

National Aeronautics and Space Administration

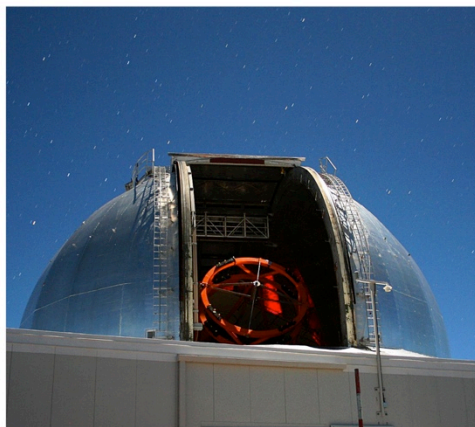
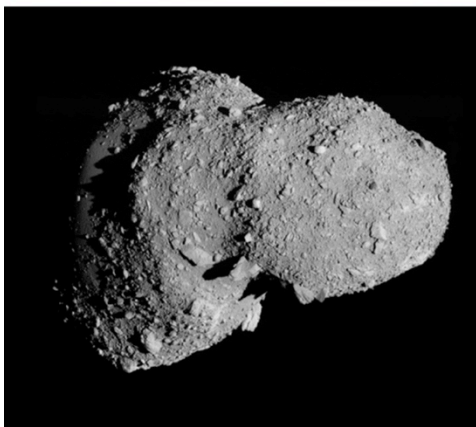


# Asteroid Initiative Idea Synthesis

## Asteroid Observations

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Join the discussion and send questions to: [#NASAasteroid](#)

# Purpose of Asteroid Observation Session



## RFI text:

**Asteroid Observation: NASA is interested in concepts for augmenting and accelerating ground and space-based capabilities for detecting all near-Earth asteroids (NEAs) – including those less than 10 meters in size that are in retrievable orbits – determining their orbits, and characterizing their shape, rotation state, mass, and composition as accurately as possible.**

# Selecting RFIs for Presentation



- **90 Responses received**
- **Team evaluated using criteria:**
  - Relevance, Impact, Maturity, Affordability
  - Scored 1-3 in each. Perfect score = 12
- **Need return within 3 years in detection/characterization**
- **Many very good responses:**
  - Scored 9-12: 29
  - Scored 6-9: 44
  - Scored 3-6: 17
- **Time allocated at workshop allowed 15 presentations**
  - We insisted on having 18!
    - But one dropped out

# Well Known, Highly Rated Responses - 14



Amy Mainzer	JPL	Reactivating NEOWISE spacecraft to discover and characterize NEOs
Donald Yeomans	JPL	Augmenting NEO Program Office activities to accelerate NEO discovery and characterization
Jose Luis Galache	IAU Minor Planet Center	Establish hub at Minor Planet Center to coordinate amateur astronomers taking NEA light curves
Fengchuan Liu	JPL	Near Earth Objects Camera (NEOCam) IR space telescope at Earth-Sun L2
Mark Hammergren	Adler Planetarium	Leasing time on 3.5-m telescope at the Apache Point Observatory to find and characterize very small asteroids
Lance Benner	JPL	Upgrading the Goldstone Radar to achieve 1.25-m resolution
Michael Nolan	Arecibo Observatory	Upgrade the Arecibo radar system and dish to increase rate of asteroid observation
Ed Lu	B612 Foundation	Overview of B612 Sentinel mission; 0.5 m IR space telescope to detect asteroids
Mark Trueblood	Winer Observatory	Consider using the 4-m Mayall telescope at Kitt Peak; Develop real-time data reduction techniques
Steven Kahn	Large Synoptic Survey Telescope	The Large Synoptic Survey Telescope (LSST) will be capable of detecting asteroids as small as 10 m at 0.1 AU
Martin Elvis	Harvard-Smithsonian Center for Astrophysics	LINNAEUS program uses Kitt Peak 2.1m telescope and spectrograph to boost characterization rate of NEAs.
Dan Britt	Univ. of Central Florida	Establish coordinated network of telescopes at different longitudes around the Earth to observe small asteroids
Michael Shao	JPL	Use synthetic tracking technique on Palomar 5-m telescope to improve signal-to-noise ratio
Amy Mainzer	JPL	IR sensor hosted on geosynchronous spacecraft to detect NEOs

# Session Agenda - 1



<b>Small Ground Based Telescopes</b>		
Phil Beffrey	Individual	Substantially increase the number of amateur astronomers looking for asteroids by developing low-cost equipment
Doug Walker	Univ. of Canterbury	Use amateur astronomers for follow-up observations from Southern Hemisphere.
Ray Pickard	Bathurst Observatory, Australia	Involve small private observatories in asteroid observations; More telescopes for asteroids in Southern Hemisphere
Gary Hall Gary Matthews	Exelis	Leverage existing 1.1-m commercial telescope
Kurt Klaus John Lambert	Boeing	Boeing has expertise developing space surveillance sensors for the Air Force
<b>Software Solutions</b>		
Jeffrey Mitchell	StormBourne, LLC	Web portal for aggregating, disseminating, and standardizing observations
Vadym Savanevych	Kharkiv National University (Ukraine)	Developing algorithms for automatic detection of asteroids. Interested in cooperation to determine asteroid orbits.
Stephen Eikenberry	Univ. of Florida	Development of a high-performance, information theory-based data mining tool for asteroid threat determination
Mark Poole C Clark	ExoAnalytic Solutions	Leverage algorithms developed for Missile Defense Agency for automated NEA detection
Paul Noonan Sara Case	a.i. solutions, inc.	FreeFlyer software for asteroid observation and mission design

# Session Agenda - 2



<b>Radar/LADAR</b>		
Al Reisz	Reisz Engineers	Geometric Nonlinear Signal Processing algorithm to enhance range performance of NASA radars for tracking asteroids
Greg Berthiaume	MIT Lincoln Lab	Laser radar for characterization and orbit determination of NEOs.
Bijan Nemati	JPL	Measuring the size of NEAs with coherent doppler ladar
<b>Space based / Small Sats</b>		
Stephan Klene	Individual	Use star tracker from existing satellite missions to measure light variation due to rotation of asteroid.
Chris Lewicki	Planetary Resources	Leveraging Planetary Resource's network of Arkyd 100 space telescopes to be launched in 2015
David Rabanus	SpaceAppsChile	Cubesat swarm with IR sensors and onboard data processing
David Gump	Deep Space Industries	Scouting missions are required to characterized potential asteroid targets.

# Key Topics of Value



## • **International Participation**

- Cannot directly fund foreign entities
  - May be subcontracts to US prime contracts
- Will encourage support by UN COPUOS member state governments
  - Can bring worthy proposals to your representatives attention
- Saw good presentations from New Zealand, Australia, Ukraine

## • **Improve Engagement for Amateur Astronomers**

- Assistance to learn astrometric and photometric skills
- Assistance to procure appropriate yet economic observing hardware and software
- Assistance to learn interface with MPC and professional community

## • **Repurpose of existing US assets**

- Surplussed capabilities from US SSN and NSF

## • **Partnerships for Characterization**

- Space-based precursor and “ride-along” small spacecraft
- Economic and/or cost sharing for target characterization



# NEO Observations Annual Solicitation



- **Contained in annual omnibus Research Opportunities in Space and Earth Sciences (ROSES)**
  - Released every February
  - See NSPIRES site: <http://nspires.nasaprs.com/external/>
  - Look for latest ROSES NASA Research Announcement (NRA)
  
- **NEO Observations is Appendix C.9**
  - Notices of Intent due in April
  - Proposals due early June
  - Peer Reviewed late summer
  - Awards announced when budget available following fiscal year