

**International Asteroid Warning Network
(IAWN)**

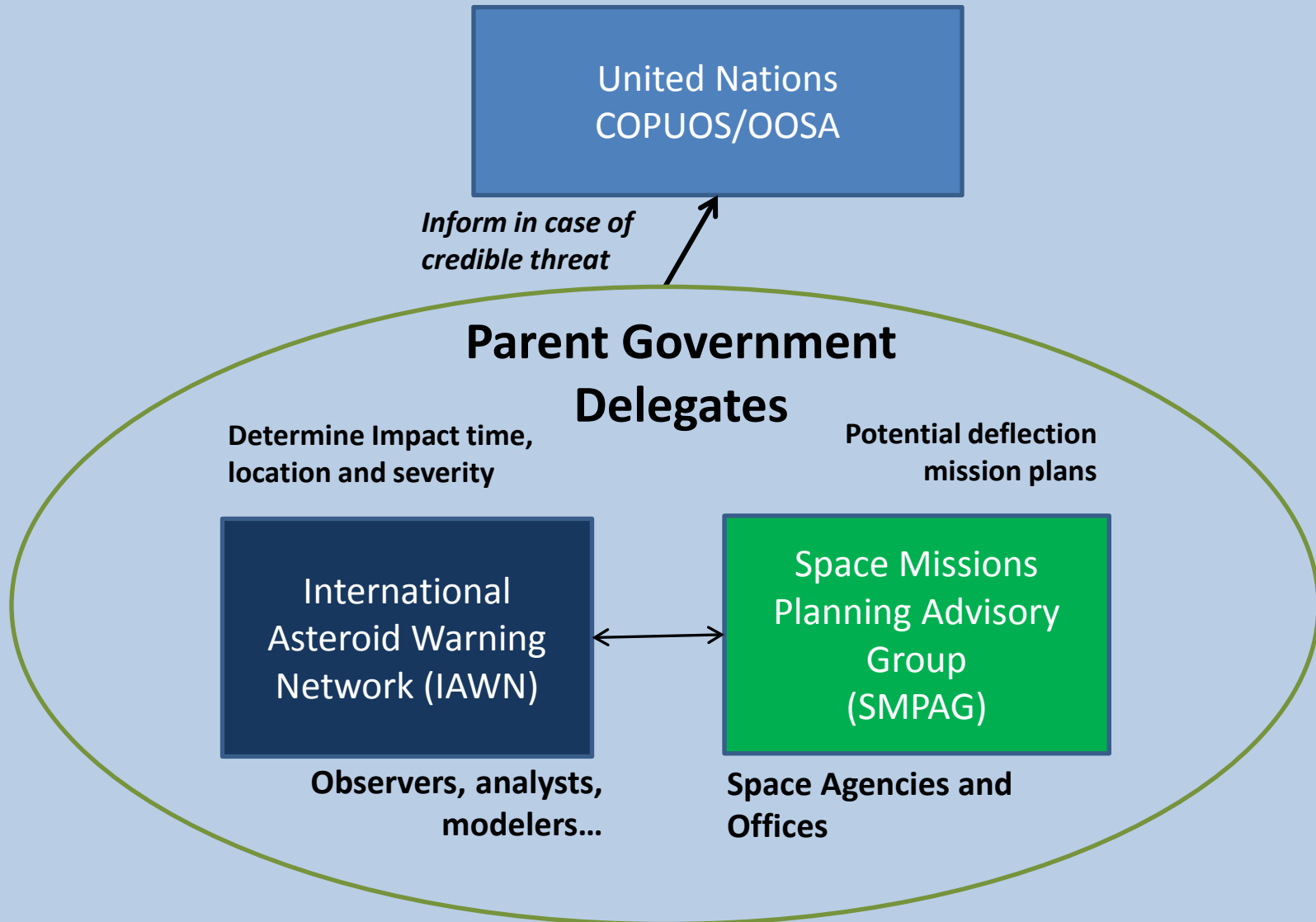
**Space Mission Planning Advisory Group
(SMPAG)**

Status Report to STSC 2017

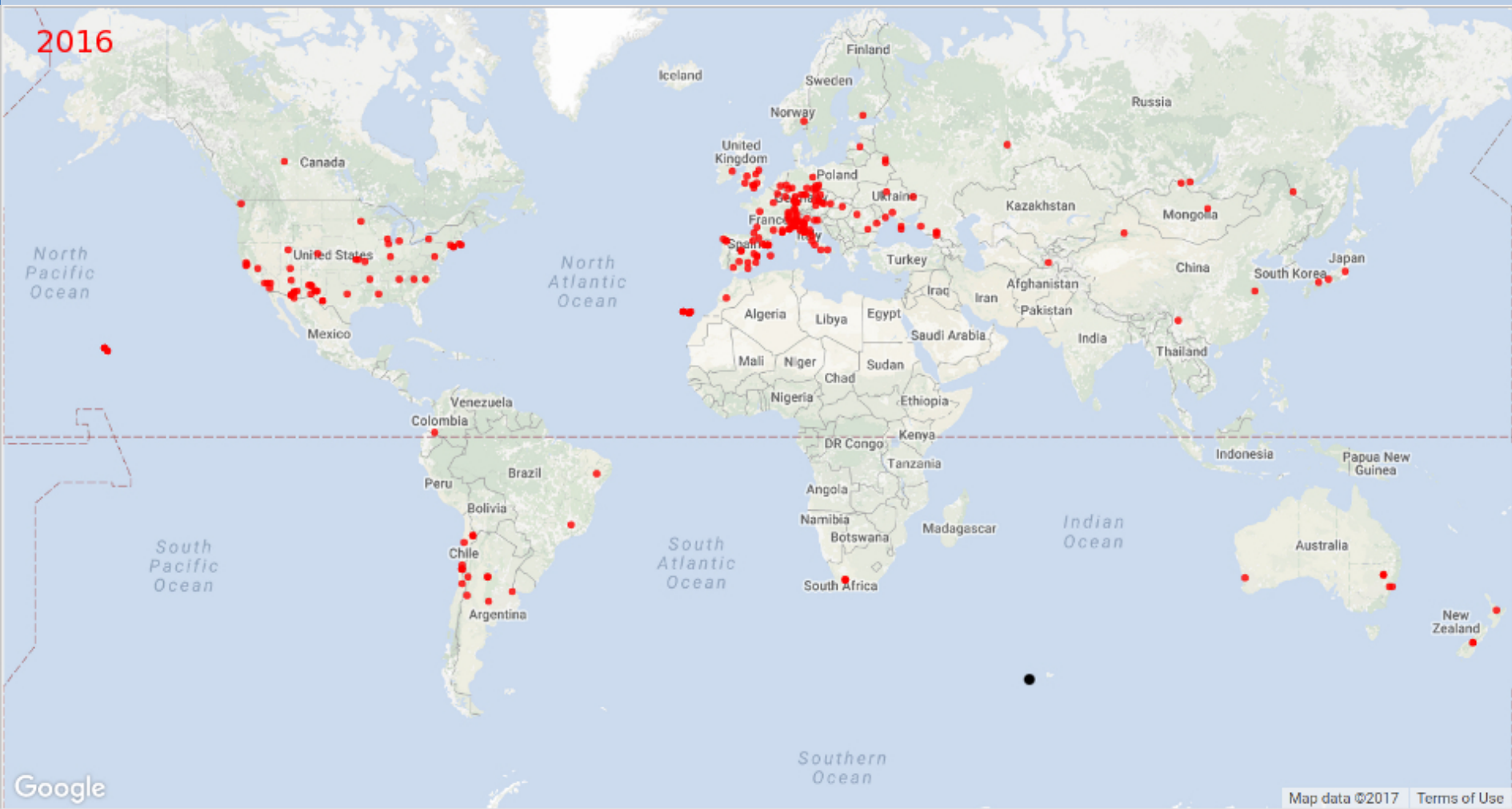
Lindley Johnson (IAWN)

Gerhard Drolshagen (SMPAG)

03 February 2017



Worldwide Observing Network

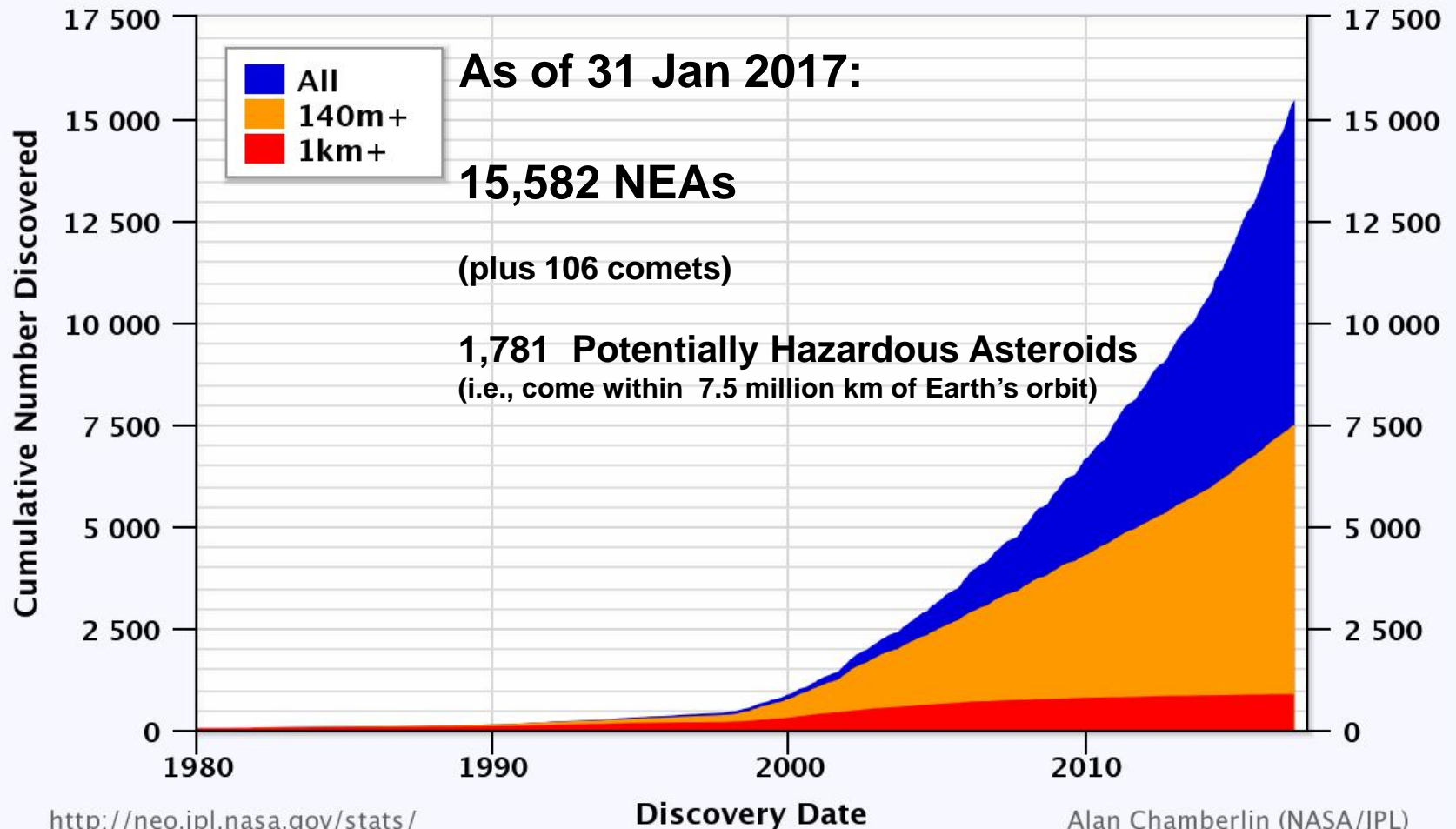


**Received ~18.6 million observations (1.7 million on NEOs) from 76 countries in 2016
(and one in space!)**

Known Near-Earth Asteroid Population

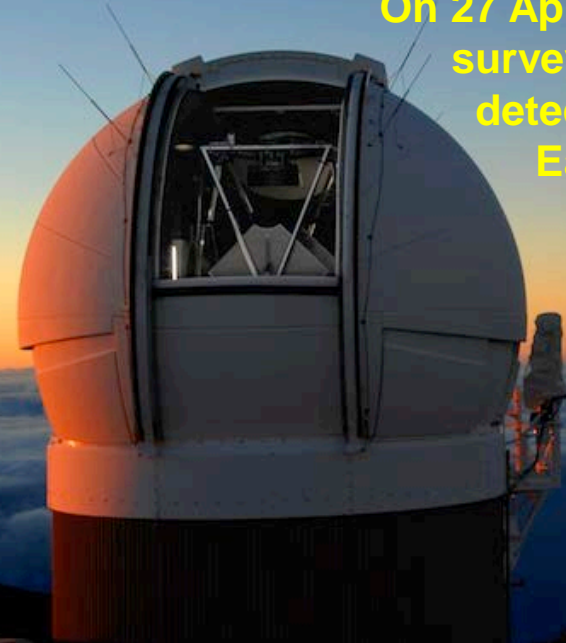
Near-Earth Asteroids Discovered

Most recent discovery: *2017-Jan-20*

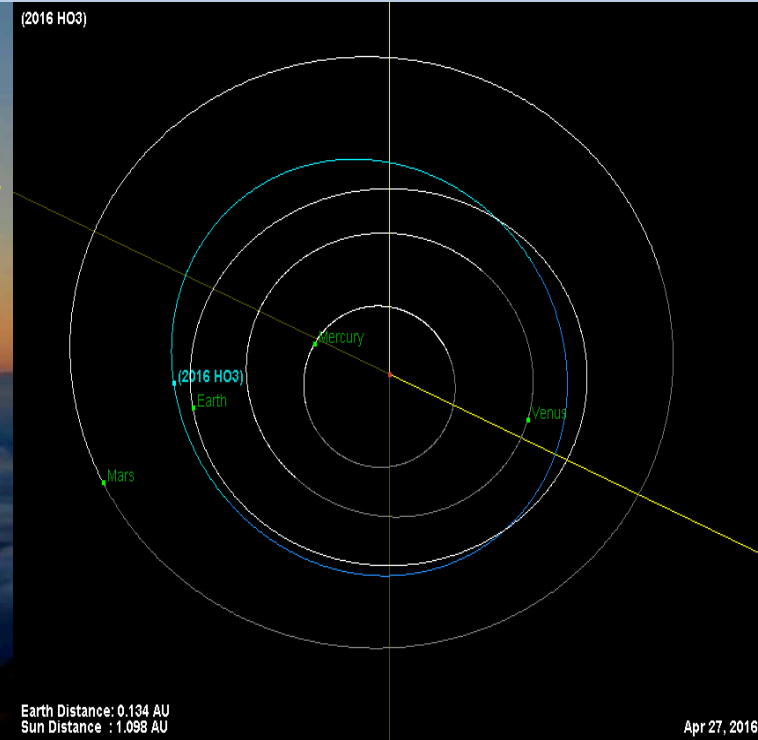


Discovery of 2016 HO₃: Earth's Quasi-Moon

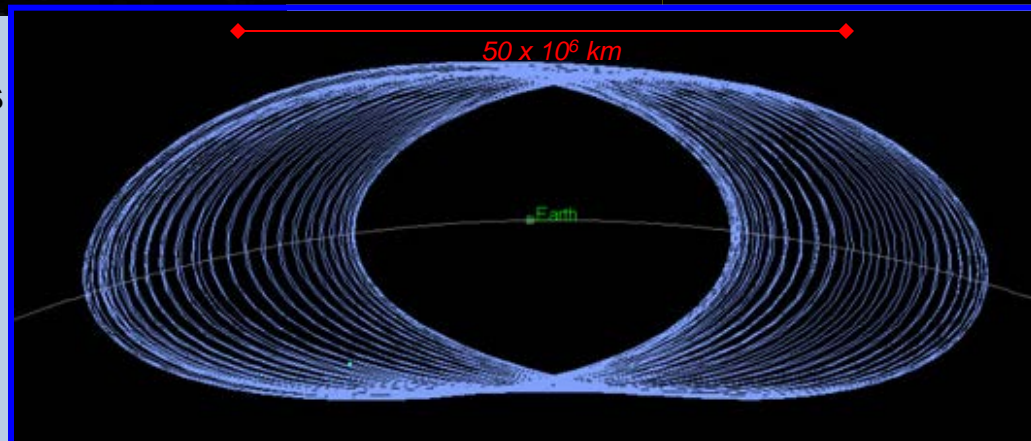
On 27 April 2016, the Pan-STARRS 1 survey telescope on Haleakalā, detected a “quasi-moon” of the Earth. 2016 HO₃, is probably a small asteroid between 40 to 100 meters in size.



Pan-STARRS 1 on Haleakalā Summit, Maui, Hawaii



A distant but, constant companion of the Earth, this plot of the 2016 HO₃ over 60 years (1960-2020) shows its librating orbit relative to the Earth. (Shown here in a rotating frame centered on the Earth and projected onto the ecliptic plane.) 2016 HO₃ never approaches closer than 14 million km nor ventures further than 40 million km away.



IAWN Functions

- ✓ (a) To discover, monitor, and physically characterize the potentially hazardous NEO population using optical and radar facilities and other assets based in both the northern and southern hemispheres and in space;
- ✓ (b) To provide and maintain an internationally recognized clearing house function for the receipt, acknowledgement and processing of all NEO observations;
- ✓ (c) To act as a global portal, serving as the international focal point for accurate and validated information on the NEO population;
- ✓ (d) To coordinate campaigns for the observation of potentially hazardous objects;
- ✓ (e) To recommend policies regarding criteria and thresholds for notification of an emerging impact threat;
- (f) To develop a database of potential impact consequences, depending on geography, geology, population distribution and other related factors;
- (g) To assess hazard analysis results and communicate them to entities that should be identified by Member States as being responsible for the receipt of notification of an impact threat in accordance with established policies;
- (h) To assist Governments in the analysis of impact consequences and in the planning of mitigation responses.

Signatories to IAWN

- **KASI — Korean Astronomy Space Science Institute, Daejeon, South Korea**
- **INAOE - the National Institute of Astrophysics, Optics, and Electronics in Cholua, Mexico**
- **INASAN - the Institute of Astronomy, Russian Academy of Sciences, Moscow, Russia**
- **ESO - European Southern Observatory**
- **ESA – European Space Agency**
- **NASA – Includes Minor Planet Center, Center for NEO Studies, 4 major NEO search projects and x object characterization projects**
- **University of Nariño, Pasto, Colombia**
- **Peter Birtwhistle, amateur astronomer, West Berkshire, England**

Discussions and initial agreements

Estimating NEO size:

- **Object size estimates should use a visual albedo range of 5 to 25% when only brightness data has been collected**
- **If a single size estimate is required, use a visual albedo value of 14%**

For announcement of close approaches to Earth, give minimum distance from Earth's surface instead of the astrodynamical convention of distance from center of mass

IAWN/SMPAG:

Criteria/Thresholds for Impact Response Actions

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 is recommended to 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.

SMPAG formation and status

- The SMPAG was officially established in February 2014
- SMPAG Terms of References were finalized in June 2014
- SMPAG has established a work plan in November 2015 which is a living document
- 2 SMPAG meetings took place in 2016:
 - **Feb 2016 at STSC in Vienna**
 - **Oct 2016 in Pasadena, USA, (just before DPS)**

SMPAG Membership

(Status 1 February 2017)

Official members with nominated delegations:

AEM (Mexico)	JAXA (Japan)
ASI (Italy)	KASI (South Korea)
Belspo (Belgium)	NASA (USA)
CNES (France)	ROSA (Romania)
DLR (Germany)	ROSCOSMOS (Russian Federation)
ESA	SSAU (Ukraine)
IAWN (ex officio)	SUPARCO (Pakistan)
ISA (Israel)	UKSA (UK)

Permanent Observers:

ASE, IAA, IAU, UNOOSA

Intention of Membership indicated:

CSA (Canada), China , Czech Republic, Austria

SMPAG Workplan

A list of 11 activities has been identified by SMPAG:

- 5.1: Criteria and thresholds for impact threat response actions. (Lead: NASA)
- 5.2: Mitigation Mission Types and technologies to be considered (Lead: UKSA)
- 5.3: Mapping of threat scenarios to mission types (Lead: ESA)
- 5.4: Reference missions for different NEO threat scenarios (Lead: ASI)
- 5.5: A plan for SMPAG action in case of a credible threat (Lead: NASA/IAA)

SMPAG work plan, cont.

- 5.6: Communication guidelines in case of a credible threat (Lead: NASA)
- 5.7: Roadmap for future work on planetary defense (Lead: DLR)
- 5.8: Consequences, including failure, of NEO mitigation space missions (Lead: TBD)
- 5.9: Criteria for deflection targeting (Lead: ROSA)
- 5.10: Study the nuclear device option (Lead TBD)
- 5.11: Toolbox for a characterization payload (Lead: CNES)

SMPAG Ad-Hoc Legal Working Group

- An ad-hoc working group on legal issues was officially established during the 7th SMPAG meeting in Oct 2016.
- The objective of the group is to review and assess legal and policy issues (e.g. liabilities) that may arise in undertaking NEO mitigation actions
- A first physical meeting took place on the margins of STSC, on 2 February following 2 prior telecons.