

IAA-PDC-25-10-240

The Virtual Telescope Project: a unique resource in near-Earth object outreach and education.

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Abstract

Near-Earth objects (NEOs) - asteroids and comets that come into close proximity with Earth - have become increasingly central in discussions of planetary science, defense and public engagement. Communicating the importance of these objects to a global audience is essential, particularly in light of the potential risks they pose and their mitigation, together with the excitement they generate. Since its foundation in 2006, the Virtual Telescope Project (VTP) has pioneered the use of the internet to deliver real-time astronomical observations to a worldwide audience, with live commentary provided by professional scientists and science communicators. The VTP has made NEO flybys and other cosmic events accessible to millions of people, providing their scientifically accurate live coverage, bridging the gap between professional astronomy and public engagement, significantly contributing to outreach and education.

Keywords: NEO, planetary defense, public outreach, asteroids.

1. Introduction and Goals.

Launched by Italian astrophysicist Gianluca Masi in 2006, the Virtual Telescope Project (1) was one of the first initiatives to combine robotic telescope technology with the potential of online broadcasting. Its goal was twofold: to share live astronomical events with a global audience and to raise awareness of space science, planetary defense and observational astronomy in a captivating, accessible way. All this offering reliable information.

The project's early adoption of live-streaming technology made it a pioneer in science communication via the web, particularly in the realm of asteroid tracking. Over its first 18 years, the VTP produced hundreds of live events, showcasing asteroid flybys, lunar eclipses, supernovae, comets and more (2). These sessions were always free to join, creating a strong culture of inclusivity and global participation.

All the telescopes part of the VTP are installed in Italy, see section 4 for details.

2. Performance and highlights.

As of today, more than 16 million individuals from more than 200 Countries visited the VTP's website (FIGURE fig01.jpg) and a similar number of viewers enjoyed our feeds covering the most spectacular astronomical events, mainly NEO close approaches (3). These viewers include amateur astronomers, educators, students and space enthusiasts, all drawn by the project's unique combination of scientific depth and broad accessibility.

Among the most memorable online events, the VTP's live coverage of asteroid 2012 DA14 in February 2013 marked a significant achievement, with exceptional footage captured (4). The asteroid passed closer to Earth than many satellites, a rare and highly publicized event. The VTP's real-time video stream, enhanced with accurate, accessible commentary, drew hundreds of thousands of viewers as well as the most important international media, setting a standard for what such events could offer the public (FIGURE fig02.jpg).

Another highlight came in 2022 with the NASA DART mission, which intentionally impacted the moonlet Dimorphos of the asteroid Didymos to test a planetary defense technique. The VTP commented and shared in real-time the resulting dust plume in collaboration with the Klein Karoo Observatory in South Africa. People could personally see an historic event while it was happening, from the comfort of their homes. Images were also made available to the international media soon after the impact (5).

3. Supporting the Media and the Scientific Community worldwide.

A key role of the VTP is its support for international media coverage of astronomical events, based on the solid reputation the project gained in the field. When a near-Earth asteroid approaches, the VTP swiftly captures high-quality images and time-lapse sequences, which are made available to journalists, editors, and science communicators worldwide, with clear comments and complete information (6).

By maintaining an agile, media-friendly workflow, the VTP helps ensure that important astronomical events are covered responsibly and engagingly, reinforcing the connection between the scientific community and the public sphere. The VTP's strong connection with media also promotes a deeper understanding of planetary defense as a very important, coordinated field of scientific inquiry and international cooperation.

4. Developments.

In 2023, the VTP took a significant leap forward with the relocation of its robotic telescopes to Manciano, a rural town in Tuscany, Italy (FIGURES fig03.jpg and fig04.jpg). Nestled under some of the darkest skies in Italy (SQM > 21.5), this location drastically improved observing conditions, increasing both the scientific return and visual quality of the images shared online.

The new facility was officially recognized with the observatory code M50 by the Minor Planet Center (MPC), making it a registered contributor to the global network of asteroid and comet observers. Moreover, the VTP has become a member of the International Asteroid Warning Network (IAWN).

As of now, three fully robotic telescopes are available as part of the VTP facility (7):

1. A 17", f/6.8 astrograph + CCD camera;

2. A 14", f/6.7 Schmidt-Cassegrain + CCD camera;
3. A 10". f/4.5 astrograph + CMOS camera.

5. The Future.

Looking ahead, the VTP is preparing for one of the most anticipated astronomical events of the coming decade: the 13 April 2029 close approach of asteroid (99942) Apophis. Once considered a potential impactor, Apophis will safely pass within 31,000 kilometers of Earth, closer than many geostationary satellites. Thanks to its ideal geographic location and upgraded facilities, the VTP will be perfectly positioned to observe Apophis under optimal conditions and share the experience with the world. Plans are underway to produce an extended series of live events, educational activities and international media collaborations, turning this rare celestial event into a global moment of scientific outreach and shared learning. The VTP will strongly support the International Year of Asteroid Awareness and Planetary Defence (IYAPD) 2029 (8).

6. Conclusion.

The VTP stands as a unique and highly effective model for outreach and education in the field of near-Earth object science. Through its innovative use of robotic technology, engaging communication style and free global access, it has contributed significantly to how the public experiences and understands asteroid science and planetary defense. Its reputation, media readiness and vision make it a valuable tool in today's landscape of science communication and outreach, as well as a precious contributor to the broader international community concerned with monitoring, understanding and preparing for cosmic hazards.

The VTP will continue to serve not only as a window on the universe, but as a bridge between science and society, making space closer and more meaningful than ever before.

7. Acknowledgements.

The VTP acknowledges Software Bisque, Seeweb and Telescope Live for their important technological support.

References

- (1) The Virtual Telescope Project's website: <https://www.virtualtelescope.eu>
- (2) Past live observing sessions hosted by the VTP since 2012: <https://www.virtualtelescope.eu/past-events/>
- (3) The youtube channel of the VTP: <https://www.youtube.com/GianMasiVirtualTelescope>
- (4) Near-Earth Asteroid 2012 DA14 flyby at the VTP: <https://www.virtualtelescope.eu/2013/02/16/asteroid-2012-da14-very-close-encounter-an-exceptional-sequence/>
- (5) DART impact observed via the VTP: <https://www.virtualtelescope.eu/2022/09/11/dart-slams-into-dimorphos-online-live-observation-of-the-impact-26-sept-2022/>

- (6) The VTP on the international media: <https://www.virtualtelescope.eu/the-media-about-us/>
- (7) The telescopes part of the VTP: <https://www.virtualtelescope.eu/the-telescopes/>
- (8) The International Year of Asteroid Awareness and Planetary Defence (IYAPD) 2029: <https://www.un.org/en/observances/asteroid-awareness-year>

Captions

- fig01.jpg: The homepage of the Virtual Telescope Project website.
- fig02.jpg: Certificate of appreciation issued by the JPL, acknowledging the support of the VTP to Nasa's media coverage with asteroid 2012 DA14.
- fig03.jpg: The 10" (left) and 14" robotic units part of the Virtual Telescope Project.
- Fig04.jpg: the 17" robotic unit part of the Virtual Telescope Project.