



Arecibo Science Advocacy Partnership

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The Arecibo Science Advocacy Partnership Board

Scientists Say the NSF Will Stop the Heart of STEM in Puerto Rico

Arecibo, Puerto Rico — The Arecibo Science Advocacy Partnership (ASAP) lauds the National Science Foundation’s solicitation for a new multidisciplinary, world-class educational center at the Arecibo Observatory in Puerto Rico, but strongly disagrees with the plan to not include rebuilding the 305-meter telescope or to provide operational support for current scientific infrastructure or personnel. Without active, multidisciplinary, world-class research, there is no platform for a world-class educational center.

Education in science, technology, engineering, and mathematics (STEM) has always been a foundational component of the Arecibo Observatory. At the Angel Ramos Foundation Visitor Center, more than 100,000 students and members of the public access educational materials and a view of the 305-meter telescope every year. In addition, the Arecibo Observatory has instituted a wide variety of scientific training programs for high school and university students, as well as for early-career scientists.

Since 1972, Arecibo Observatory has hosted student internship programs aimed at training the next generation of scientists, and, in 1987, the Observatory became one of the original NSF Research Experience for Undergraduates (REU) program sites. The scientists at the Observatory host several training workshops per year to enhance the understanding of radio astronomy, planetary science, and ionospheric science. These programs include for example the Single Dish Summer School (co-hosted with the Green Bank Observatory) and the Incoherent-Scatter Radar Summer School (co-hosted with the Millstone Hill and EISCAT radar observatories).

The Arecibo Observatory has also maintained a robust and successful STEM outreach program through the STEM Teaching at Arecibo (STAR) Academy, and previously the Arecibo Observatory Space Academy (AOSA). These programs target high school level students in

Puerto Rico, providing them the resources to do independent research and prepare for college. The STAR Academy includes a separate component for Puerto Rican teachers to help improve their STEM teaching skills.

Fundamental to all of the training and education programs offered at Arecibo Observatory is the ability to work alongside scientists on-site, get hands-on experience operating the instruments, and directly analyze new scientific data. A variety of instruments and equipment are still intact at Arecibo, including the 12-meter radio telescope and the optical lidar telescopes. All current instrumentation could be kept operational with a modest amount of annual funding.

In addition, the six 100-kW high-frequency (HF) transmitters, the 430-MHz radar transmitter, the power generation plant, and electronic measurement and test equipment all survived the December 2020 platform collapse and are in operation condition. Filling in the missing 30 percent of the 305-meter dish with a mesh that would work up to 1 GHz, similar to the original dish from the 1960s, would allow renewed high-frequency (HF) operations, 430-MHz radar measurements, and radio astronomy observations. In addition to the dish, HF transmissions would require repairs to the transmission lines and installation of a new, lightweight subreflector. All of this could be implemented in the immediate future at low cost.

Héctor Arce of the Arecibo Science Advisory Partnership asks, “If the U.S. were serious about expanding the numbers of scientists from under-represented groups, would it cut out all the actual science being done at a world-renowned research institution in Puerto Rico? What has inspired generations of students there at all levels is the ability to work alongside Observatory scientists on-site, get hands-on experience operating the instruments at the facility, and directly analyze new scientific data. That’s what makes scientists, not sitting in a classroom or hearing reports.”

The NSF solicitation ignores, undermines, and undercuts the excellent ongoing scientific research at Arecibo with the existing instruments. This research provides the leverage required for world-class STEM education and outreach. Many of the existing Arecibo STEM programs depended on the presence and participation of Observatory scientists and scientific instrumentation.

The NSF and NASA mutually fund decadal surveys to guide them in the funding decisions for the following decade. The 2020 Decadal Survey for Astronomy and Astrophysics states: “The loss of Arecibo is a setback for pulsar timing experiments, and underscores the need for radio facilities that can continue this critical science”, in addition to calling out Arecibo’s “continuation as an important nexus for education, community, and developing a diversified STEM workforce”.

Furthermore, the Planetary Science and Astrobiology Decadal Survey found that: “The loss of the Arecibo Observatory planetary radar greatly inhibits the ability to perform follow-up NEO [near-earth object] characterization. Existing radar infrastructure can observe only half the asteroids once observable with Arecibo.” In addition, ground-based radar observations of Venus are no longer possible: “Radar mapping of the Venusian surface is most feasible at L- and S-

band; the current GSSR [Goldstone Solar System Radar] infrastructure is unable to support radar observations of the Venusian surface”, and the detailed radar imaging of other planetary bodies is now largely impossible due to the inadequate sensitivity of the Goldstone radar, which, since the loss of the Arecibo radar, is the only remaining solar system radar.

The planetary decadal survey also recommends that “NASA and NSF should support studies to develop a plan for ground-based planetary radar capabilities comparable to or exceeding those of the Arecibo Observatory necessary for achieving planetary defense objectives.” Until such a study is conducted, the NSF should not remove one of the viable options, i.e. rebuilding the Arecibo telescope. To retain this option would require continued site investment and maintenance of equipment. The current funding opportunities are ill-equipped to do so.

The Arecibo Observatory was at the core of U.S. leadership in space sciences. Puerto Rico has hosted the telescope since its inception and has been proud to be the heart of radio and radar astronomy, atmospheric and geospace sciences, and related fields, for decades. For individual Puerto Rican students, there has been a priceless opportunity not just to visit the Observatory, but to see real multidisciplinary science happen, and, for some, to participate in it through hands-on experience. Many of the Arecibo telescope operators were inspired by visits they made as children. Puerto Rican astronomers cite the importance of the Observatory in cultivating their belief that world-class science could be done right there, and by them.

The NSF solicitation will provide an alarming reduction of funds compared to earlier levels of support for the Observatory. Arecibo used to operate on about \$12 million a year. The current proposal opportunity includes \$5 million over five years and a not-yet-announced amount for maintenance, while NSF itself is requesting a \$1.7 billion budget increase in its federal budget allocation. \$1 million per year for Arecibo is not commensurable to the people who have given their lives to the Observatory, and to the Puerto Ricans who have hosted and supported it.

Abandoning science as the primary activity at Arecibo is especially outrageous given that the NSF announcement disregards the encouragement of the U.S. Senate for the NSF, in consultation with NASA, “to study means of replacing the scientific capabilities that were lost at the Arecibo Observatory, utilizing new state-of-the-art technologies at the site” ([S.Res.467](#)) [1], as well as to study the “future research capabilities and technology at the site”, as guided by the CHIPS and Science Act. The Act acknowledges the vitality and importance of science and technology in our country’s future, and specifically mentions Arecibo’s significance. Despite what NSF [claims](#) [2], cherry-picking Arecibo’s educational programs, while eliminating science and research, is **not** consistent with the CHIPS Act.

NSF’s proposed abandonment of research at Arecibo is a serious blow to the notion of equity in STEM, at a time when achieving equity is a national policy driver. NSF’s proposal would match the disparity of the Federal disaster response to hurricanes in Puerto Rico with a parallel inequity in support for STEM education. The response by the scientific community should not compromise on a serious commitment by NSF to supporting ongoing research at Arecibo and to rebuilding the Arecibo radar and radio telescope.

The Arecibo Science Advocacy Partnership (ASAP) Board

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References:

[1] S.Res.467 – A resolution recognizing the contributions made by the 305-meter radio telescope at the Arecibo Observatory

<https://www.congress.gov/bill/117th-congress/senate-resolution/467/text>

[2] Arecibo Observatory: Media Resources

https://www.nsf.gov/news/special_reports/arecibo/