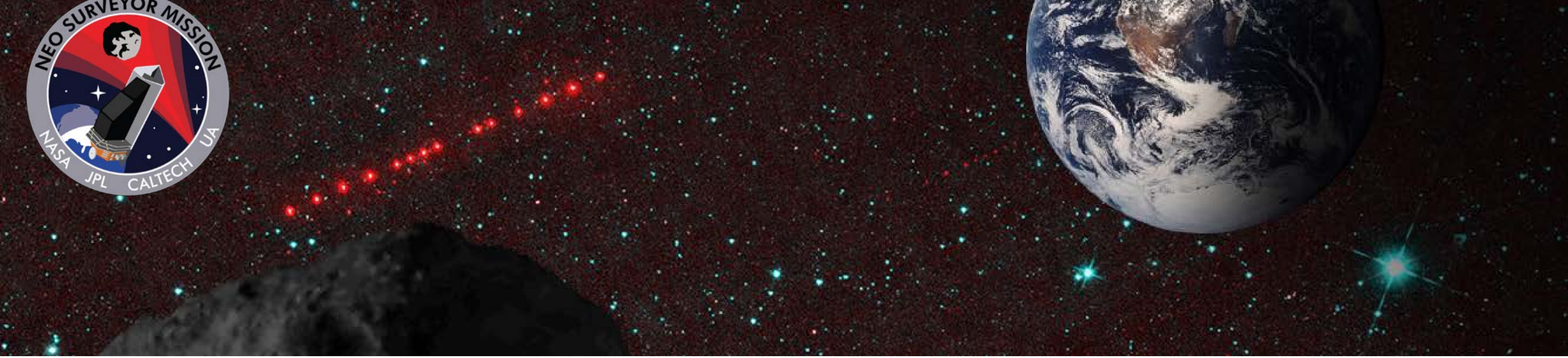


Near-Earth Object Surveyor and Planetary Defense

Prof. Amy Mainzer, Survey Director

NEOs: The Critical Questions

- **Need to know when impacts could occur and how bad they will be**
  - When: Comes from finding objects & determining good orbits for them
  - How bad: Comes from measuring the impact energy (KE)

- **Impact energy scales as KE = 1⁄2 mass x velocity^2**
  - Velocity comes from orbit
  - Mass = density x volume = density x diameter^3
    - → Impact energy depends strongly on diameter (size)

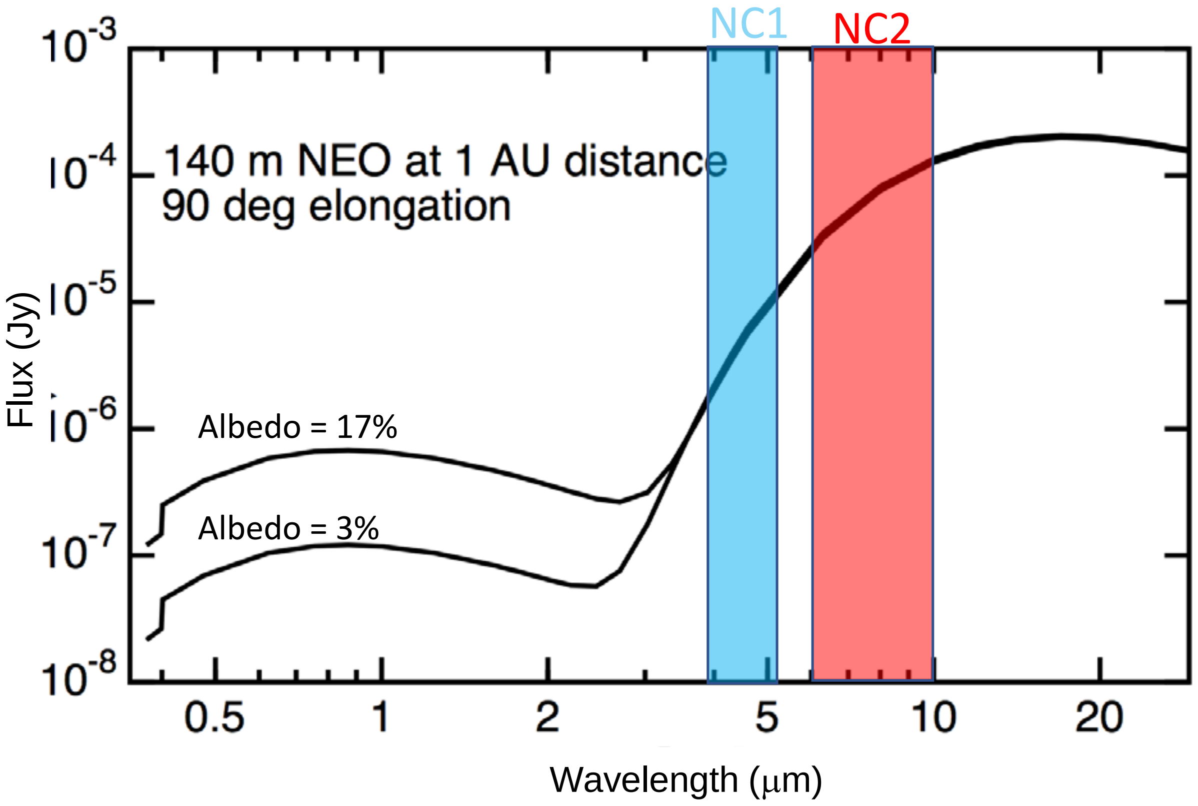
The Future of Planetary Defense

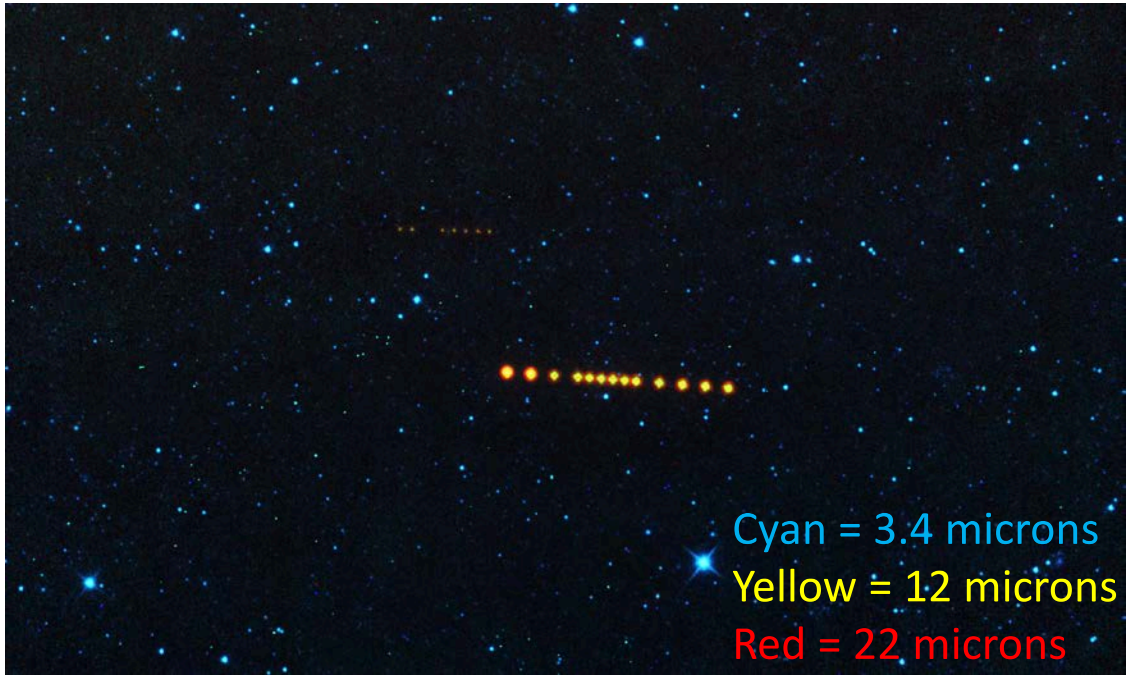
- **Present events demonstrate that rare disasters can sometimes happen**
  - A modest effort to be prepared can significantly improve outcomes
- **We can provide best chance of mitigating an asteroid or comet impact if we know about it well in advance: ideally years to decades**
- **Surveys that combine great sensitivity with large field of view offer best chance of comprehensive coverage**
  - Planetary defense is a “team sport”: experience has shown it takes multiple facilities with complementary capabilities to provide thorough coverage
  - Ideally want basic physical property measurements for large numbers of objects to quickly quantify any potential hazard
  - NEOs can become unobservable for long periods of time, and are often brightest at the discovery apparition

Priorities for Planetary Defense

- **Finish survey of 100m+ NEAs & calculate basic physical properties for them (diameter, albedo, spin state, thermal inertia)**
  - Evaluate future survey strategies based on population statistics found in the course of performing this survey
  - Follow up targets of concern: radar, spectroscopy, dense lightcurves, etc.
- **Provide an all-sky monitoring capability for comets**
- **Strengthen and expand international collaborations**
- **Ensure robust lab/modeling capabilities for predicting impact effects**
- **Demonstrate reconnaissance missions for rapid in situ characterization of NEAs/comets**
- **Demonstrate additional mitigation technologies e.g. gravity tractor**

Asteroid Spectral Energy Distributions Peak in the Infrared

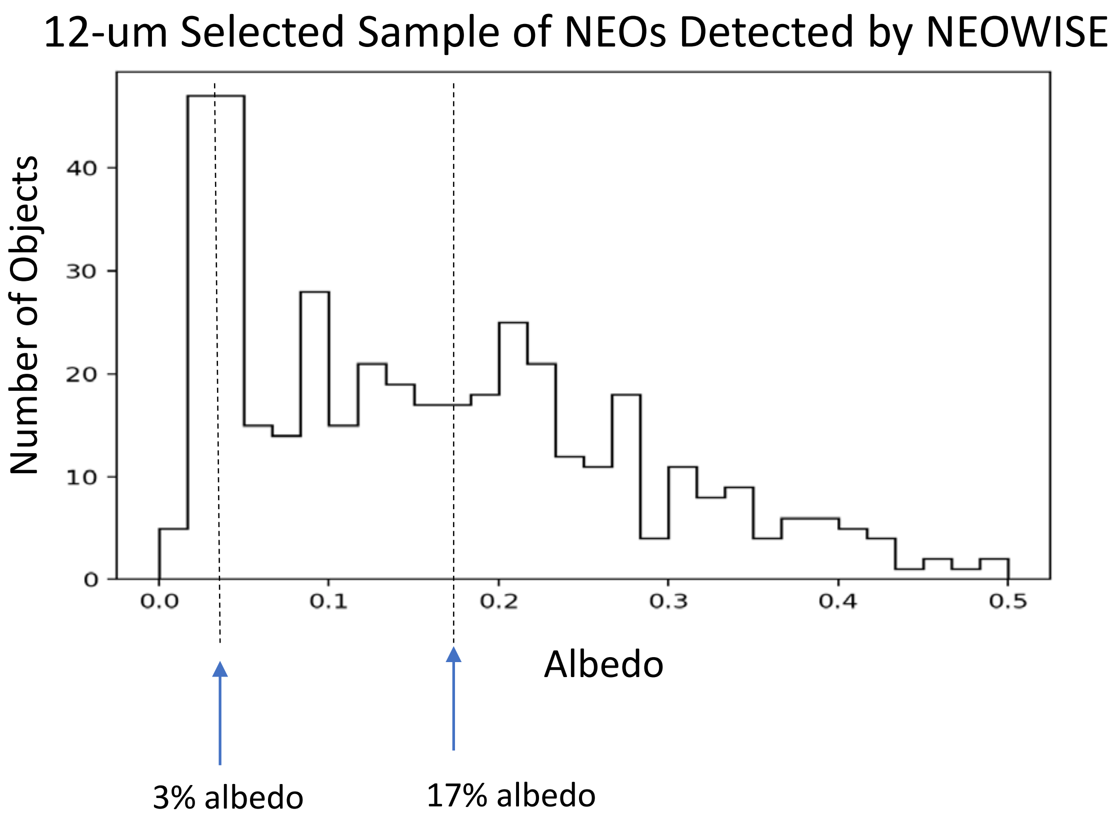




NEO Albedo Distribution

- **There is an important population of very dark NEOs (3% albedo), and a population of less dark ones (17% albedo)**

- **Visible surveys can find bright NEOs, but struggle to find dark ones.**
  - Finding >90% of NEOs >140m requires reaching 90% completeness at H<23 mag (Wright et al. 2016)



Mission Summary:
NEO Surveyor Is a Planetary Defense Mission

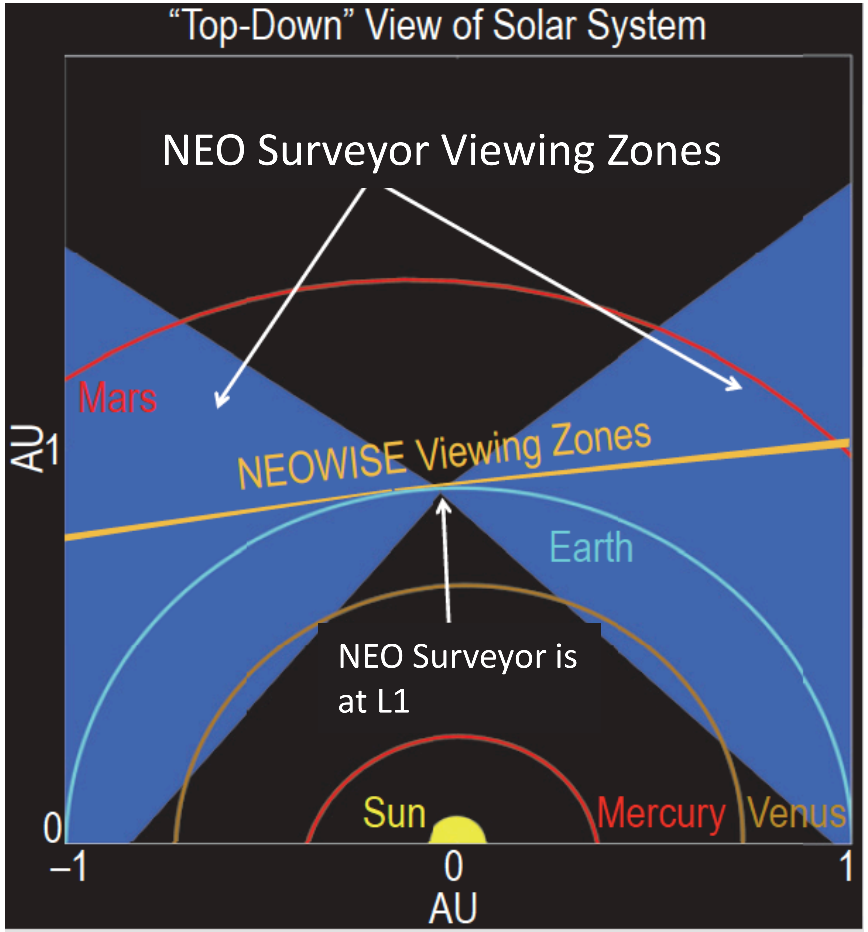
- **NEO Surveyor is designed to respond to the objectives of NASA's Planetary Defense Coordination Office by detecting, cataloging, and characterizing NEOs**
- **Mission is optimized for the task of finding and characterizing the impact risks posed by potentially hazardous objects (PHOs), both as individual objects and as populations – quantifies the risk**
- **NEO Surveyor provides critical decision support for stakeholders who must assess the risks of NEO impacts to Earth and must identify potential mitigation strategies**

Mission Objectives – Introduction

- **Mission objectives break into groups:**
  - Finding potentially hazardous asteroids (PHAs) and comets
    - PHA = asteroid with orbit that comes within 0.05 AU of Earth's orbit
  - Informing us about the nature of NEOs, including their subpopulations and related source regions
  - Providing the capability for detailed follow-up of individual objects with unusually high impact risks

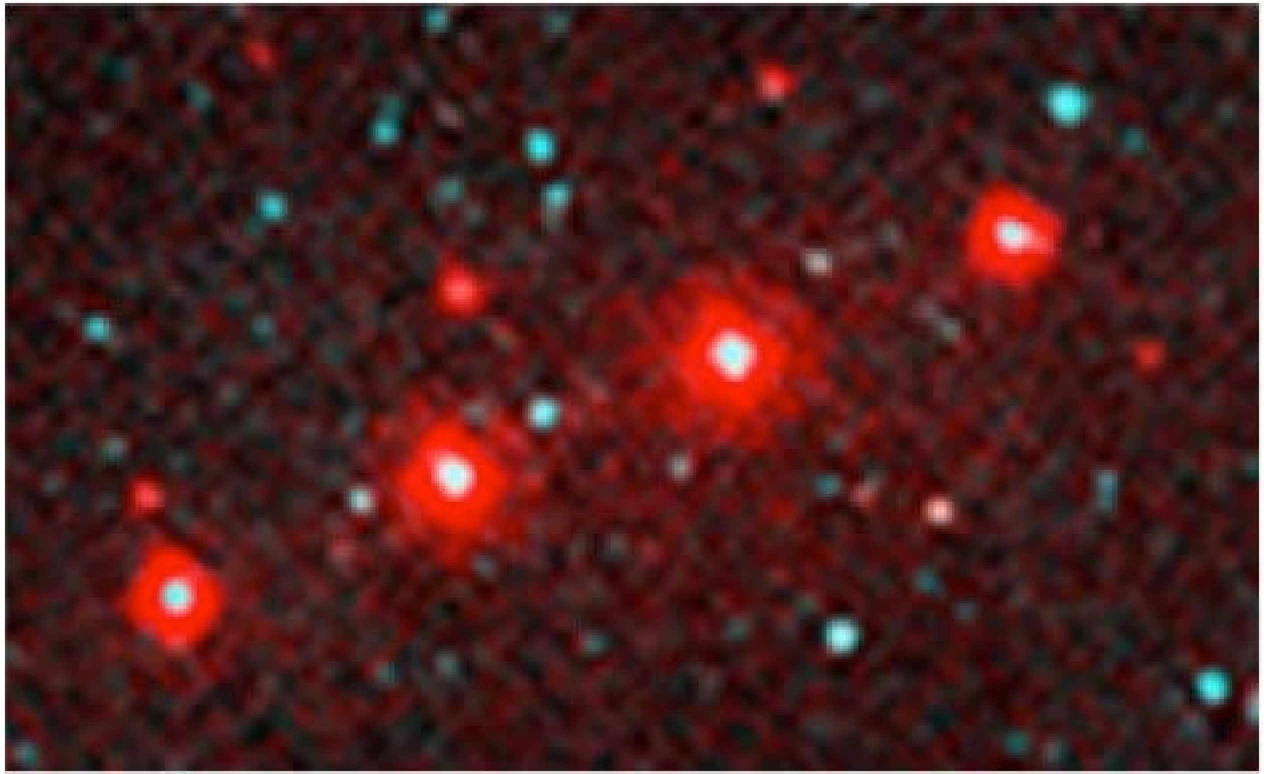
NEO Surveyor Is Optimized for NEOs

- The single instrument consists of a 50-cm infrared (IR) telescope that collects images simultaneously at 4-5 and 6-10 µm
- It surveys a large fraction of the entire sky, focusing on the regions where PHAs spend most of their time
- Spacecraft is stationed at Sun-Earth L1 Lagrange point: nominal 5-year lifetime allows for discovery of large fraction of PHAs >140 m (goal: 12-year lifetime)



Mission Design

- L1 is close enough to Earth to allow f full images to be downlinked and searched using optimal algorithms
- Single instrument
- Yet far enough from Earth to support passive cooling, thus avoiding costly complex cryocoolers and life-limiting cryostats
- Survey pattern is fixed, highly repeatable, and optimized for potentially hazardous asteroid and comet discovery: single operating m



Asteroid detections from NEOWISE

• **NEOs >140m only**