



## *Arecibo Science Advocacy Partnership (ASAP)*

<http://areciboscience.org>

### **Why a New Arecibo Observatory?**

Arecibo Observatory, with its huge 1000-foot (305-meter) reflector, was the world's largest single-dish radio telescope. Arecibo led the world in high-sensitivity radio astronomy until 2020, when China's 500-meter FAST radio dish came online.

Shortly thereafter, due to an unfortunate error in its construction, one of Arecibo's twelve main structural cables slipped from its anchor. Three months later, on December 1, 2020, the 57-year-old Arecibo telescope collapsed, leaving future discoveries in high-sensitivity astronomy to Chinese scientists.



However, China's FAST observatory lacks several of Arecibo's key capabilities. These included the world's most powerful planetary radar system, vital for tracking near-Earth asteroids, which are potential impactors. The United States lost more than a telescope when we lost Arecibo. We lost our scientific competitive edge, not only in radio astronomy and asteroid and planetary radar, but also in atmospheric and geospace radar sciences.

Arecibo Observatory was essential to key U.S. scientific accomplishments, including:

- Detailed mapping of the shapes and trajectories of asteroids and other near-Earth objects.
- Monitoring of ionospheric signatures of nuclear detonations and other important national security observations.
- Providing a wealth of data about hurricanes and other aspects of extreme weather, improving our ability to predict and prepare for major storms.
- Discovery of the first exoplanets, a major milestone in the search for life in the universe.
- Discovery of the first pulsars, high-density stars spinning hundreds of times a second, and among the most accurate clocks in the universe.
- The first indirect detection of gravitational waves, confirming Einstein's General Theory of Relativity, which is a key design constraint in enhanced GPS navigation. The Nobel Prize in Physics was awarded for this discovery.
- The first maps of the surface of Venus, which have been vital to further exploration.

## Why a New Arecibo Observatory? (continued)

The United States has the opportunity to create a new, cutting-edge, multi-disciplinary observatory in an already established facility on U.S. soil, in Puerto Rico, which would complement and surpass all other current and planned facilities. It will build on the millions of dollars of investment in Arecibo instrumentation, techniques, facilities, and personnel over the past sixty years. Here's why it should proceed:

### ***Restore U.S. science leadership***

If the National Science Foundation (NSF) goes forward with its plan to dismantle the Arecibo Observatory's scientific mission, abandoning millions of dollars in instrumentation and leaving just a STEM education center, we will unwisely cede U.S. leadership in astronomical, planetary, and atmospheric radio and radar science to other countries: FAST and Sanya in China, the VLBI Quasar Network in Russia, the Square Kilometer Array in Australia and South Africa, EISCAT 3D in Europe, and other cutting-edge instruments in Asia, South America, and elsewhere.

### ***Enhance national security***

The Arecibo radar was capable of higher resolution and more extensive coverage than any other atmospheric observatory. It was built in part to detect the ionospheric signatures of nuclear detonations, and a new observatory could do this even more accurately. Using Arecibo's unique radar and radio capabilities, Air Force and Navy scientists have studied the disturbances created by spacecraft engine burns and powerful radio transmissions. The location of Arecibo is ideal for these studies, because the upper atmosphere over Puerto Rico is among the most pristine locations in the world.

Measurements made at Arecibo can also play a key role in improving over-the-horizon radar observations of the strategic Caribbean region, which has some of the world's highest traffic in vessels and marine cargo. A new Arecibo can help solve the serious and urgent crisis of space debris, and in the development of radar methods for deep subsurface resource exploration of asteroids and the moon, detection and monitoring of cislunar spacecraft (close to the moon) and hypersonic vehicles (many times faster than the speed of sound). These are new and challenging national security priorities, in which a new, advanced, multifrequency radar system at Arecibo can play a key role.

### ***Collect essential data on extreme weather to build on years of prior information***

Because Puerto Rico is on the hurricane path between the Atlantic and the mainland USA, atmospheric studies done at Arecibo can help to predict and thus prevent billions of dollars in damage and casualties caused by these storms. Arecibo Observatory has contributed uniquely to the enormous, long-term, high-resolution data sets, spanning the atmosphere through the ionosphere, required by climatologists. Advanced atmospheric radars are now coming on line in Europe, Asia, and South America. A new Arecibo could match and far surpass their capabilities.

### ***Maintain leadership in planetary defense: From asteroids to space situational awareness***

The modern-day protection of our planet from wayward asteroid impacts depended for years on Arecibo's highly detailed ability to map and track near-Earth objects. Only the new Arecibo can reliably tell us which of the over two thousand asteroids classified as "potentially hazardous" are a real threat. The Arecibo deep space radar was the best in the world by a factor of fifteen over the next most powerful, and a new telescope would improve on that margin. In 2019 alone, the legacy Arecibo radar observed over one hundred asteroids, about twice as many as can be done using our remaining radar infrastructure. Arecibo data just helped NASA divert an asteroid, so we know intervention works — but, to do it, we need the data that only Arecibo can provide.

**Investing in the Arecibo Observatory will help  
to re-establish the USA's competitive advantage  
in science, national security, and planetary defense.**