The Arecibo Observatory Celebrates 40 Years
A Timeline

1958
William E. Gordon, a Cornell University professor of electrical engineering, and his colleagues conceive of a very powerful radar system, consisting of a giant antenna and high-powered transmitter, for studies of the ionosphere, the layer of the atmosphere 50 to 1,000 kilometers (31 to 621 miles) above the Earth.


Robert Barker / CU

William Gordon

1960
Construction of the system begins at Arecibo, Puerto Rico. The first five Cornell families arrive at Arecibo on July 1 and open an office.

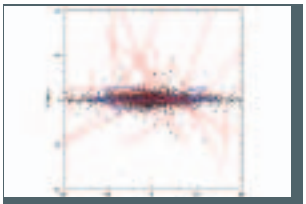
1963
The Arecibo Ionospheric Observatory is completed under Cornell's construction management. The U.S. Advanced Research Projects Agency funds the project, the U.S. Air Force administers it, and Cornell manages the facility for the Air Force. Intended for radar studies of the Earth's ionosphere, scientists realize the telescope's impact for radio and radar astronomy, as well.

1964
The Arecibo Observatory begins producing data: the first incoherent scatter measurements of the ionosphere and the first radar detection of Venus.

1965
Astronomers determine the rotation rate of Mercury (the length of time it spins once on its axis), which is 59 days, two-thirds of the planet's 88-day orbital period (the time it takes to orbit the Sun), meaning that the planet has just two days every three years.

1970
First measurement of winds in the ionosphere.

1971
The National Science Foundation (NSF) assumes funding responsibility for the Arecibo Observatory. The Cornell-based National Astronomy and Ionosphere Center (NAIC) is created to manage the huge radio telescope for the NSF.

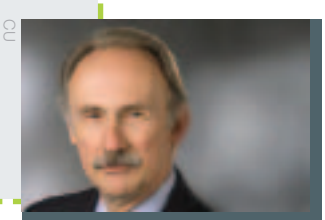

Fast-moving pulsars—red lines; slower-moving pulsars—blue lines; ordinary stars—black dots

"When we were talking about building it back in the late '50s, we were told by eminent authorities it couldn't be done. ...We were in the position of trying to do something that was impossible... it took a lot of guts...we were young enough that we didn't know we couldn't do it. It took five years from idea to dedication, and that is short. But we were in the right place at the right time and had the right idea and the right preparation. We had no rules or precedents. ...These days if you proposed a big project it would take five years to get the committee appointed."

William E. Gordon
Professor Emeritus
Rice University
(Arecibo telescope designer and former Cornell engineering faculty)

"It's really fascinating to see the development of this instrument and how it evolved in technology and how it's moved into new areas of science. scientifically, it's very alive."

Harold D. Craft, Jr.
Vice President for Administration and CFO
Cornell University
(A former Cornell graduate student who did research on pulsars at the observatory from 1967 to 1969, former director of Arecibo, 1973-1981, and NAIC director for a year)


CU
Harold Craft, Jr.

1972
First detection of the high frequency-enhanced plasma line in the ionosphere using the first ionospheric modification facility in the United States.

1974
First upgrade at the observatory, costing $9 million and financed by the NSF and NASA, is completed. The telescope's original wire-mesh surface is replaced with 38,788 very accurately shaped aluminum panels, allowing the telescope to operate at frequencies as high as 3 gigahertz (GHz—billions of cycles per second) at a 10-centimeter wavelength. A high-powered transmitter (420 kilowatts) operating at 2.4 GHz is installed for planetary radar studies.

Late 1970s
Observations at Arecibo show that galaxies are far more massive than previously thought and are largely made of "dark" matter, which cannot be seen directly.

Arecibo radar images of Venus provide the first detailed look at the surface of the planet and show that the age of the surface is less than one billion years.


NAIC
Arecibo Telescope

1980s
Detailed maps are assembled showing the filamentary nature of the 3-D distribution of galaxies in the universe.

1982
Discovery of the first known OH (hydroxyl) megamaser—a radio emission that is now known often to be indicative of collisions between two galaxies.

Discovery of the first millisecond pulsar (a fast-spinning neutron star), PSR B1937+21.

1986
Verification of the escape of hydrogen from Earth's exosphere (the outermost region of the atmosphere) using optical Fabry-Perot measurements.

1988
Arecibo celebrates its 25th anniversary.

1991
The first planets outside the solar system are discovered around a pulsar by Alex Wolszczan, a staff scientist at the observatory.

1992
The second upgrade of the telescope begins to facilitate observations at frequencies up to 10 GHz (3-centimeter wavelength) and increase the sensitivity at all frequencies. A new 1-megawatt transmitter is planned for planetary radar observations and a dual beam capability for ionospheric research.


NAIC
Arecibo Telescope

In a normal galaxy, baryonic matter—stars and interstellar gas and dust—resides deep inside a huge, massive envelope of dark matter, known as a "halo."

Martha P. Haynes
Astronomy, Cornell University

1994

Detection of the helium layer in the Earth's ionosphere.

1997

Completion of the second upgrade of the telescope: The $25 million cost was funded by the NSF and NASA, with a contribution from Cornell. It includes installation of a Gregorian reflector system, which is suspended 137 meters (450 feet) above the telescope's 305-meter-diameter (1,000-foot) dish, a 50-foot-high, steel wire mesh groundscreen around the perimeter of the dish, and a 1-megawatt radar transmitter. The Gregorian reflector system allows the telescope to operate over the full frequency range allowed by the accuracy of the 38,788 panels of the primary reflector, up to 10 GHz. The upgrade greatly increases the telescope's sensitivity, frequency coverage, and agility, and enables dual-beam incoherent scatter radar capability, providing new research opportunities.

The Angel Ramos Foundation Visitor and Education Center opens to promote a greater public understanding of science.

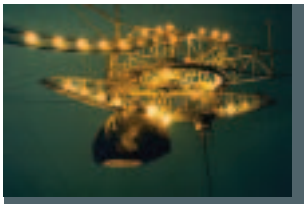
NAIC

Visitor Center

"The Terzian research group plans to use the sensitivity of the Arecibo radio telescope to survey the plane of the galaxy and map all the ionized radio-emitting interstellar clouds.

Yervant Terzian
Astronomy, Cornell University

NAIC



Gregorian Dome

"Allan [Allan Love of Rockwell International who designed the telescope's circular line feed] built a line feed that still works perfectly. ...Yet it has never had a bath, and it has never melted."

Astrophysicist Frank Drake
Professor Emeritus
University of California, Santa Cruz
(A former staff astronomer and director of the Arecibo Observatory)

Molecules play a key role in the structure and evolution of galaxies, stars, and planets, although it is surprising that molecules can exist in the harsh environment of interstellar space. How are they formed? How do they survive?

Paul F. Goldsmith
Astronomy, Cornell University

"...An important recipient of NSF's public investment in educational programs, in astronomical and atmospheric research, and in scientific facilities and infrastructure."

Rita Colwell
Director
National Science Foundation
(The funder of the Arecibo Observatory)

2000

First images of binary near-Earth asteroids, and the first measurements of micrometeor decelerations.

2002

Galactic turbulence, an ingredient in cosmic cloud and star formation, is discovered in starless areas of the Milky Way.

Detection of interstellar micrometeors.

2003

Radar reveals the first evidence of liquid hydrocarbon lakes on Titan, the largest moon of Saturn. A Cornell-led astronomy team detects specular—or mirrorlike—glints from Titan with properties that are consistent with liquid hydrocarbon surfaces. Cornell astronomer Donald Campbell, who led the observation team, does not dismiss that the reflections could be from very smooth, solid surfaces.

November 1, 2003

Arecibo Observatory celebrates its 40th anniversary.

2005

The NSF-funded, multimillion-dollar Arecibo L-band Feed Array, dubbed ALFA, will begin operation. The new instrument will greatly improve how radio astronomy research is conducted. It will enable major survey projects of the heavens and will lead to a big increase in the volume of astronomical data that will flow from Arecibo.

NAIC

Arecibo Telescope

Robert Barker/CU

Donald Campbell

> the multiple feeds of the arecibo l-band feed array (alfa) will allow the sky to be surveyed faster and also provide the ability to remove radio frequency interference that can mimic pulsar signals.
>
> james m. cordes
> astronomy, cornell university

Robert Barker/CU

Attending the Arecibo celebrations were, from left, Cornell President Emeritus Dale Corson; Robert Brown, director of NAIC; Sixto González, director of Arecibo Observatory; Robert Richardson, Cornell Vice Provost for Research; and Joseph Burns, Vice Provost for Physical Sciences and Engineering

> "el radar arecibo could be addressed as one of the most important classrooms in puerto rico. ...here at arecibo observatory, many teachers, many students have enriched their capacity to see the world with imagination, with a sense of wonder, a sense of marvel."
>
> césar a. rey hernández
> secretary of education
> puerto rico

Excerpts from news releases of the Cornell News Service