Preliminary 2017 PDC Mission Design Considerations

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NEO Size Uncertainty

- H = 21.9 ± 0.4 (1σ)
- Albedo is unknown
  - Could, in principle, range from 0.03 to 0.6
- Minimum size: H = 22.3 and albedo = 0.6
  - **59 m**
- Maximum size: H = 21.5 and albedo = 0.03
  - **385 m**
- Mean size:
  - **221.5 m**
- Reasonable assumed size range: **100—300 m**
- **Factor of ~30 uncertainty in mass**

This will strongly affect the size of the deflection campaign needed to deal with the NEO

Unintentional NEO Disruption

- Simulation results (LLNL) indicate that the risk of weak disruption of an NEO increases as the imparted Δv rises above ~10% of the NEO's surface escape velocity
  - We need to better understand how much Δv an NEO can tolerate, given the NEO's properties, scenario circumstances, etc
- Weak NEO disruption is undesirable, as sizeable NEO fragments may continue on an Earth collision course
- In some cases, the Δv necessary to deflect an NEO may exceed the Δv that the NEO can tolerate
  - Robust disruption/dispersal (high particle velocity, low particle size) is preferred if deflection cannot be done without unacceptable weak disruption risk
- Weak disruption of the NEO may be avoided by a sequence of smaller Δv applications via multiple spacecraft

If so, this means that deflecting smaller NEOs (with lower escape velocity) may still require multiple kinetic impactors, as is often the case for larger NEOs

Example NEO Escape Velocities

- **Diameter = 112 m**, Mass = 1.4712×10^9 kg
  - V_{esc} = 5.92 cm/s, **10% V_{esc} = 0.59 cm/s**
- **Diameter = 259 m**, Mass = 1.3645×10^{10} kg
  - V_{esc} = 11.86 cm/s, **10% V_{esc} = 1.18 cm/s**
- **Diameter = 350 m**, Mass = 2.9184×10^{10} kg
  - V_{esc} = 14.91 cm/s, **10% V_{esc} = 1.49 cm/s**
- **Diameter = 385 m**, Mass = 7.7688×10^{10} kg
  - V_{esc} = 23.21 cm/s, **10% V_{esc} = 2.32 cm/s**

Flyby Characterization

- 2017 PDC's orbit makes rendezvous very difficult
  - The required flight time for efficient rendezvous is long, but the time to act is short
- More opportunities exist for missions to fly by the object (with various flyby relative speeds)

What are the capabilities & limitations of flyby missions for characterization (at high relative speeds) of a ~several hundred meter object?

Summary of Key Dates