

Planetary Defense Task Force

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Task Force formed April 2010
to report back to NASA Advisory
Council Chair, NASA
Administrator & NASA Mission
Directorates on Planetary
Defense issues.

Outbriefed NAC in Oct 2010

Briefings in 2011 also given to
Waleed Abdalati (NASA Chief
Scientist) and Chris Scolese
(NASA AA)

Task Force Observations & Assumptions

- ▶ NASA NEO activities: exploration, deep space ops, science, characterization, and planetary defense (PD)
- ▶ NASA is already assumed to have PD responsibilities.
- ▶ Long period comets were not considered.
- ▶ NASA should integrate PD into science and human exploration missions
- ▶ Many PHOs will have “worrisome probability of impact”
- ▶ Deflection decision frequency considerably higher than actual impact frequency (20:1, 50:1, 100:1 ?)
- ▶ International leadership needed

Task Force Recommendations

1. Organize for Effective Action on Planetary Defense
2. Acquire Essential Search, Track, and Warning Capabilities
3. Investigate the Nature of the Impact Threat
4. Prepare to Respond to Impact Threats
5. Lead U.S. Planetary Defense Efforts in National and International Forums

1: Organize for Effective Action on Planetary Defense

NASA should establish an organizational element to focus on the issues, activities and budget necessary for effective Planetary Defense planning; to acquire the required capabilities, to include development of identification and mitigation processes and technologies; and to prepare for leadership of the U.S. and international response to the impact hazard.

1: Organize for Effective Action on Planetary Defense

Establish Planetary Defense Coordination Office

- ▶ Officer responsible directly to the NASA Administrator
 - ▶ Small staff, support seconded from agency offices
- ▶ Coordinate expertise and resources to establish a capability to detect NEO impact threat, plan and test measures to mitigate such a threat.
- ▶ Plan, submit , disburse budgets for PD program
- ▶ Coordinate and oversee all PD activities by Mission Directorates, centers, and agency projects
- ▶ Provide U.S. government PD interface for international space agencies and partners
- ▶ Develop public awareness activities

1: Organize for Effective Action on Planetary Defense

Needed PD Activities and Support

- ▶ A near-term survey effort to accomplish the George E. Brown NEO Survey Act of 2005 (90% / 140m)
- ▶ Long-term, continuous monitoring of the NEO population, characterization, PD demo missions
- ▶ Short term impact response procedures with DHS, FEMA, other emergency agencies (e.g., tabletop exercises in 2013)
- ▶ International initiatives for joint potential PD demo missions
- ▶ NASA should challenge international community to join analytical, operational, and decision-making PD activities (e.g., NEO Working Group within UN-COPUOS, IAWN)
- ▶ Augmented budget for a decade to fund space-based survey like NEOCAM or Sentinel (not diverted from existing NASA science, exploration or other missions).

2: NASA should significantly improve the nation's discovery and tracking capabilities for early detection of potential NEO impactors, and for tracking them with the precision required for high confidence in potential impact assessments.

NEO Search

The task force recommends that NASA immediately initiate a space-based infrared telescopic NEO search project as the primary means of meeting the George E. Brown Survey goal (stay tuned for Amy's NEOCAM discussion – next).

- ▶ Deploy faster, efficient IR telescope while assisting ground-based facilities
- ▶ Meets survey goal in < 7 yrs; enables follow-up orbit determination
- ▶ Observing frequency and geometry reduces need for deflection campaigns
- ▶ Mission cost balanced by avoided deflection/transponder launches
- ▶ Investigate cost/benefit of a pair of IR, Venus-like-orbit s/c
- ▶ Rapid ID of NEOs accessible for human exploration

2: Acquire Essential Search, Track, and Warning Capabilities

Radar Astrometry and Characterization

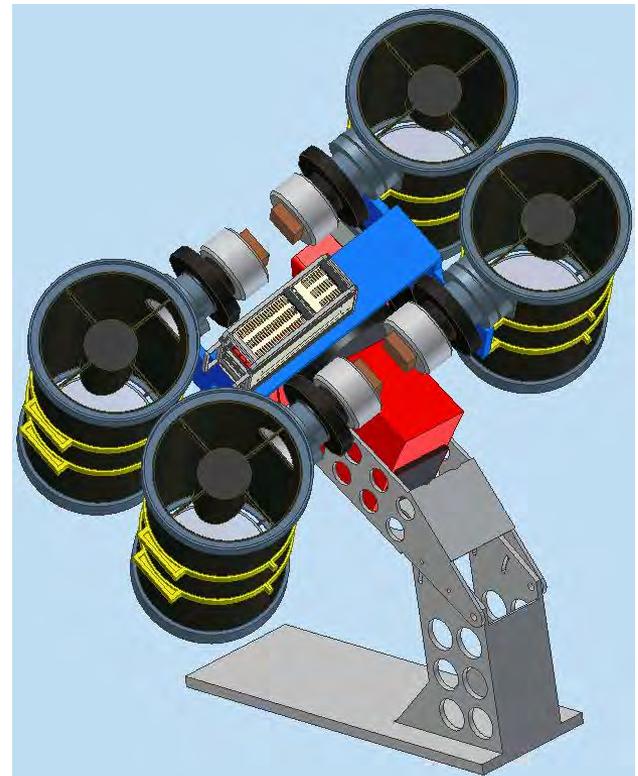
NASA should plan and budget for the incremental costs of maintaining the Arecibo and Goldstone planetary radars.

- ▶ Facilitate rapid orbit refinement and detailed physical NEO characterization
- ▶ Provides definitive orbit precision for subset of NEOs observable
- ▶ Can determine binary NEOs, component masses, 3-D shape, rotation state (comparable to flyby missions for subset of NEOs)

2: Acquire Essential Search, Track, and Warning Capabilities

NASA should investigate development of low cost, short-term impact warning systems

- ▶ Short-term Warning (ATLAS syst. Under development)
- ▶ Aimed at most frequent impactors (20–30 m objects, avg. impact ~100 yrs)
- ▶ Provides days or weeks of impact warning for ~ 60% of these events
- ▶ Addresses, at low cost, gap in current search \$1–2M/unit



3: Investigate the Nature of the Impact Threat

To guide development of effective impact mitigation techniques, NASA should acquire a better understanding of NEO characteristics by using existing and new science and exploration research capabilities, including ground-based observations, impact experiments, computer simulations, and *in situ* asteroid investigation.

3: Investigate the Nature of the Impact Threat

Physical Characteristics

NEO survey programs should provide initial physical characterization of discovered objects.

- ▶ Primary characteristics of value include size, reflectivity, and color brightness (1st order mineralogical composition)
- ▶ NASA's science, exploration, and survey missions aimed at NEOs should include determination of the physical characteristics most directly related to planetary defense (i.e., size, mass, density, porosity, composition, rotation, interior structure, binary, surface morphology, surface properties)

4: Prepare to Respond to Impact Threats

To prepare an adequate response to the range of potential impact scenarios, NASA should conduct a focused range of activities, from in-space testing of innovative NEO deflection technologies to providing assistance to those agencies responsible for civil defense and disaster response measures (FEMA, DHS).

Disaster Response -- NASA should work with FEMA, DHS and other relevant U.S. Government agencies to assign roles and formulate plans for civil defense, such as evacuation of threatened areas, should NEO deflection prove impractical (e.g. continue Tabletop exercises).

4: Prepare to Respond to Impact Threats

Deflection Research Program

In parallel with impact disaster response planning, NASA should perform the necessary research and development to perform an in-space test of a deflection campaign, with the goal of modifying, in a controlled manner, the trajectory of a NEO.

- ▶ Computer simulations and lab gas gun experiments to bound momentum multiplier
- ▶ Perform in space test of deflection campaign
- ▶ Collaborate with DoD and DoE to develop an analytic research program to inform NEO deflection/disruption techniques via nuclear explosions.
- ▶ Develop a reference set of a few impact threat scenarios and corresponding deflection campaigns

5: Lead U.S. Planetary Defense Efforts in Public and International Forums

NASA should provide leadership for the U.S. government to address Planetary Defense issues in interagency, public education, media, and international forums, including conduct of necessary impact research, informing the public of impact threats, working toward an internationally coordinated response, and understanding the societal effects of a potential NEO impact.

5: Lead U.S. Planetary Defense Efforts in Public and International Forums

- NASA and other PD–relevant agencies should develop representative impact threat timelines (linked to reference deflection missions).
- NASA should help:
 - Develop a comprehensive PD public communications plan
 - Develop a public education and outreach program to inform govt. and public about NEO impact hazards and mitigation options.
 - Understand the legal basis for potential actions related to PD
 - Support research into the physical, environmental, and social consequences of a range of NEO impact scenarios
 - Study effects of land and ocean impacts, tsunamis

Summary of Some Major Points

▶ NASA should:

- Establish PD Coordination Office
- Provide leadership for U.S. govt. to address PD issues
- Carry out in-space IR survey to meet Congressional goal
- Plan and budget for the incremental costs of maintaining the Arecibo and Goldstone planetary radars
- Continue to investigate short-term impact warning systems
- Perform research and development to carry out in-space test of a deflection campaign
- Develop representative impact threat timelines that are linked to reference deflection missions.
- Leverage science missions for PD information and deflection tests