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Marcia Rieke

MARCIA RIEKE RECEIVES $500,000 GRUBER COSMOLOGY PRIZE

May 8, 2022, New Haven, CT – The 2024 Gruber Cosmology Prize recognizes Marcia Rieke of the University of Arizona's Steward Observatory for her pioneering work in infrared astronomy, especially her oversight of instruments allowing astronomers to explore the earliest galaxies in the universe.

Rieke will receive the $500,000 award as well as a gold laureate pin at a ceremony that will take place August 8 at the General Assembly of the International Astronomical Union in Cape Town, South Africa. The citation recognizes her "lasting impact on our understanding of the universe," in particular through her role as Principal Investigator on a key instrument aboard the James Webb Space Telescope (JWST)—an infrared camera that, in the nearly two years since the telescope began scientific operations, has both reinforced and challenged the understanding of the early universe.

Infrared astronomy investigates the part of the electromagnetic spectrum where the wavelengths of light are slightly to substantially longer than in the visible portion—the sliver of the spectrum that our eyes can see. Observing the universe in infrared light allows astronomers to probe the first stars and galaxies by exploiting a physical phenomenon that cosmologists call "redshift."

When light left the first galaxies, in the period 100 million to 1 billion years after the Big Bang, it occupied the visible and ultraviolet sections of the electromagnetic spectrum. In the 13.7 to 13 billion years since then, the expansion of the universe—the expansion of space itself—has stretched those light waves, lengthening them, shifting them not just toward the red end of the visible spectrum but into the infrared.

Rieke has devoted much of her career to infrared astronomy, both as an observer and in the capacity for which she is receiving the Gruber Prize—as an instrumentalist on major space missions. Astronomers desiring observations in the infrared observe from space because the infrared sky seen through the Earth's atmosphere is too bright to see distant galaxies.

She served on the Science Working Group for the Space Infrared Telescope Facility (later the Spitzer Space Telescope, which was operational from 2003 to 2020) and as the co-investigator for its onboard Multi-band

Imaging Photometer. She then assumed the role of deputy principal investigator for the Near Infrared Camera and Multi-Object Spectrometer on the Hubble Space Telescope. While that instrument allowed Hubble to see galaxies at significantly higher redshifts (and therefore at significantly earlier epochs in the universe) than any previous instrument, it also capped Hubble's observing capabilities at around a billion years after the Big Bang. If astronomers wanted to see the universe's first stars and galaxies, they would need a telescope that could see deeper into the infrared.

For that reason, Hubble's successor, the James Webb Space Telescope (originally the Next Generation Space Telescope), was always going to be primarily an infrared instrument. From 1997 to 2000 Rieke served on the telescope's ad hoc working group, helping to formulate its instrumentation and aspirations. She next chaired the telescope's Interim Science Working Group, from 2000 to 2003. In 2002, when the telescope was entering full design and production mode, NASA appointed Rieke the Principal Investigator for JWST's Near-Infrared Camera (NIRCam). Over the next twenty years, Rieke oversaw the development, delivery, and, after JWST's launch in December 2021, commissioning of NIRCam.

She has also availed herself of the telescope for her own research as well as her colleagues'. One of the perks of being a principal investigator on a major JWST instrument is an allotment of Guaranteed Observing Time—in Rieke's case, 900 hours. She and her collaborators have apportioned that observing time among teams that use another advantage of infrared astronomy—the ability to see through the universe's plentiful repositories of dust—to study the cosmos from the planets, moons, and loose bodies in our solar system, through the star- and planet-forming regions in the rest of our Milky Way galaxy, and across galaxies stretching to Hubble's 1 billion-years-after-the-Big-Bang horizon.

As for what lies beyond that horizon, NIRCam has repeatedly produced results redefining cosmology. According to JWST, galaxies in the early universe developed earlier, grew larger, and spawned a richer array of elements than previous theories had predicted. While that mismatch of prediction and observation initially resulted in a flurry of articles and essays proclaiming that "Webb broke cosmology," Rieke (like the vast majority of cosmologists) sees the process as an example of the scientific method at work.

"There's a story beginning to emerge," Rieke says, "but we still need some more pieces to the story." For the next twenty years or more—the duration of JWST's lifetime—many of those pieces will emerge from the instrument that Rieke, more than anyone else, willed into existence.

Additional Information

In addition to the cash award, the recipient will receive a gold laureate pin and a citation that reads:

The Gruber Foundation is pleased to present the 2024 Cosmology Prize to Marcia Rieke for her pioneering work on astronomical instrumentation to reveal the breadth and details of the infrared universe. Her contributions to flagship space missions have opened new avenues for understanding the history and mechanisms of star and galaxy formation. She enabled the development and delivery of premier instruments providing groundbreaking sensitivity to near-infrared wavelengths to both the James Webb Space Telescope (NIRCam, as Principal Investigator) and the Hubble Space Telescope (NICMOS, as Deputy Principal Investigator). Through these substantive contributions along with earlier work, Marcia Rieke has had a lasting impact on our understanding of the universe.

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The Cosmology Prize honors a leading cosmologist, astronomer, astrophysicist or scientific philosopher for theoretical, analytical, conceptual or observational discoveries leading to fundamental advances in our understanding of the universe.

Laureates of the Gruber Cosmology Prize:

- **2023 Richard Ellis**, for contributions in galaxy evolution, onset of cosmic dawn and reionization in the high redshift universe, and detection of earliest galaxies via the Hubble Ultra Deep Field study
- **2022 Frank Eisenhauer**, for instruments that collected evidence of a black hole at our galaxy center
- **2021 Marc Kamionkowski, Uroš Seljak, and Matias Zaldarriaga,** for contributions to methods essential for studying the early universe
- **2020**: **Lars Hernquist** and **Volker Springel,** for computer simulations that revolutionized the study of processes behind the structure of the cosmos
- **2019: Nicholas Kaiser** and **Joseph Silk,** revolutionized cosmology with contributions to two of its vital components: dark matter and relic radiation from the Big Bang
- **2018: The Planck Team, Jean-Loup Puget** and **Nazzareno Mandolesi,** for measuring the universe's contents and the geometry and test inflation with unparalleled precision
- **2017: Sandra M. Faber,** for a body of work that has helped establish many of the foundational principles underlying the modern understanding of the universe on the largest scales
- **2016: Rainer Weiss, Kip Thorne, Ronald Drever,** and the entire **LIGO team,** for a first detection of gravitational waves that emanated from the collision of two black holes
- **2015: John Carlstrom, Jeremiah Ostriker,** and **Lyman Page**, for their individual and collective contributions to the study of the universe on the largest scales
- **2014: Jaan Einasto, Kenneth Freeman, Brent Tully** and **Sidney van den Bergh,** for pioneering contributions to the understanding of the structure and composition of the nearby Universe
- **2013: Viatcheslav Mukhanov** and **Alexei Starobinsky,** for contributions to inflationary cosmology and the theory of inflationary perturbations of the metric, which changed our views on the origin of our universe and on the mechanism of formation of its structure
- **2012: Charles Bennett** and the **WMAP Team,** for their exquisite measurements of anisotropies in the relic radiation from the Big Bang---the Cosmic Microwave Background
- **2011: Marc Davis, George Efstathiou, Carlos Frenk**, **Simon White,** pioneering use of numerical simulations to model and interpret the large-scale distribution of matter in the Universe
- **2010: Charles Steidel,** for his groundbreaking studies of the distant Universe
- **2009: Wendy Freedman, Robert Kennicutt** and **Jeremy Mould,** for the definitive measurement of the rate of expansion of the universe, Hubble's Constant
- **2008: J. Richard Bond,** for his pioneering contributions to our understanding of the development of structures in the universe
- **2007: Saul Perlmutter** and **Brian Schmidt** and their teams: the **Supernova Cosmology Project** and the **High-z Supernova Search Team,** for independently discovering that the expansion of the universe is accelerating
- **2006: John Mather** and the **Cosmic Background Explorer (COBE) Team,** for studies confirming that our universe was born in a hot Big Bang
- **2005: James E. Gunn,** for leading the design of a silicon-based camera for the Hubble Space Telescope and developing the original concept for the Sloan Digital Sky Survey
- **2004: Alan Guth** and **Andrei Linde,** for their roles in developing and refining the theory of cosmic inflation
- **2003: Rashid Alievich Sunyaev,** for his pioneering work on the nature of the cosmic microwave background and its interaction with intervening matter

- **2002: Vera Rubin,** for discovering that much of the universe is unseen black matter, through her studies of the rotation of spiral galaxies
- **2001: Martin Rees,** for his extraordinary intuition in unraveling the complexities of the universe
- **2000: Allan R. Sandage** and **Phillip J. E. (Jim) Peebles**, Sandage for pursuing the true values of the Hubble constant, the deceleration parameter and the age of the universe; Peebles for advancing our understanding of how energy and matter formed the rich patterns of galaxies observed today

The International Astronomical Union partners with the Foundation on the Prize and nominates the members of the Selection Advisory Board that chooses the Prize recipients. Its members are:

Jeremy Butterfield, University of Cambridge; **Mihalis Dafermos**, Princeton University; **Luis Ho**, Kavli Institute for Astronomy and Astrophysics at Peking University; **Angela Olinto** (Chair), Columbia University; **Jean-Loup Puget**, The National Centre for Scientific Research (CNRS); **Suzanne Staggs**, Princeton University; **Licia Verde**, Universitat de Barcelona. **Wendy Freedman** of The University of Chicago and **Martin Rees** of The University of Cambridge also serve as special Cosmology advisors to the Foundation.

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The Gruber International Prize Program honors individuals in the fields of Cosmology, Genetics and Neuroscience, whose groundbreaking work provides new models that inspire and enable fundamental shifts in knowledge and culture. The Selection Advisory Boards choose individuals whose contributions in their respective fields advance our knowledge and potentially have a profound impact on our lives.

The Gruber Foundation was established in 1993 by the late Peter Gruber and his wife Patricia Gruber. The Foundation began its International Prize Program in 2000, with the inaugural Cosmology Prize.

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For more information on the Gruber Prizes, visit www.gruber.yale.edu, e-mail info@gruber.yale.edu or contact A. Sarah Hreha at +1 (203) 432-6231. By mail: The Gruber Foundation, Yale University, Office of International Affairs, PO Box 208320, New Haven, CT 06520..

Media materials and additional background information on the Gruber Prizes are in our online newsroom: https://gruber.yale.edu/news-media

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