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The International Asteroid Warning Network: History, Background, and Current Status

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EXTENDED ABSTRACT

The International Asteroid Warning Network, or IAWN, is a United Nations- endorsed organization composed of a wide variety experts in the field of near-Earth Objects (NEOs). In addition, the IAWN has experts in public policy, disaster relief and communication, and education. The IAWN was formally established in 2013 and has been growing in membership since. There are currently 8 signatories to the Statement of Intent (see http://iawn.net/2017/01/25/current-list-of-iawn-signatories/), including members in Europe, Asia, South and North America. The main IAWN functions include:

- the conduct and coordination of the NEO search effort;
- follow-up and characterization of NEOs;
- communicating the risks and benefits of NEOs to a wide audience;
- educating the public on NEOs;
- maintaining a clearinghouse for NEO data;
- maintaining a databse of potential impact consequences;
- serving as the single trusted source for information on NEOs.

In addition to the aforementioned background and history of this network, IAWN, in concert with the Space Mission Planning Adivsory Group (SMPAG)[1] has recently established a set of agreed-upon threshold criteria in the event of an pending impact threat. Given the continual (and remarkable) increase in the NEO discovery rate, IAWN's role will expand.

NEOs have been recognized as potential threats to life on Earth for centuries. While many associate the recognition of the threat from asteroids, the initial awareness of the problem came from studying the orbits of comets. Discovered by Charles

[1] Like IAWN, SMPAG was also established at the 50th session of the STSC of UNCOPUOS in 2013. The primary purpose of SMPAG is to prepare for an international response to the NEO threat through the exchange of information, development of options for collaborative research and mission opportunities, and to conduct NEO threat mitigation planning activities. The European Space Agency (ESA) currently chairs SMPAG (while NASA is the *de facto* lead for IAWN).

Messier on 14 June 1770, Comet Lexell (D/1770 L1)[2] is notable for being the comet that passed closer to Earth than any other comet in recorded history. On 1 July 1770, Comet Lexell passed within 0.015 AU (~2,2 million km) of the Earth. While it was not called such at the time, Comet Lexell was the *first known* NEO. Over 100 passed before the discovery of (433) Eros, but it was not until 1932 with the discovery of (1862) Apollo than an asteroid with an Earth-crossing orbit was first found.

Targeted searching for NEOs was not done with any regularity until the 1970s, when the team of Eugene Shoemaker and Eleanor Helin used the 18" Schmidt at Palomar for discoveries. Tom Gehrels founded the Spacewatch project within a few years, and also began searching with the first digital detector used for NEO surveying. However, international recognition of the threat from NEOs really did not happen until the impact of Comet Shoemaker-Levy 9 with Jupiter in 1994.

Around this time, the United States Congress commissioned a study of the threat of NEOs; the resulting 'Spaceguard Report' (Morrison, *et al*. 1992) recommended discovering all objects with sizes larger than about 1 km in order to prevent a global catastrophe. Just three years later, in 1995 the United Nations Office of Outer Space Affairs held a meeting in New York to discuss the threat of NEOs. And during Unispace III in 1999, the subject was again considered by the United Nations. At this point the United Nations recommended formal study of the threat of NEOs, and founded Action Team 14 in 2001. AT-14 was a technical body consisting of a mixture of non-governmental and governmental entities. The group worked inter-sessionally, and also established an NEO Working Group. Part of this work involved several presentations to the Science and Technical Subcommittee (STSC) over the years, as well as several interim reports. A final report was presented to the STSC in December 2013, with 74 member states present. In this final report, AT-14 made 3 recommendations. They were to *establish an* ***International Asteroid Warning Network;*** *establish a* ***Space-mission Planning Advisory Group*** *and lastly to establish an* ***Impact Disaster Planning Advisory Group.*** While the first two groups were endorsed by the Working Group on NEOs, the IDPAG was not. It is felt at this time that these roles and responsibilities are already present in several other UN groups.

The IAWN was established by tying together many existing organizations. In practice, IAWN exists to link NEO discovery teams, NEO observers, orbit computation centers, as well as communication experts in order to assist governments in understanding of asteroid impacts, their frequency, consequences, and possible responses. (The full charter of the IAWN can be seen here: http://iawn.net/wp-content/uploads/2016/04/open_forum_landis.pdf). In practice IAWN operates simply by each of the constituent parts doing their specific tasks and publishing where appropriate. With existing robust orbit computation centers (eg,

[2] While referred to as 'Comet Lexell' or 'Lexell's comet,' Messier discovered the comet after observing Jupiter and examining several nebulae. Anders Johan Lexell was a Swedish-Finnish astronomer/mathematician who was amongst the first to calculate its orbit and spent the bulk of his life in Russia and known as *Андрей Иванович Лексель*. Lexell's work on D/1770 L1 commenced the first efforts and modern understanding of orbit determination.
Morrison et. al 1992. Report of the NASA International Near-Earth Object Detection Workshop.

the MPC, CNEOS, or NEODyS-2, and discovery teams (Catalina, Pan-STARRS), and follow-up programs (NASA teams, Birtwhistle, ESA), much of the initial work suggested by AT-14 is already being done. However, IAWN has many additional functions it needs to perform to fulfil the charter responsibilities. Among these are communicating the subject of NEOs and impacts to a wide variety of audiences and languages. We currently envision regional communication experts to begin to disseminate information in a more appropriate fashion for a more local audience. A robust but not complete list of IAWN functions is listed in Appendix 2; note checkmarks indicate functioning (but perhaps not complete) components of the Network.

Now that IAWN and SMPAG are in operation, the goal of sharing information on all aspects of the NEO issue can be met. IAWN is set up to alert SMPAG in the event of an imminent impact, or an object that meets threshold criteria established in recent meetings. Further, more interest in the study of NEOs is reaching higher levels in governments and scientific institutions, and we can now expect more focus on discovery, recognition of the problem, and education of the threats and opportunities NEOs represent in the future.