SCIENCE

An Influential Female Astronomer Is Getting Her Due

A new observatory has been renamed in honor of Vera Rubin, whose work led astronomers to the mysteries of dark matter.

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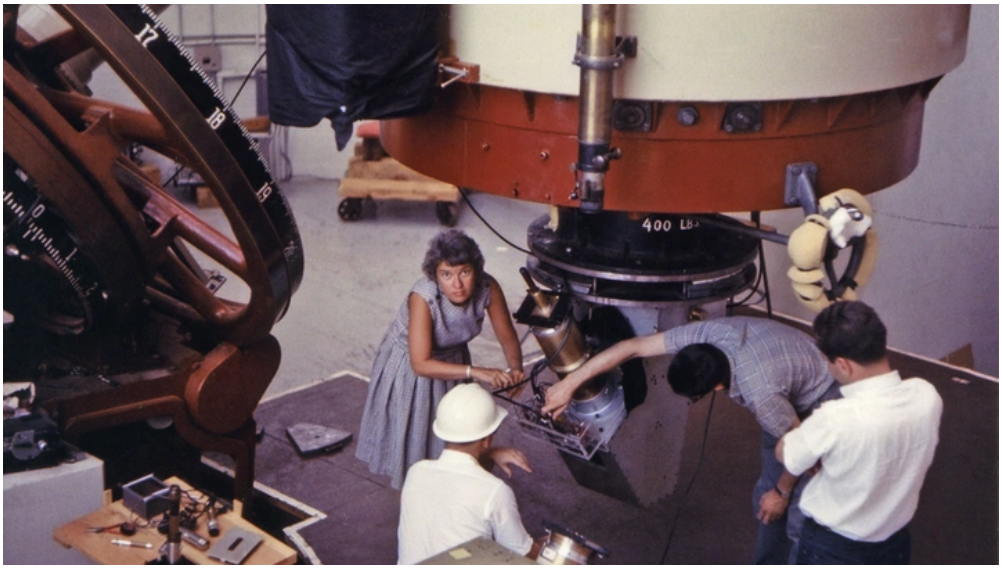

Vera Rubin in 1965 (COURTESY OF THE CARNEGIE INSTITUTION FOR SCIENCE)

In too many early accounts of women working in fields dominated by men, the story includes a bathroom. Specifically, that there wasn't one for them to use.

For Vera Rubin, this particular predicament came in the mid-1960s, when she was invited to the Palomar Observatory, a telescope facility in California. The mountaintop observatory, as well as its living quarters, were not open to women; if you wanted to get some telescope time at Palomar, you had to sneak in under your husband's name. As such, the lavatories were labeled for men. Rubin, the first woman to be formally allowed in, cut paper into the shape of a skirt and stuck it to the door of one of the bathrooms. "There you go," Rubin said, according to a former colleague. "Now you have a ladies' room."

Rubin worked in astronomy for more than half a century after that, and this week, officials announced that a new observatory will be renamed in her honor. According to the National Science Foundation, the Vera C. Rubin Observatory, née the Large Synoptic Survey Telescope, is the first American observatory to be named after a woman.

Starting in 2022, the Rubin observatory will collect data on the solar system, the Milky Way, and, among other things, its namesake's specialty: dark matter, the invisible material that permeates the universe. Rubin's work in the 1970s provided convincing evidence that dark matter existed, a revelation that sparked, as *The New York Times*'

Dennis Overbye put it—and without any exaggeration—"a Copernican-scale change in cosmic consciousness."

Rubin was not an invisible figure in her field, and she received significant recognition for her work, including the National Medal of Science and an eponymous ridge on Mars. Such accolades, on top of her perspective-shifting work, could have earned her a Nobel Prize in Physics, many of her peers felt. For years, members of the scientific community lobbied in support of Rubin's consideration, and every year since her death in 2016, her name has come up during announcements of Nobel Prizes, which are given to living recipients, as an example of the committee's abysmal record of recognizing female scientists.

The christening of the observatory was announced this week at an annual meeting of the American Astronomical Society, which once hosted a 22-year-old Rubin for a presentation of her master's thesis, on the motions of galaxies, in 1950. Her adviser had offered, because of the circumstances—Rubin wasn't a member of the society, and she was a month away from her first child's due date—to deliver the thesis for her, in his name. "I said to him, 'Oh, I can go,'" Rubin wrote in an autobiography. She drove, with her husband and infant in tow, and gave the talk, which turned out to be more controversial than she expected. "One by one many angry sounding men got up to tell me why I could not do 'that,'" she recalled.

In the 1960s, one of Rubin's colleagues at the Carnegie Institution for Science, Kent Ford, developed a telescope instrument that amplified starlight, and together they observed the stars of galaxies once too faint to be seen. Their first target was the Andromeda galaxy, the nearest major galaxy to our own. Rubin and Ford expected that the contents of this spiral galaxy—stars, gas, dust—would spin faster at its center, where there were many of them, than at its edges.

But they found that the matter at the fringes was rotating just as quickly. This seemed impossible. If matter were indeed traveling at these speeds, the galaxy should have been flying apart in all directions. And yet there it was, a glittering, intact spiral, seemingly unaware that, according to the laws of gravity that humankind had worked out, it shouldn't exist.

For this phenomenon to make sense within our definitions of physics, something else had to be contributing to the mass of the galaxy, far more than the stars that were visible and thus could be measured. Rubin pored over the data, punched into card paper. There was nothing there. Nothing they could see anyway.

After Rubin and Ford published their work in 1970, they were told, unsurprisingly, to look at more galaxies. When they did, they found the same pattern, again and again. So did other astronomers. Eventually, the community was forced to reckon with an uncomfortable but obvious explanation: that there is some kind of matter around us—much more than the type that can be detected—that does not emit or reflect light, and that stitches together the cosmos like an invisible seam.

[Read: Why the search for dark matter depends on ancient shipwrecks]

Rubin did not discover dark matter, a clarification she used to make herself. No one has. Astronomers have so far seen dark matter only indirectly, in the way it interacts,

through gravity forces, with the ordinary, light-producing matter that makes up galaxies and galaxy clusters. They have worked out that not only does dark matter keep webs of galaxies intact; it was probably responsible for drawing matter together in the first place, when the universe was young. While the existence of the invisible substance is not in dispute, individual particles of dark matter have yet to be detected. "It's like looking at a huge sand dune," Priyamvada Natarajan, a theoretical astrophysicist at Yale for whom Rubin was a source of professional support, once explained to me. "You know how the sand dune is assembled, you can show how it dissipates in the wind, how it's washed out by water. But you don't know what a grain of sand is made of."

The absence of a bona fide detection shaped the argument against a Nobel Prize for Rubin. Some questioned "whether her indirect evidence was enough to determine the existence of dark matter," Lisa Randall, a physics professor at Harvard, wrote in 2017, "or whether she was responsible for interpreting the overly rapid rotations of galaxies—a phenomenon that she and her collaborators had decisively observed—as evidence" for its existence.

These were "legitimate controversies," Randall said, but in the Nobel committee's history, such concerns have not always blocked awards. The 2011 Nobel Prize in Physics went to three men for discovering that the expansion of the universe is accelerating rather than slowing down. The contributing force is thought to be dark energy, another invisible kind of matter that permeates the universe and, in fact, accounts for most of it. But the nature of dark energy is as mysterious as that of dark matter. And last year, the prize went to James Peebles, who, among other significant research, provided the theoretical work that supported the effects Rubin and Ford had observed.

[Read: The absurdity of the Nobel Prizes in science]

The gender ratio in astronomy, as in many sciences, remains lopsided, inside the laboratory and behind the lectern. Only as recently as 2018 did the stewards of Hubble, the world's premier space telescope, decide to hide gender information during reviews of research proposals; they found that a system blind to applicants' identities erased the gender disparities that the institution had long seen.

Rubin, who kept going into her office at the Carnegie Institute until her 80s, was well known for her support of other women in astronomy. Her observations helped give rise to a new wing of the discipline, but it was her personal guidance and public support that encouraged the female scientists who worked within it. It is impossible to say when the mysteries of dark matter will be truly uncovered. But an observatory named Rubin might play a pivotal role, as its namesake did, with an eye toward the sky and, one would hope, bathrooms for everyone.

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