A Facility for Communication: A New Website for the International Asteroid Warning Network

A Report to the IAWN Steering Committee

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With significant contributions by E. Warner, T. Farnham, T. Spahr, and NASA PDCO
IAWN Website at UMD

• UMD is the home of the NASA Planetary Data System’s Small Bodies Node – responsible for data concerning Asteroids and Comets.
• As of January, 2017, UMD began oversight of the Minor Planet Center as a sub-node of the SBN. Regular, unfettered communications with the MPC and quality assurance are key factors of this relationship.
• NEO Sciences LLC CEO, Tim Spahr, a founding member of the IAWN Steering Committee now also has a sub-award with the SBN to help in overseeing the MPC and in managing the IAWN activity.
• The SBN already participates in worldwide distribution of data and international agreements with, for example, ESA and its PSA.
• UMD has experience organizing data collection and distribution for worldwide observing campaigns, including observations of C/2013 A1 Siding Spring, the Mars close-approaching comet, the upcoming close approach of comet 46P/Wirtanen, and recently the October 12, 2017 close approach of 2012 TC4, in part for IAWN.
The 2012 TC4 Observing Campaign

Introduction
Welcome to the website for the 2012 TC4 Observing Campaign. Our intention is to provide a central clearinghouse for basic information about the near-Earth asteroid 2012 TC4 and about the observations that will be obtained during its upcoming apparition.

This site will contain background information about 2012 TC4, a list of observations that are planned/scheduled/obtained, and status reports on the events leading up to the close approach. We will also produce an email list where updates can be broadcast to subscribers.

What is special about 2012 TC4?
2012 TC4 is a near-Earth asteroid discovered in 2012. It has the potential to get very close to the Earth. There is significant interest in observing it this fall to improve its orbit so that future Earth encounters can be investigated.

2012 TC4 makes a very close approach to the Earth this fall.
On 12 Oct 2017, it will pass within the orbit of the Moon. At closest approach, it will be ~50,000 km from Earth.

Observing conditions vary through the encounter.
During its approach to the Earth, the observing conditions are good (near opposition for ~2 months, with Earth-facing surface mostly illuminated). After passing the Earth, however, it will be difficult to observe (small solar elongation, with most of the Earth-facing surface in shadow).

NASA Bulletins
2012 TC4 NASA Notification - Recovery - Exercise
2012 TC4 NASA Notification - Close Approach in 2 Weeks - Exercise

Updates & News
2017.10.16: New orbit solution predicts any Earth impact for the next 100 years. Orbit solution JPL#56, which included radar astrometry and close encounter optical data, has ruled out any impact with the Earth in the next 100 years. As of 16 Oct 2017, 2012 TC4 has been removed from the Sentry: Impact Monitoring List.

2017.10.13: lots of updates! Properties, new images and movies....

2017.10.11: Two movies showing 2012 TC4 moving across the sky have been obtained. In both movies, the asteroid can be seen getting brighter and fainter, exhibiting its rapid rotation rate.

One was obtained by Ryos Ohsawa and collaborators at the Kiso observatory in Japan on Oct. 10 and 11, using a newly developed CMOS camera. It is available here.

The other is seen here, or enlarged on the Gallery Page.

Details: 2012 TC4 moving across the sky on Oct 11, 2017
Credit: Alberto Quijano Vodniza and Mario Rojas Pereira, University of Nariño Observatory, Colombia
Initial effort provides much of the critical content.

*However*, Free-flowing format, blog-like, lacks prioritization.

Items sometimes difficult to find.
Changes in Website Organization

• More compartmentalized – Landing pages should provide user with a path to the information they are seeking.

• NEO community resource.

• Also serves a resource for IAWN members in providing “Uniform and timely announcement(s) 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. ... with consistent definitions” (Levels 1-3 – c.f. Billings 2015)
IAWN.net -> umd
Mock-up of New Website:
IAWN History/Membership

The IAWN was established (2013) to create an international group of organizations involved in detecting, tracking, and characterizing NEOs. The IAWN is tasked with developing a strategy using well-defined communication plans and protocols to assist Governments in the analysis of asteroid impact consequences and in the planning of mitigation responses.

In 2013, the United Nations' General Assembly endorsed the final report of action team 14 (AT-14) of the Committee Of the Peaceful Uses of Outer Space (COUPOS) that recommended tasks for the science technical sub-committee to coordinate the international response to an NEO Impact Threat. These included the establishment of an International Asteroid Warning Network (IAWN), and of a Space Mission Planning Advisory Group (SMPAG). IAWN satisfies the first of these mandates by fulfilling several functions.

IAWN's functions are:

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 reception, 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.

Steering Committee Membership

- Sergio Camacho (UNCOUPUS)
- Lindley Johnson (NASA HQ)
- Börne Shudiev (NASAN)
- Giovanni Valsecchi (INAF-IAPS/NEOcyS)
- Patrick Michel (Observatoire de la Côte d'Azur)
- Alan Harris (DLR)
- Detlef Koschny (ESA/ESTEC)
- Paul Chodas (JPL)

IAWN Signatories and their capabilities

Below are the current signatories of the IAWN Statement of Intent.

- Peter Birtwhistle, West Berkshire, England:
- CNSA (Chinese National Space Administration): CNSA statement
- CIAM (China Astrophysical Observatory, Russian Academy of Sciences): CIAM statement
- ESA (European Space Agency): ESA statement
- ESO (European Southern Observatory): ESO statement
- IMAG (the National Institute of Astrophysics, Optics, and Electronics in Cholula, Mexico): INAOE statement
- INASAN (the Institute of Astronomy, Russian Academy of Sciences): INASAN statement
- ISTP (Institute of Solar-Terrestrial Physics, Russian Academy of Sciences): ISTP statement
- KAO LIFU (Kourovka Astronomical Observatory of the Ural Federal University): KAO LIFU statement
- KASI (Korean Astronomy Space Science Institute, Daejeon, South Korea): KASI statement
- SADO RAS (Special Astrophysical Observatory of the Russian Academy of Sciences): SADO RAS statement
- NASA (National Aeronautics and Space Administration, United States): USA statement
- University of Narino, Pasto, Colombia:

Readers will note a broad range of expertise among the signatories, from amateur astronomers providing follow-up after an event to professional institutions tasked with analyzing the impact consequences. If you are currently participating in NEO-related activities and interested in joining, please contact us for more information.
Assets
Upgraded IAWN Capabilities — Telescopes & Web Sites

In the past several months, some significant upgrades in capability have taken place. We will take this opportunity to present details on these upgrades here, as well as their effect. These upgrades have allowed a large increase in discoveries of NEOs over the previous year. With a couple further immediate upgrades in capability, we expect another surge in discoveries when we compute annual totals in about a year.

Upgraded CCD detector for Mount Lemmon Survey telescope

The most important capability upgrade in 2016 was the installation of a monolithic 10K X 10K CCD for the Catalina Sky Survey’s Mount Lemmon (observatory code G96) 1.5m reflector. This new detector allowed for approximately 5 times the area coverage as the previous camera, and the results were impressive. G96 had more than a 100% increase in discoveries over the previous year. This increase is almost entirely responsible for the 20% increase in discoveries from the previous year.

Upgraded CCD detector for Catalina Sky Survey telescope

In addition to the upgraded chip for G96, Catalina was also able to secure and install an identical 10k chip for the Catalina Sky Survey Schmidt telescope (observatory code 703). After some tweaks, this system is now performing well and the resulting sky coverage is truly impressive. 703 can cover the entire observable sky from their site in ~3 nights of observing.

ATLAS telescope(s)

The ATLAS Project has installed and began operation of a 0.5m telescope capable of covering the entire observable sky from their site in Hawaii every few nights. Some adjustments to the optics are in progress that will allow for fainter limiting magnitudes; however the combination of these telescopes with the CBB Schmidt will result in the entire observable northern hemisphere sky being observed every couple of clear nights. ATLAS has also proposed for additional systems, and if successful they will also install one in the southern hemisphere.

Pending upgrade: A new CCD camera for the Pan-STARRS 2 telescope.

The Pan-STARRS project will also provide a major upgrade boost, commensurate with those described above. A second 1.6m telescope with a large field of view will begin operation shortly. It is expected that the telescope’s capabilities will be very similar to the existing system (PS1) and thus should result in another surge in NEO discoveries, particularly at fainter limiting magnitudes than most other facilities. Because of all of the upgrades described here, we hope for another major increase in NEO discoveries by year-end.

New CNEOS web page

JPL’s Center for NEO Studies has completed a major overhaul of their web services and has completed initial release to the public. Part of this upgrade is an application programming interface (API) service. This system can be linked here. We encourage users to give this site a good look, and we also look forward to more good stuff from the folks at JPL in the near future.
## Enhanced CA Content:

### 2017 WA14 Geometry

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<th>Distance (AU)</th>
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### Solar Elongation

- **Aug**: 0.34
- **Sep**: 0.37
- **Oct**: 0.41
- **Nov**: 0.44
- **Dec**: 0.47

**Date (2017)**

<table>
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<th>Value</th>
<th>Date</th>
<th>Value</th>
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<tr>
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<td>30 Oct</td>
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**Latest orbit & observations**

Graphs courtesy Dr. Tony Farnham
By Month, Number of Discoveries On the IAWN Close Approach Pages

- Slow trend towards more over time, with statistical variations.

- Number of Discoveries/Month, Minimum CA Dist. < 1LD

Months Starting July 2016

- Close Approach Pages
Number of Discoveries/Year within 1LD

![Graph showing the number of discoveries per year within 1LD](chart.png)

- **All**: Total number of discoveries.
- **Discoveries $H_v < 23$**: Number of discoveries with $H_v$ magnitude less than 23.
- **Discoveries $< 0.1$ LD**: Number of discoveries within 0.1 LD.
Context: Total Numbers of NEOs

17611 Total
Guidance of the IAWN Steering Committee

• Look and Usability of the website

• Key Decision of Close Approach Criteria
  – Distance (presently 1LD)
  – No Mag. Limit