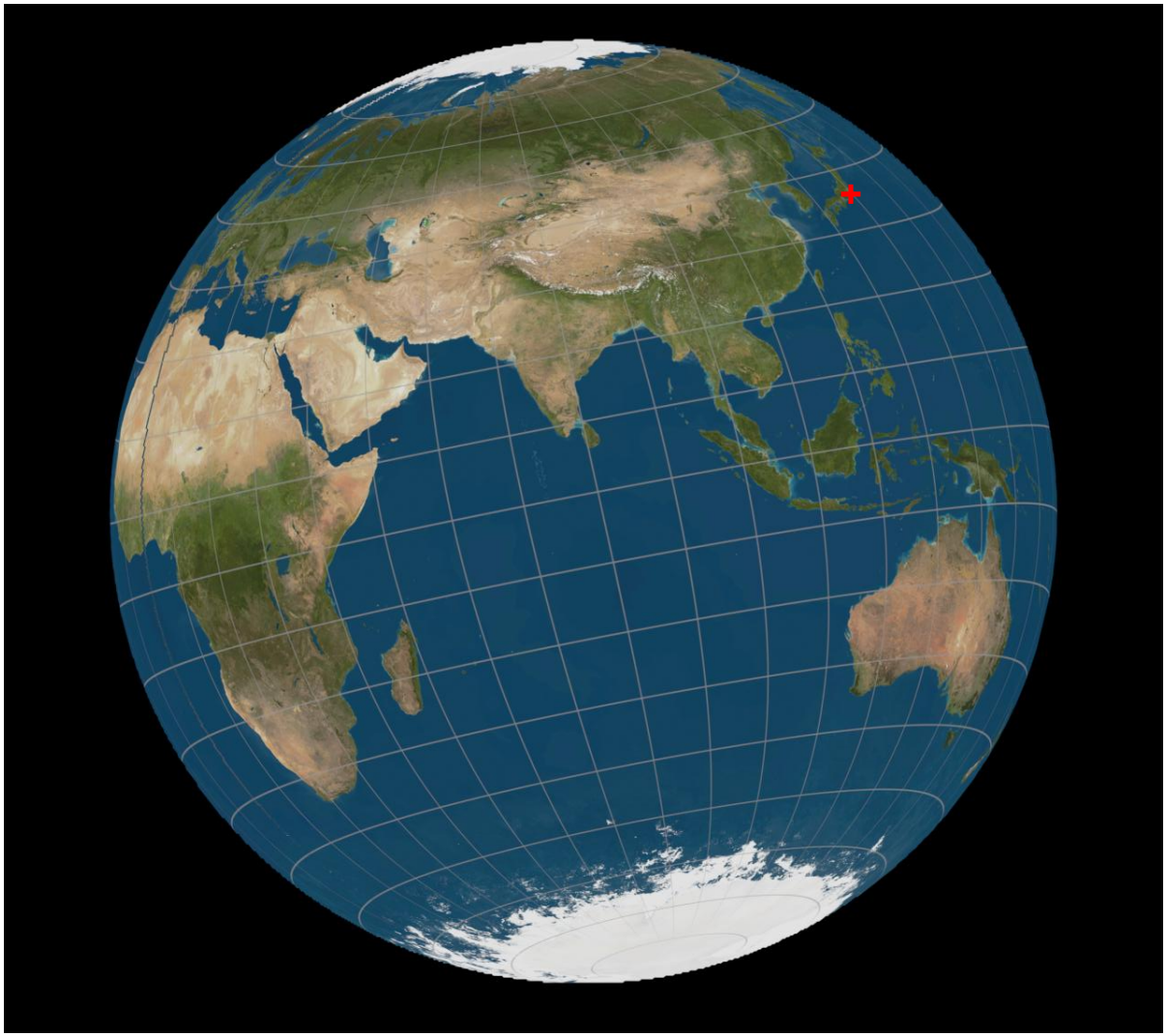
3700 km ←
→ 460 km



Delta-IVH,
Diameter: 270 m,
ρ = 1.5 g/cc, β=1

Deflect:
West: 2024-Jan-23
East: 2024-Feb-24

EXERCISE ONLY!!

Trajectory for Early Flyby Mission

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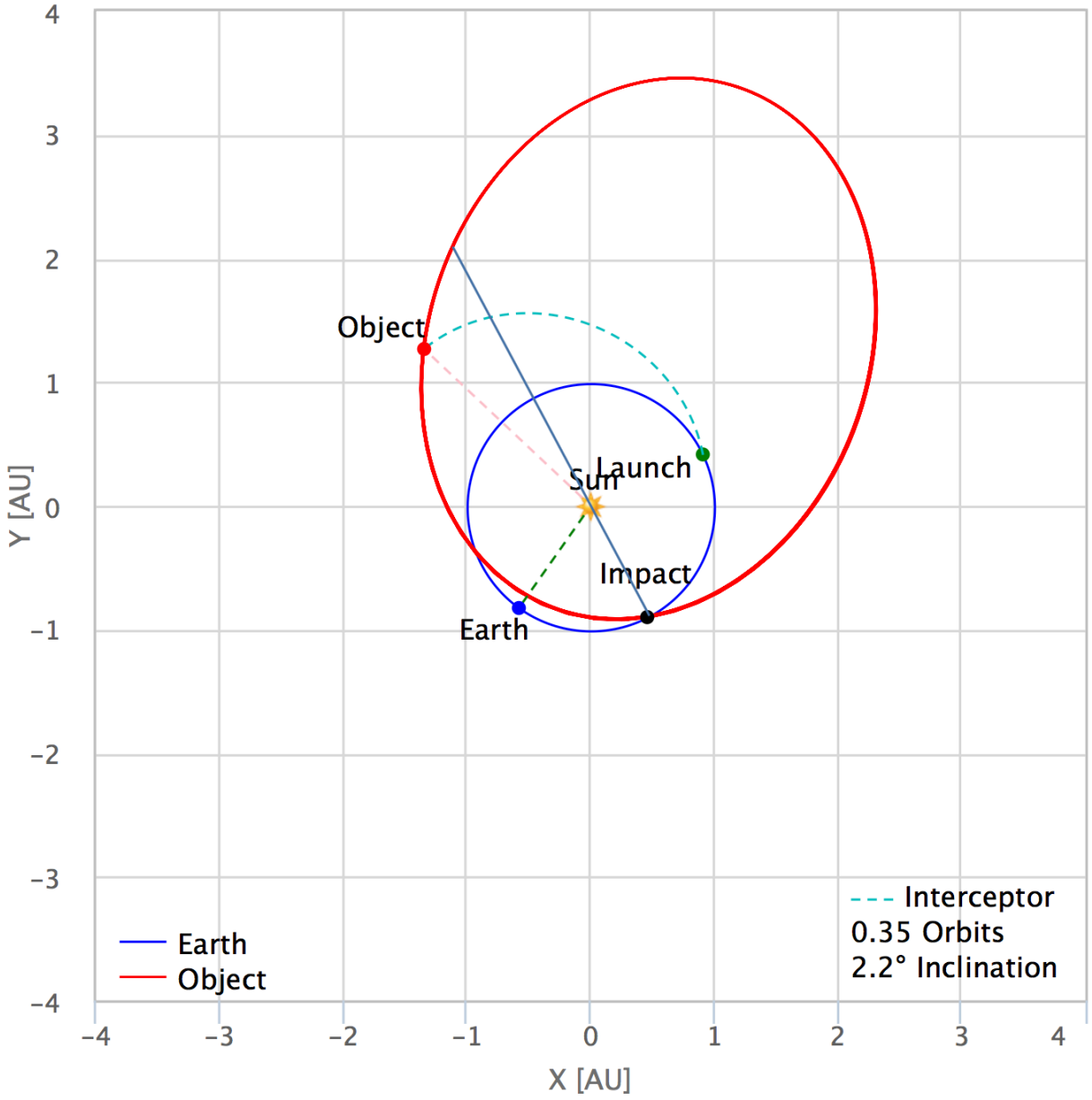
California Institute of Technology

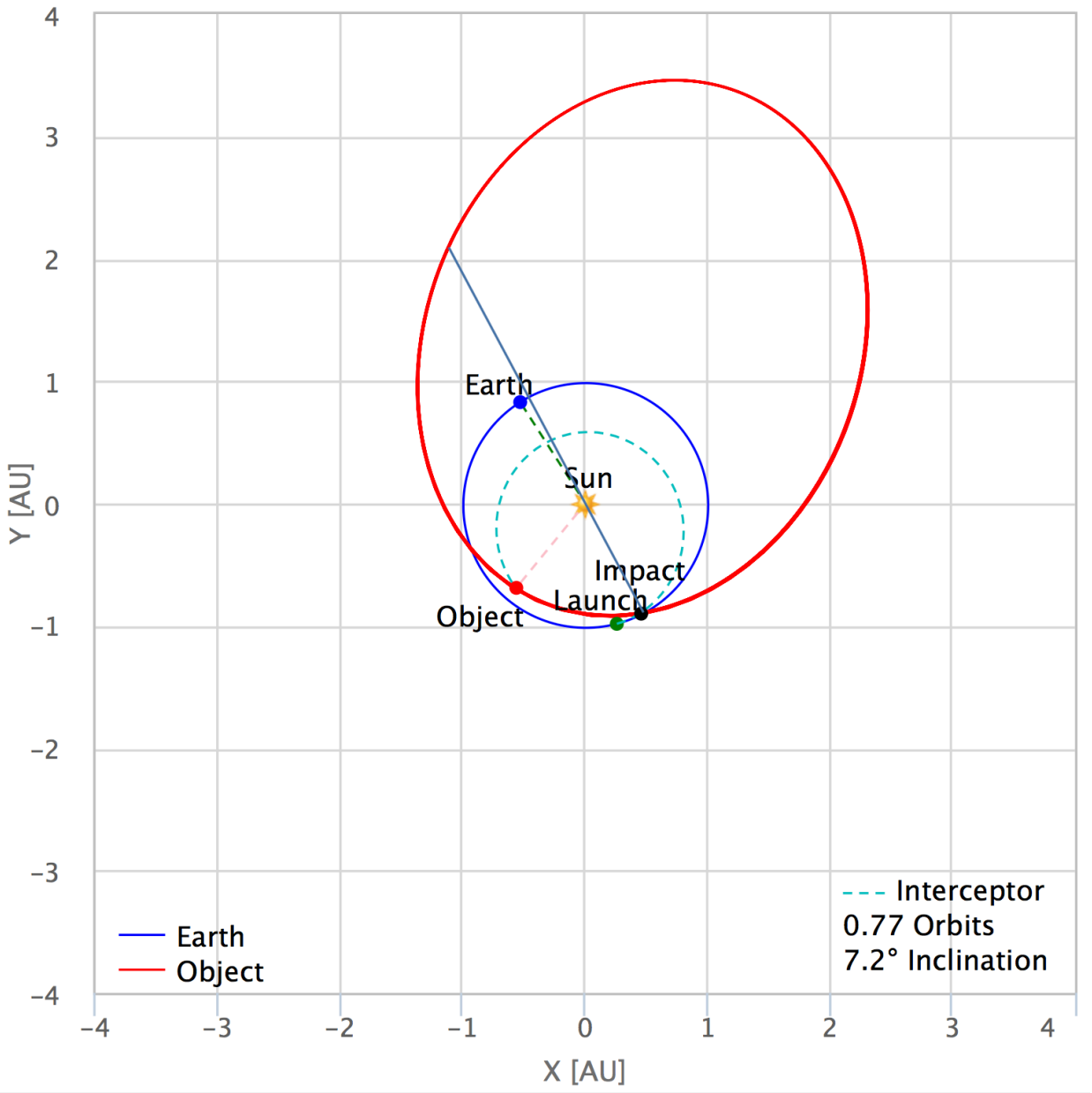


Launch: Oct. 18, 2019

Arrive: May 15, 2020

EXERCISE ONLY!!

Trajectory for KI-Westwards Mission

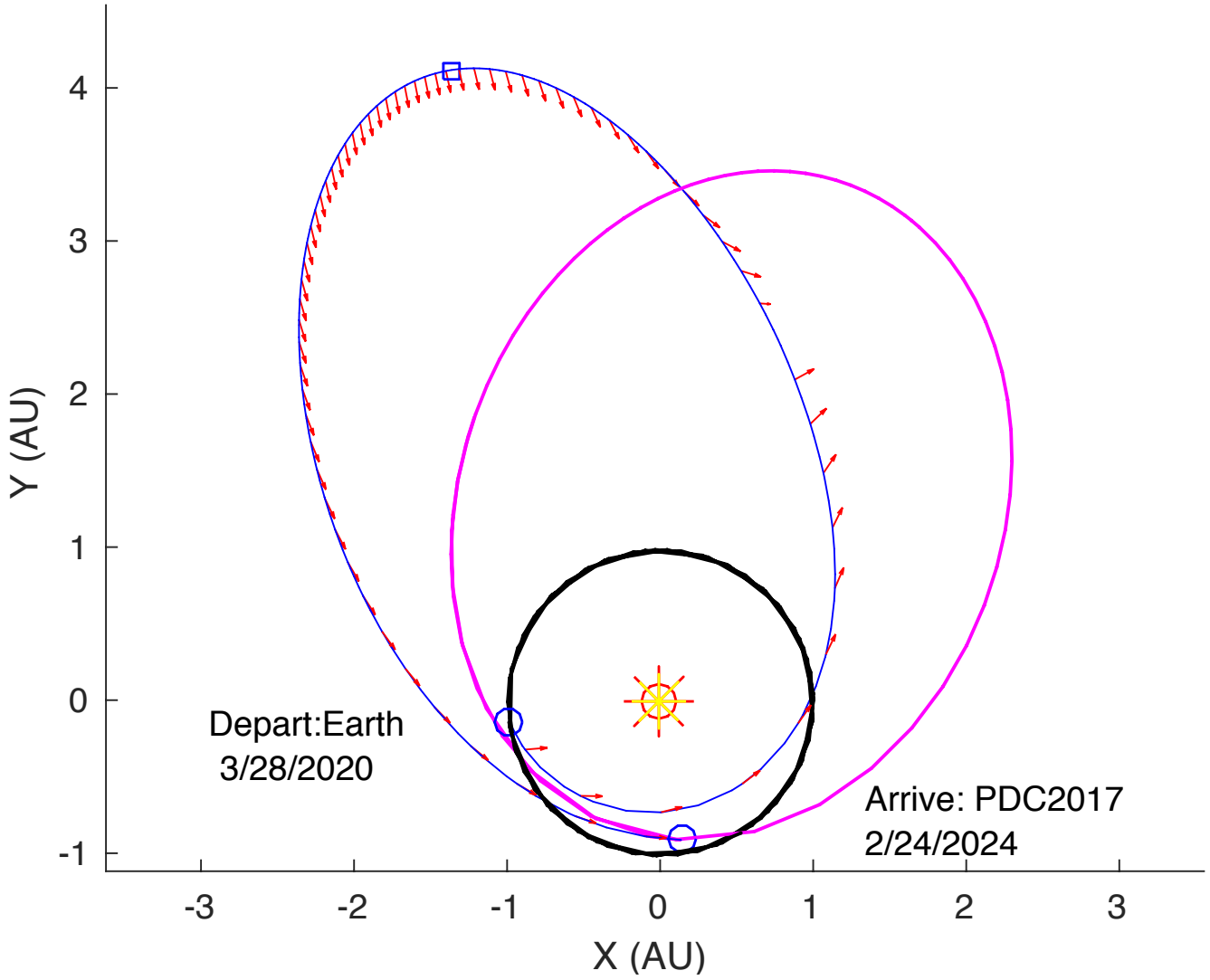


Launch: July 7, 2023

Deflect: Jan. 23, 2024

EXERCISE ONLY!!

Trajectory for KI-Eastwards Mission

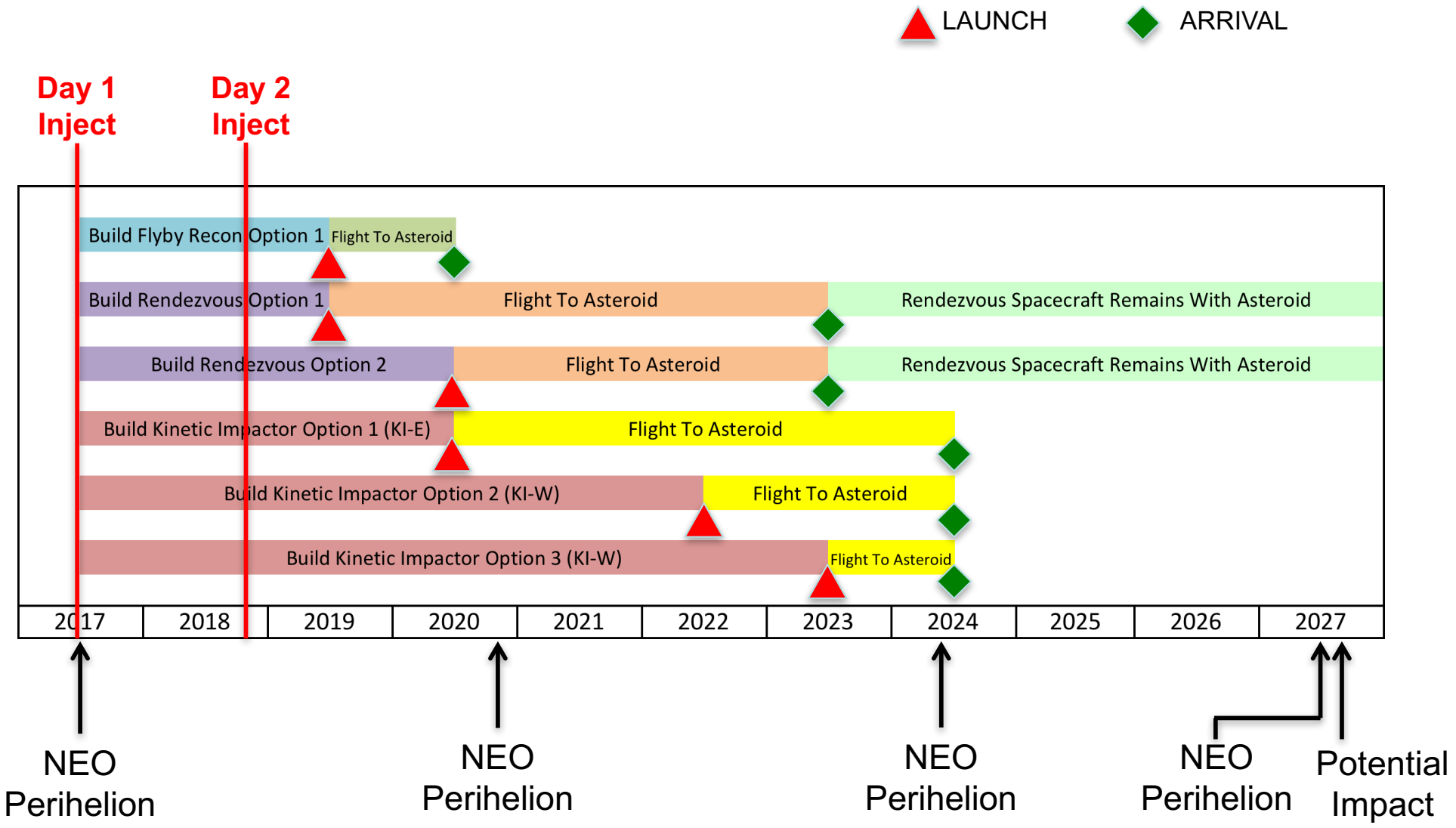


Launch: Mar. 28, 2020

Deflect: Feb. 24, 2024

EXERCISE ONLY!!

Summary of Key Dates



Courtesy of Brent Barbee (NASA/GSFC)