

ASTEROID INSTITUTE

A PROGRAM OF B612

ANNUAL PROGRESS REPORT 2024

PROGRESS UPDATES



Thanks to the generosity of our donors, including leadership gifts from Scott McGregor, Laurie Girand, Tito's CHEERS, and Google Cloud, we made one of our most significant announcements to date: the discovery of tens of thousands

of asteroids using our Asteroid Discovery Analysis and Mapping (ADAM) platform. This milestone marks the first of many contributions to global asteroid discovery efforts we can make moving forward.

Highlights of our outreach this year included Dr. Joachim Moeyens presenting at the IAU after winning a prize for his PhD thesis, 'Characterization and Discovery of Solar System Small Bodies in Modern Astronomical Surveys,' funded by B612 donors. Astronauts and cofounders Dr. Ed Lu and Rusty Schweickart presented alongside science fiction author David Brin during the solar eclipse in Texas. Dr. Lu also made the case for mapping our solar system and mentored students at Yerkes Observatory.

In addition, we were honored to award PhD student Joseph DeMartini the inaugural Schweickart Prize for his outstanding planetary defense proposal.

Our achievements this past year were made possible by our team's dedication and the generosity of our supporters.

Looking ahead,

Danica Remy
President, B612 Foundation
Cofounder, Asteroid Day



This has been an incredible year for asteroid discovery. We identified 27,500 asteroids by unleashing the power of massive computation using our ADAM platform on years-old astronomical datasets. We've continued expanding

our unified collection of astronomical observations, and we expect even more discoveries in the future.

With the discoveries earlier this year, we have directed much of our efforts toward building collaborations with key astronomical community members, such as the Minor Planet Center and ATLAS Observatory. ADAM's open-source tools are already benefiting researchers and institutions contributing to the global effort for asteroid discovery, and we will continue working closely with them as we expand and refine our software to meet the growing needs of the emerging new space economy.

Later this year, the Vera Rubin Observatory will capture its first light, with full operations beginning in summer 2025. For almost a decade now, we have been talking about how the Rubin Observatory will be the most powerful mapping telescope ever built, and the time is finally upon us. The combination of Rubin observations when combined with the analysis power of ADAM will revolutionize our mapping and understanding of the solar system.

I could not be more excited about the prospects for mapping our solar system.

Dr. Ed Lu
Executive Director, Asteroid Institute
Cofounder, B612 Foundation

ABOUT US

Asteroid Institute, a program of B612, unites scientists, researchers, and engineers to develop tools and technologies that map and navigate our solar system. By leveraging advancements in computer science, instrumentation, and astronomy, we enable the economic development of space, the deepening of our understanding of the solar system, and the protection of Earth from asteroid impacts.

B612 has championed public advocacy and educational programs like the Schweickart Prize, Asteroid Day, internships, and events hosted both locally and globally.

What started in 2002 as a visionary idea to develop technologies to deflect an asteroid has grown into a world-renowned organization and scientific institute with a key role in the astronomy community. Alongside our partners and a global network of scientists, we have driven the discourse on asteroid detection and deflection in scientific, governmental, and public spheres. Our work is funded entirely by private donors from 46 countries.

IN THE LAST YEAR

ADAM Discovery of 27,500 Asteroids

In April, the Asteroid Institute used the THOR algorithm on the ADAM platform, powered by Google Cloud, to discover 27,500 asteroids. This breakthrough surpasses last year's total discoveries by all telescopes worldwide, marking a significant leap in our understanding of the solar system.

Google Next Conference

At Google Next, Ed highlighted how Google Cloud's scalability enabled the discovery of hidden asteroids. This collaboration showcases the future of asteroid detection and the crucial role of advanced computing in enhancing astronomical research.

Solar System Readiness Sprints

For four years, B612 has supported the LSST Solar System Science Collaboration (SSSC) in developing tools for Rubin Observatory data analysis. Our support allows for workshops, collaborations, and fellowships aimed at tackling challenges in observing proposals and ensuring rapid community follow-up on key targets in LSST's initial two years.

Rusty Schweickart's Legendary Explorer Award

Apollo 9 astronaut and B612 cofounder Rusty Schweickart received The Explorers Club's Legendary Explorer Award in April. This award honors his pioneering contributions to space exploration and planetary defense, including his role in founding Asteroid Day, the Association of Space Explorers, and B612 Foundation.

Dr. Ed Lu's IAF Hall of Fame Induction

NASA astronaut and B612 cofounder Ed Lu was inducted into the International Astronautical Federation (IAF) Hall of Fame in October. The recognition celebrates his distinguished career in space exploration, leadership in asteroid tracking, and tireless efforts to protect Earth from asteroid impacts.

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27,500 ASTEROID DISCOVERIES AND THE FUTURE OF ADAM

In April 2024, the Asteroid Institute, a program of B612, in collaboration with Google Cloud, announced the identification of 27,500 previously unnoticed asteroids in the NOIRLab Source Catalog. This significant finding surpasses the total number of asteroids found by all telescopes in the previous year combined, showcasing the power of software-driven asteroid discovery and advancing our understanding of the solar system.

This achievement was made possible through the computational scale of Google Cloud, which allowed the Asteroid Institute to analyze over 1.7 billion point source detections in just one month on the Asteroid Discovery Analysis and Mapping (ADAM) platform. The platform leverages algorithms like THOR (Tracklet-less Heliocentric Orbit Recovery) and Preccovery to connect disparate observations and reveal asteroids that were previously unnoticed. These software advancements allow us to extract crucial insights from vast astronomical data, revealing objects that were hidden in plain sight.

The story, initially teased at the Google Next Conference in early April, gained widespread attention after being reported by *The New York Times* and was subsequently covered by major news outlets like *Smithsonian*, *Forbes*, *Computer Weekly*, *GeekWire*, *Space.com*, and *Singularity Hub*, among others.

While the discovery of 27,500 asteroids is an achievement, it is only the beginning of ADAM's potential. This analysis was powered by 8.5 million vCPU hours on Google Cloud, using various services, including Google Compute Engine, Cloud Storage, Kubernetes Engine, BigQuery, and Cloud SQL.

Our next major milestone is preparing ADAM::THOR (pronounced THOR on ADAM) to process the immense data stream from the Vera C. Rubin Observatory, which will be one of the most ambitious astronomical surveys ever undertaken. As we prepare for this unprecedented scale, the Asteroid Institute continues to refine THOR to enhance near-Earth asteroid detection. In parallel, the team is working with Google to develop an AI model to accelerate the classification of asteroid candidates, further advancing the discovery process.

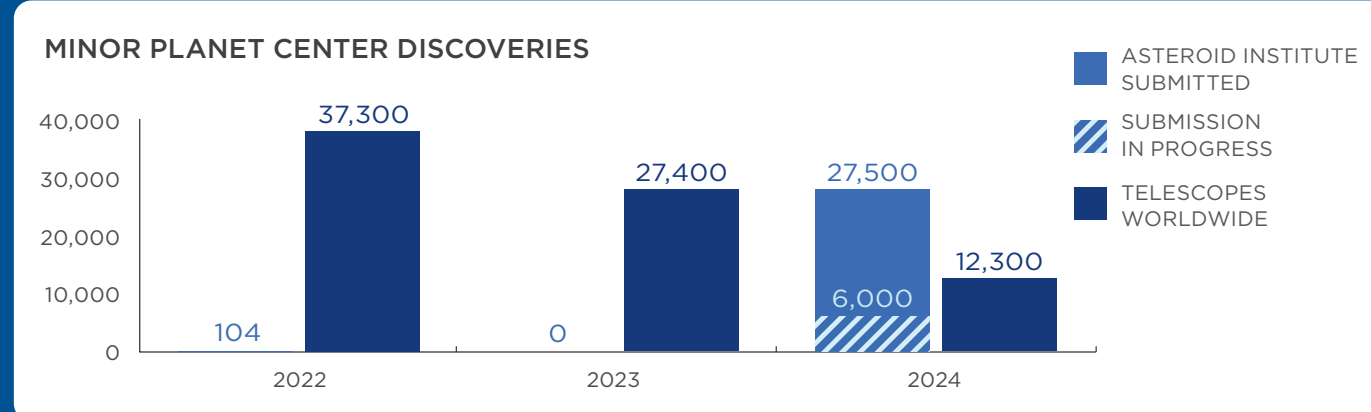
Mapping the solar system is essential for protecting our planet and expanding our scientific knowledge of the solar system's origin and evolution. Moreover, understanding the location and trajectories of these objects may be key to unlocking the economic potential of space. ADAM is more than a discovery tool—it is an open-source platform that will serve as the backbone for future mapping efforts, with the potential to shape humanity's relationship with space for generations to come.

Progress made possible thanks to our partners:



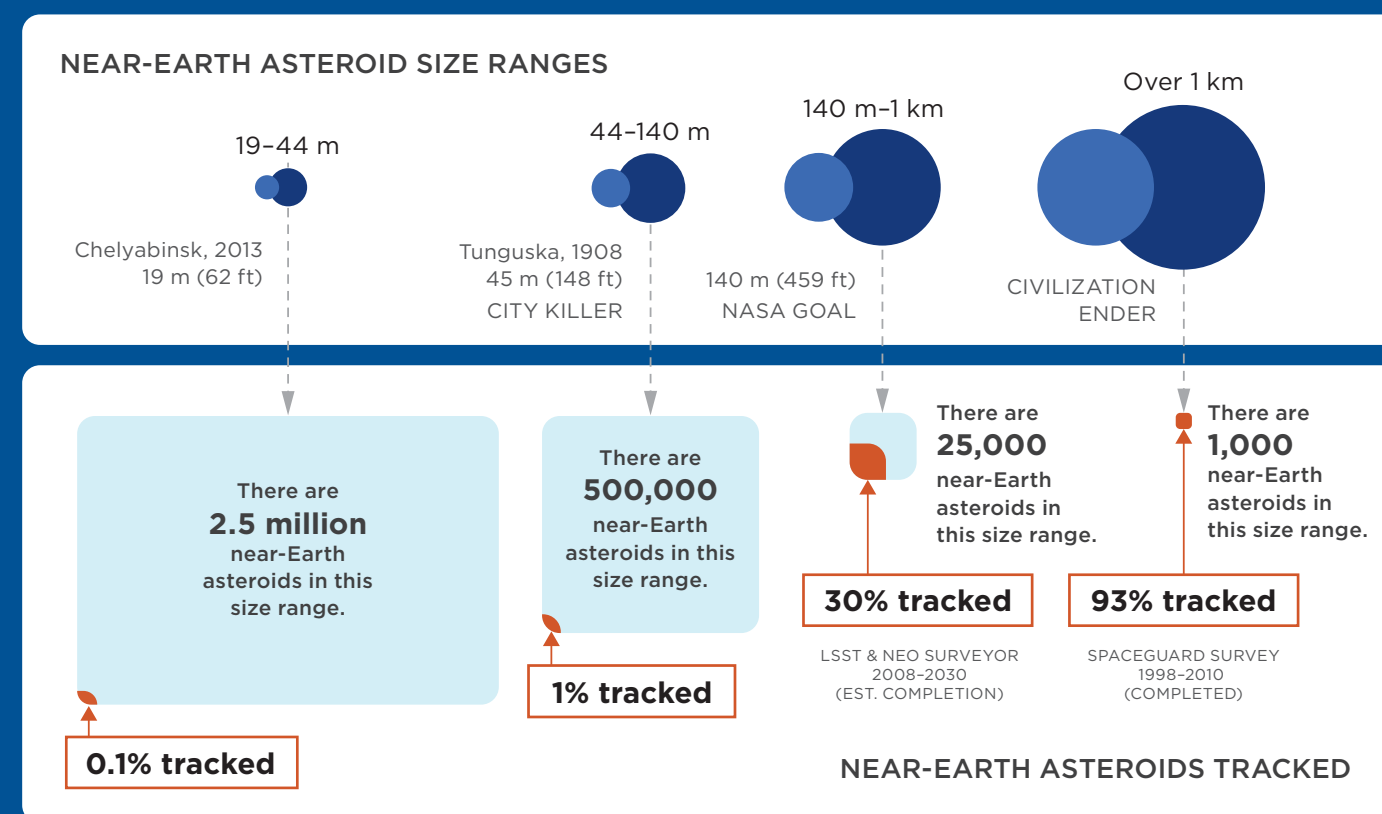
ASTEROID INSTITUTE DISCOVERY PROGRESS*

Asteroid Institute discoveries compared to Minor Planet Center recorded discoveries. Each year includes both main belt and near-Earth asteroids as well as other minor planets.



GLOBAL NEAR-EARTH ASTEROID DISCOVERY PROGRESS*

More than 99% of the asteroids large enough to destroy a city (like the Tunguska asteroid) remain untracked.



The Minor Planet Center has 36,019 near-Earth asteroids in its database. This year, 1,881 new NEAs were discovered, largely by Pan-STARRS and Catalina Sky Surveys.

*As of October 1, 2024



Asteroid Day, recognized internationally by the United Nations on June 30th annually, saw a remarkable increase in participation this year, with 600 events held worldwide—double the number from the previous year. The Asteroid Foundation and its main sponsor, the Luxembourg Space Agency, featured astronauts and asteroid experts, school visits, and a live-streamed event in Luxembourg. B612 hosted a program with the Chabot Space and Science Center that included astronauts Nicole Stott and Steve Smith, and astronomer Scott Manley.

A sample of global activities included a full-day event in Pueblito de las Vizcachas, Chile, organized by the Milenio Institute of Astrophysics; an immersive experience at Italy's Gal Hassin with lectures and sky-watching; and a regional conference in Jordan hosted by the Arab Union for Astronomy & Space Science. These events highlighted the global commitment to asteroid education and planetary defense.

Schweickart Prize

In its first year awarded to a student recipient, the 2024 Schweickart Prize was given to Joseph 'Joe' DeMartini. His SUNward NEO Surveillance and Early Twilight detection (SUNSET) Collaboration proposal aims to address the critical challenge of detecting Sunward Near-Earth Objects (SNEOs), which pose a significant threat due to their difficult-to-observe orbits and potentially short warning times before impact.

The awards ceremony was co-hosted at the Chabot Space and Science Center in Oakland, California, where Joe received a meteorite prize and a \$10K check. He plans to use the funds to bring the SUNSET Collaboration to life, working alongside B612 partners from the Vera C. Rubin Observatory. The public program featured special guests, including Apollo 9 astronaut Rusty Schweickart, NASA astronauts Nicole Stott and Steve Smith, and astronomer Scott Manley.



Schweickart Prize June 30, 2024
A PROGRAM OF B612 DATE
PAY TO THE ORDER OF *Joseph V. DeMartini* \$ 10,000.00
Ten thousand and 00/100 DOLLARS
FOR *Winner 2024 Schweickart Prize*

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Leadership Gift \$1 M-\$5 M in **bold**.

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*From September 1, 2023 to October 1, 2024