

# **SMPAG Actions**

5.1, 5.5, 5.6

# Criteria/Thresholds - Impact Response Actions

(Doc # SMPAG – PL-001/1.1, Sec. 5.1)

---

- NASA is the Lead (with support by IAWN) – to establish criteria and thresholds to communicate to SMPAG and initiate/activate the appropriate warning with gov't leaders and emergency management officials
- Description
  - Develop agreement across IAWN-SMPAG (and amongst SMPAG members) on what real-world scenarios represent a credible impact threat;
  - Develop and clearly articulate these criteria and thresholds;
  - Utilize these methods in impact scenario exercises
- Output: Summary report

# **IAWN Socialization/Realization**

---

- **UNCOPUOS established IAWN (and SMPAG) in 2013. Both groups have had numerous meetings to, in the case of IAWN – establish the loosely coordinated network; and, in the case of SMPAG – develop and mature a workplan.**
- **IAWN was first publically discussed at the 2015 Planetary Defense Conference in the context of a simulated impact event scenario over Western Europe.**
- **It was again utilized in the U.S. joint-FEMA/NASA asteroid impact exercise in Pasadena, California in October 2016.**
- **The next opportunity to script IAWN (and SMPAG) activities for a simulated impact exercise scenario will be at the Planetary Defense Conference in Tokyo in May 2017. The risk corridor will be over Asia. Notification from discovery to predicted impact in the exercise is just just over 10 years.**

# IAWN/SMPAG:

## Criteria/Thresholds for Impact Response Actions

### 5.1 Action

---

- IAWN shall warn of predicted **impacts exceeding a probability of 1%** for all objects characterized to be **greater than 10 meters in size**, or roughly equivalent to **absolute magnitude of 28** if only brightness data can be collected.

---
- Terrestrial preparedness planning should begin when warned of a possible impact:
  - Predicted to be **within 20 years**,
  - Probability of impact is assessed to be **greater than 10%**, and
  - Object is characterized to be **greater than 20 meters in size**, or roughly equivalent to **absolute magnitude of 27** if only brightness data can be collected

---
- SMPAG should start mission option(s) planning when warned of a possible impact:
  - Predicted to be **within 50 years**,
  - Probability is assessed to be **greater than 1%**, and
  - Object is characterized to be **greater than 50 meters in size**, or roughly equivalent to **absolute magnitude of 26** if only brightness data can be collected.

# A Plan for SMPAG Action in Case of Credible Threat

## 5.5 Action

- SMPAG (NASA) to develop a Planetary Defense Action Plan (PDAP) to define how SMPAG members will work together to understand nature of an asteroid threat
- Develop basic goals for a deflection/disruption campaign
- Develop agreed upon course of action in response
- Plan to have two approaches
  - Short-warning event
  - Long-range threat

# A Plan for SMPAG Action in Case of Credible Threat

## 5.5 Action

- **Plan to include:**
  - Identification of launch site, launch vehicle, payload hardware, and other critical resources required for a deflection campaign
  - Timeline for the response effort, including critical milestones and decision points
  - Technology readiness level of required systems
  - Approach for authorizing and coordinating a multi-nation cooperative effort
  - Recommendations for assuring open communication and transparency on the development and execution of the threat response
  - Information that each participating agency should maintain on availability of resources that might be used in a deflection campaign
  - Identification of and contact information for individuals to be notified of a credible threat
  - Possible impediments to timely and effective action and potential remedies

# List of launch sites/capabilities

Nation	Demonstrated Deep Space Capability	Launch Sites	Launch Vehicles
China	Yes	Jiuquan Satellite Launch Center; Wenchang Spacecraft Launch Site;	Long March, Long March 5
ESA	Yes	Kourou	Ariane 5, Ariane 6, Soyuz (R-7)
Japan		Tanegashima Space Center, Kumage-gun, Kagoshima	H-II
Russia	Yes	Baiknour, Vostochny, Plesetsk	Zenit, Soyuz (R-7), Proton
South Korea		Naro Space Center	
United States	Yes	KSC, WFF, VAFB	Minotaur IV, V; Antares; Falcon 9;
India	Yes		GSLV, PLSV

**Need assistance from  
SMPAG members to complete**

# Timeline

---

## Proposal

- Develop timelines for short warning ( $T_w < 5$  year),
- medium warning ( $5 < T_w < 10$  years),
- long-range ( $T_w > 10$  years)
- Include basic mission/campaign requirements (launch vehicle & payload availability), rough costs, Key national capabilities

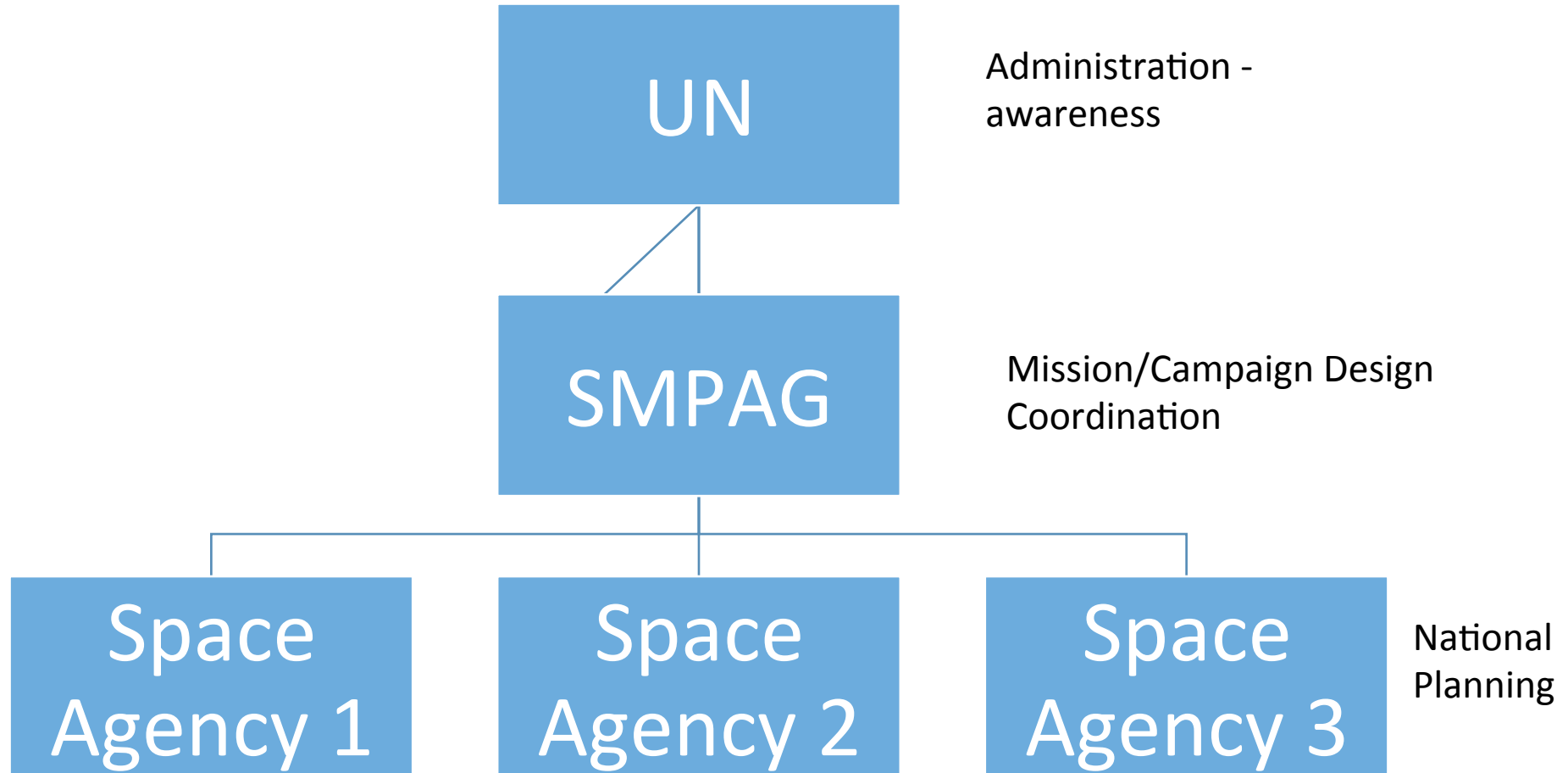


# Required Systems & Readiness

Nation	System			Readiness Level (TRL)	
A	Launch Vehicle and Payload Mass Delivered to Interplanetary Trajectory				
	Payload	Guidance			
		Hardware	Sensors		
		Software			

# Coordination

---



# Recommendations for communication and transparency

---

- SMPAG responsible for communications regarding overall campaign effort
- Partnering nations responsible for communications about their supporting efforts

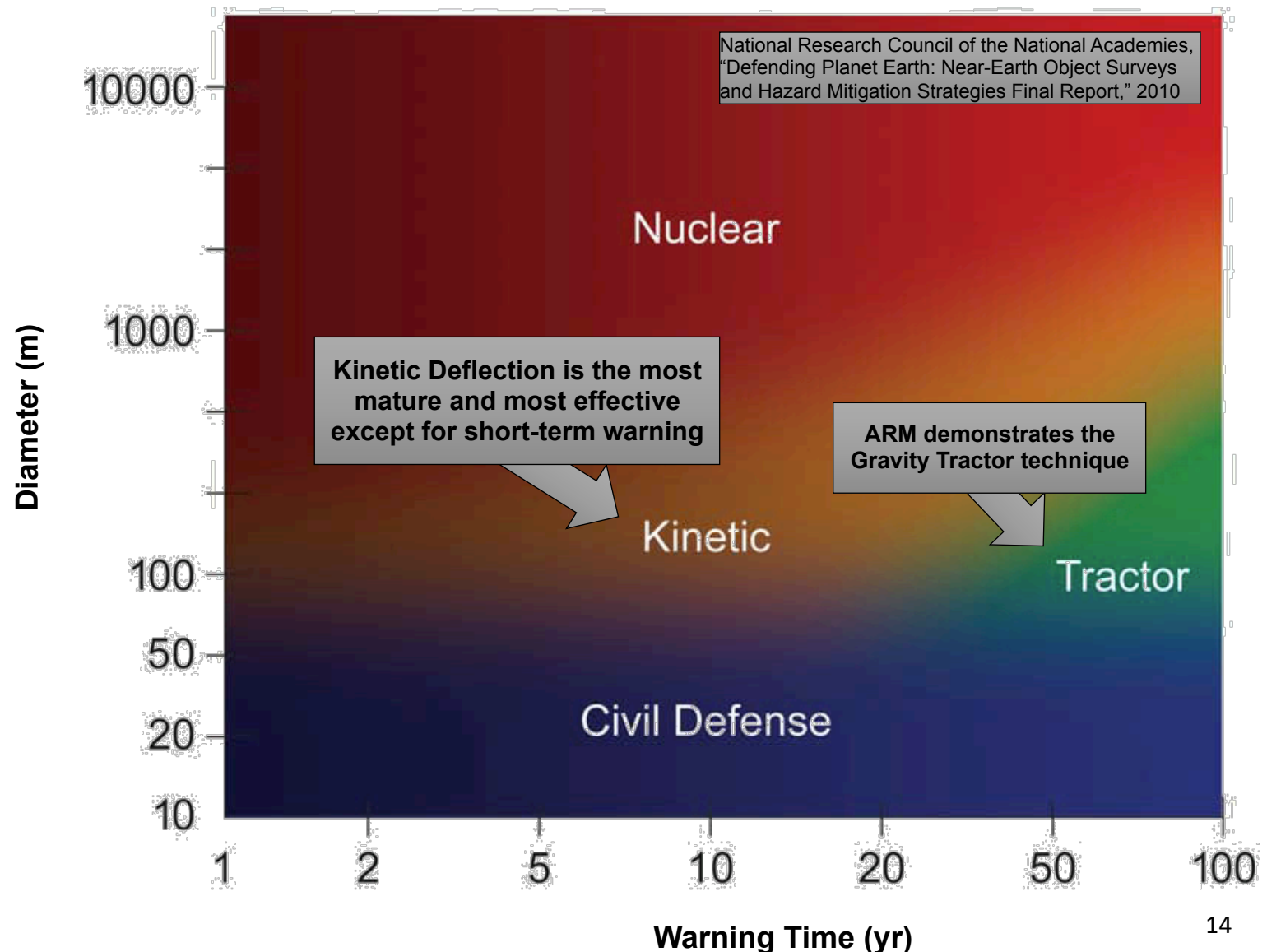
# Updated availability of resources

# **Impediments to Timely Action**

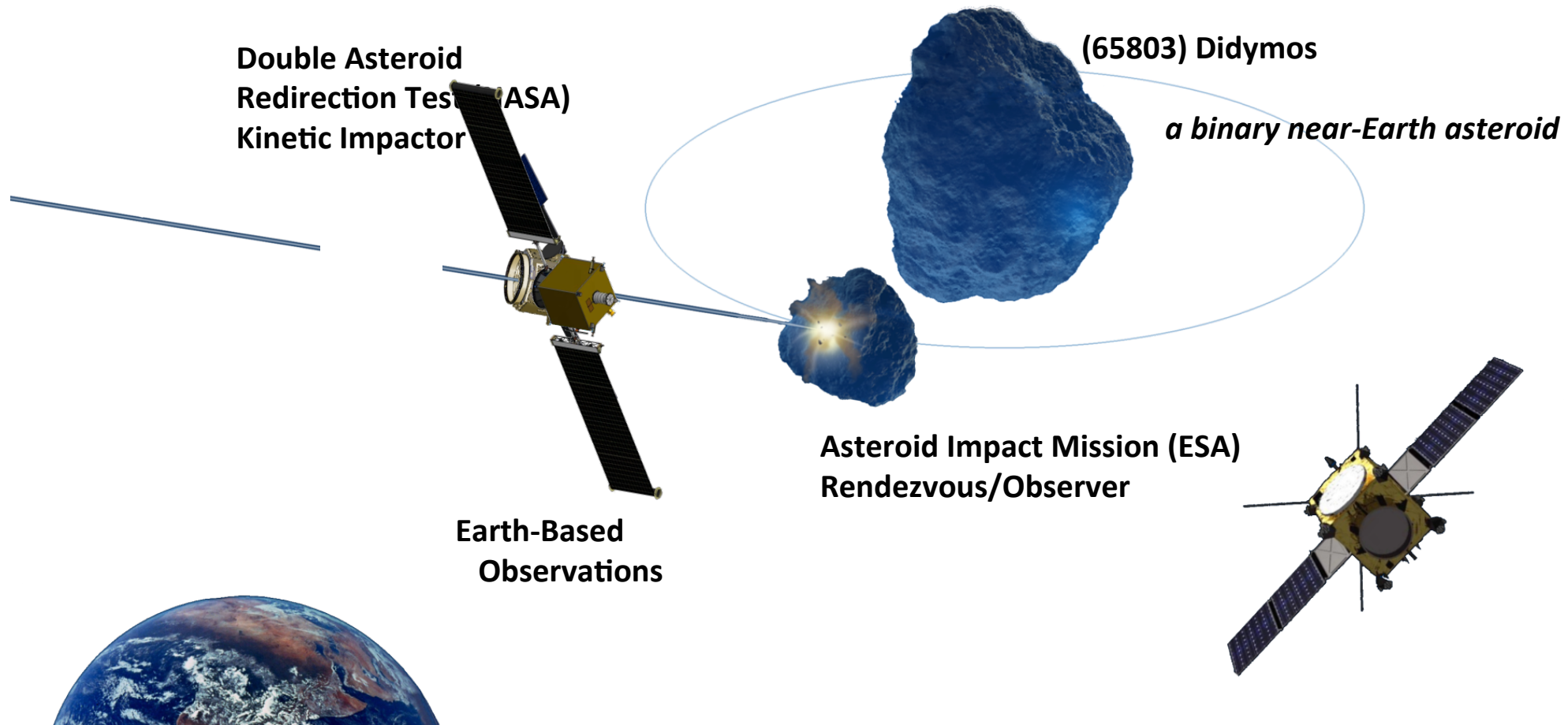
- Member nations shall identify

# Kinetic Impactor, Gravity Tractor, Civil Defense

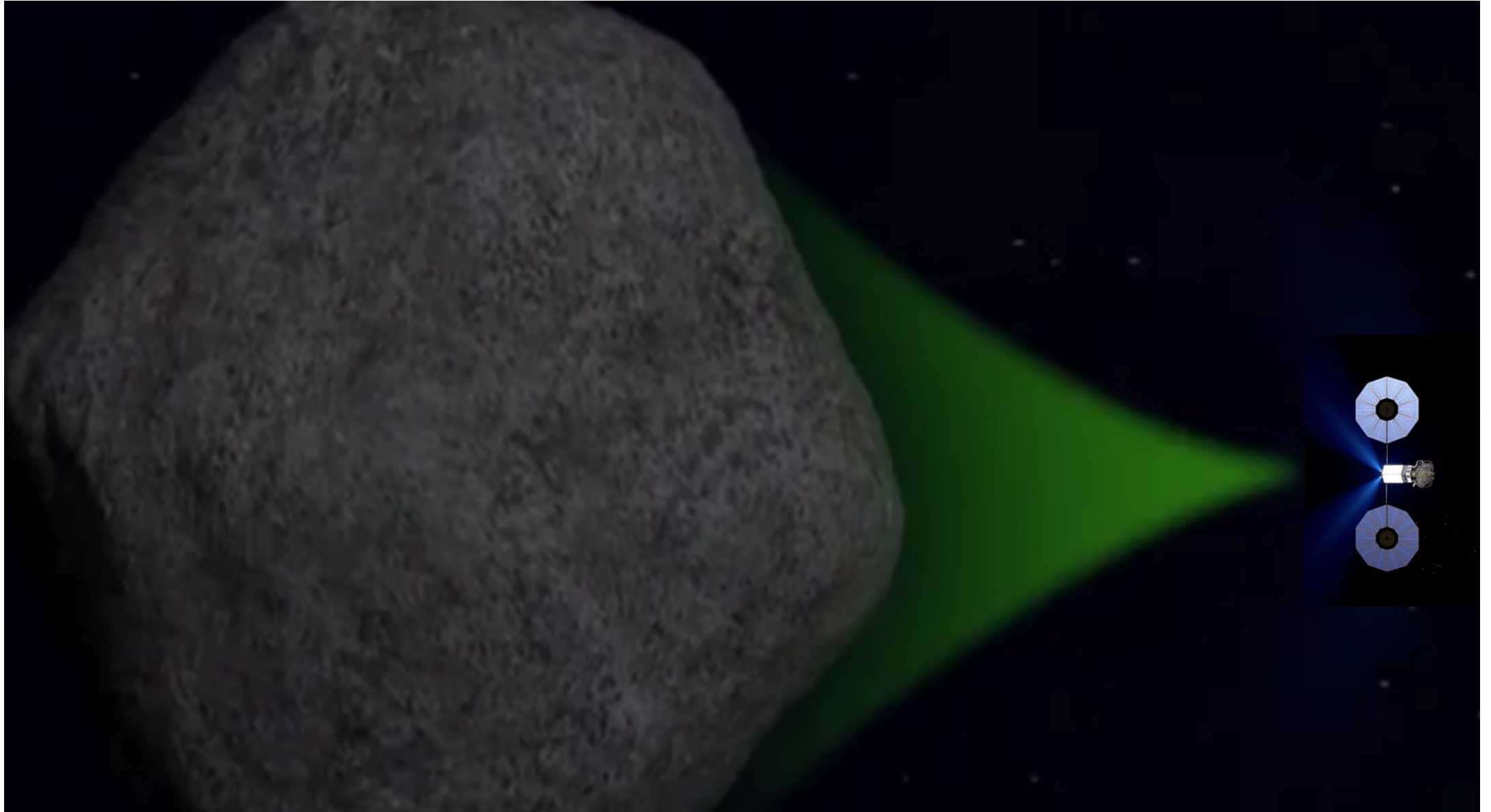
- Multiple studies of impact threat deflection have cited three techniques as most viable: Kinetic Impactor, Gravity Tractor, Nuclear Explosive Device
- Making planetary defense possible requires a series of technology demonstrations and capability tests
  - All techniques require some level of demonstration and validation before considered viable for implementation in impact emergency response
  - DART project reduces risks, validates performance models, proves out an integrated capability to provide confidence for operations and decision-makers
  - ARM would utilize the enhanced gravity tractor
- International participation in any asteroid mitigation / deflection campaign is highly desirable if not essential to overall acceptability



# ***Asteroid Impact Deflection Assessment (AIDA) Mission***



# Asteroid Re-direct Mission





# Informational Messages, Warnings, Suggestions (1/3)

Level 1\*

- Uniform and timely announcement of discovery/designation of new PHAs (“Astronomers discover new potentially hazardous asteroid”): when discovered, by whom, what’s known, what’s not, next opportunity to observe. Define PHA consistently. Avoid “threat.” Avoid “don’t worry” message. Stick to facts.

**This is currently done by the Minor Planet Center.  
And in a different format by CNEOS and NEODyS.**

# Informational Messages, Warnings, Suggestions (2/3)

**Level 2\***

- Uniform and timely announcement of results of next observing opportunity (“Astronomers update impact risk predictions for potentially hazardous asteroid (designation)”: “On DATE, potentially hazardous asteroid DESIGNATION, first discovered on DATE, came back into the view of Earth-based telescopes on its orbit around the Sun. Based on x days of observations, scientists have refined their predictions of the future orbital movements of this asteroid and now say the risk of impact is (x).” Who/where observed, refinement of orbit predictions, any new data on characteristics, any possibility of radar observations, any change in impact risk assessment, next opportunity to observe.
- If impact risk has gone up, say how much, explain why, and report on when next set of observations will be made.
- If impact risk rises above 1 percent, then move to level 3.
- If impact risk is eliminated, lead with this information and explain how it was done. (See April 2014 JPL report on 2007 VK184 as model:
- <http://neo.jpl.nasa.gov/news/news183.html> )

# Informational Messages, Warnings, Suggestions (3/3)

**Level 3\***

- If impact risk exceeds 1 percent probability of impact (still need non-probabilistic way of describing risk) – the point where action must be taken – announcement(s) must describe deflection option(s) and/or emergency response.
- PHA is a “threat” when probability of impact is greater than 1 percent (this threshold could change).
- Announcements must make clear who’s responsible for observations, deflection campaign, emergency response.
- If impact is certain, make clear who’s in charge of emergency response and provide clearest descriptions of potential damage.
- When impact is certain, warnings must provide information on:
  - Type of impact – atmospheric impacts over water or over land, surface impacts on water or on land.
  - Size of object/energy release.
  - Type of object (solid, rubble pile, other, unknown).
  - Angle of entry.
  - Geographic range and gradation of effects.
  - Always end with date and time of next update.

---

\*these levels are suggestions; have not been approved nor are these ‘official’ at the moment.

# Communication Chain for → IAWN to SMPAG

## Level 3

- This is internal to 3/3 (above) – it's internal to IAWN and SMPAG [what should this look like?]