



## Why a New Arecibo Observatory?

The Arecibo Observatory led the world as the largest single-dish radio telescope until 2020, when China's FAST instrument came online. However, that instrument lacks some of Arecibo's key capabilities, including the most powerful planetary radar system in the world, vital for tracking near-Earth objects. Arecibo was and could continue to be an unparalleled asset for U.S. space situational awareness. A large component of the United State's scientific competitive edge in Space and Atmospheric Sciences, Radio and Radar Astronomy was lost when we lost Arecibo.

The Arecibo Observatory was essential to key scientific developments including:

- Detailed mapping of the shapes and course 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 climate change, improving our ability to predict and prepare for storm damage
- Discovery of the first exoplanets
- Discovery of the first pulsars that spin hundreds of times a second
- Confirmation of Einstein's General Theory of Relativity, making the first indirect detection of gravitational waves
- Detailed maps of the surface of Venus, which are vital to further exploration or consideration of settlements there.

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

***Restore Science Leadership for the U.S.:*** If the National Science Foundation (NSF) goes forward with its plan to dismantle the Arecibo Observatory's scientific mission, mothballing millions of dollars in instrumentation by leaving just a STEM education center, NSF will unwisely cede U.S. leadership in astronomical, planetary, and atmospheric radar and radio science to instruments in other countries: FAST in China, Russian VLBI Network Quasar in Russia, the Square Kilometer Array in Australia and

South Africa, EISCAT- 3D in the Scandinavian Arctic, and other cutting-edge instruments in Europe, Asia, Africa, and the rest of the world.

***Protect 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, scientists at the Department of Defense have studied the disturbances created by spacecraft engine burns and powerful radio transmissions. The Arecibo location is essential here 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 the detection and monitoring of satellites in cislunar (unique orbits around the moon) and hypersonic (many times faster than the speed of sound) vehicles. These objects present new and challenging threats that a new advanced radar at Arecibo can detect and track as they are deployed, thus making the world a safer place.

***Collect essential data on climate change to build on years of prior information.***

Because Puerto Rico is in a hurricane zone, atmospheric studies done at Arecibo can help to predict and thus prevent billions of dollars in damage and casualties caused by these storms. The Arecibo Observatory has contributed uniquely to the enormous long-term, high-resolution data sets, spanning the atmosphere through the ionosphere, required by current and future 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 Planetary Defense Leadership: from asteroids to space situational***

***awareness*** This vital protection of our planet used to rely on Arecibo's highly detailed mapping and tracking of near-Earth asteroids. Which of the over 2,000 asteroids classified as "potentially hazardous s" are a real threat? Only the new Arecibo can tell us. The Arecibo space radar was the best in the world by a factor of 15 over the next most powerful, and a new telescope would improve on that margin. In 2019 alone, the legacy Arecibo observed over 100 asteroids, about twice as many asteroids as the existing radar infrastructure can. Arecibo data just helped NASA divert an asteroid, so we know intervention is possible – if we have the data.

**Investing in the future of this facility is an important step in allowing the US to maintain its scientific and security competitive edge worldwide.**