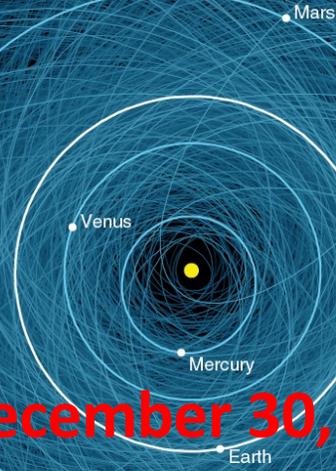


EXERCISE ONLY!!



Impact Exercise, Day 3: December 30, 2021

**Closeup Images Reveal Asteroid 2019 PDC Headed for
Denver Area: Efforts to Prevent Impact Accelerate**

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

2019 Planetary Defense Conference, College Park, Maryland, May 1, 2019

EXERCISE ONLY!!



EXERCISE

Deflection Campaign for 2019 PDC



- The Space Mission Planning and Advisory Group has coordinated an extensive deflection campaign involving multiple space agencies
- A suite of spacecraft of various designs have been under development for the last 2+ years; the updated deflection campaign consists of:
 - 6 Kinetic Impactor (KI) missions to be launched by various space agencies 16 months from now, some launches carrying multiple individual impactors
 - a rendezvous recon spacecraft scheduled to be launched in a few months that is designed to be capable of carrying nuclear explosive devices
 - a previously launched interplanetary science spacecraft is being re-tasked to visit the asteroid, to provide a second rendezvous recon spacecraft
- The KI spacecraft will use intercept trajectories that will move the asteroid's impact point eastwards; the westwards KI missions were not selected as an option due to schedule constraints and ineffectiveness
- The nuclear deflection option has many political and legal implications and faces controversy both nationally and internationally

EXERCISE ONLY!!



EXERCISE

Significant Deflection Uncertainties Remain



- The projected impact location is now well known, both geographically and in the b-plane, and so is the *required* deflection displacement in the b-plane: about 12,100 km
- The total delta-V that the KI missions must impart for a successful eastwards deflection on Aug. 30, 2024 is determined: 4.5 cm/s
- Since the asteroid's mass and β parameter are still uncertain, the amount of delta-V that each KI mission can achieve is uncertain
- Uncertainty in mass leads to uncertainty in escape velocity, and thus, uncertainty in how the asteroid will respond to the kinetic impactors
 - Will each KI delta-V exceed 10% of the asteroid's escape velocity?
- When the rendezvous recon mission arrives at 2019 PDC, its mass will become well determined, but the suite of deflection missions must have already launched by that time

EXERCISE ONLY!!



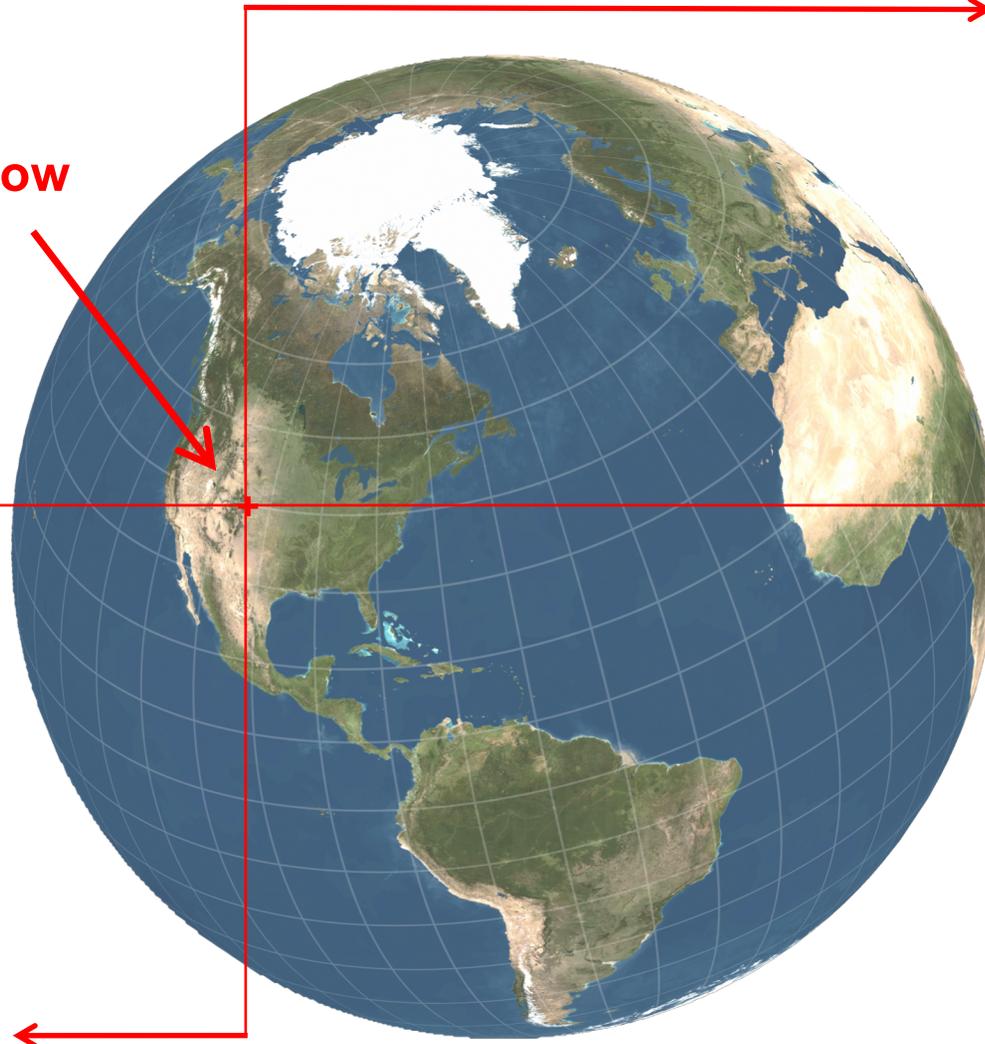
EXERCISE

Kinetic Impactor Deflection of 2019 PDC



Required deflection Eastwards: 12,100 km

Potential impact location now known



Deflection that can be expected from each KI mission is uncertain due to uncertainty in mass and β

Deflection that can be expected from each NED mission is uncertain due to uncertainty in mass and nuclear β

Required deflection Westwards: 3,800 km

EXERCISE ONLY!!