A neutron star shown to scale against the Chicago skyline.

CENTER FOR INTERDISCIPLINARY EXPLORATION AND RESEARCH IN ASTROPHYSICS

A New Era in Astronomy

Four Northwestern University astronomers—as part of an international research collaboration—played a critical role in detecting the spectacular collision of two neutron stars that occurred around 1.4 billion years ago. These Northwestern scientists and their colleagues observed this cosmic event through the first-ever utilization of multi-messenger astronomy, which measured both the gravitational waves and the light produced by the impact of the two stars. This discovery, *Science* magazine's 2017 Breakthrough of the Year, has ushered in a new era in astronomy.

Gravitational waves were the subject of 2017 Nobel Prize in Physics, and multi-messenger astronomy was named one of the National Science Foundation's 10 Big Ideas for future scientific investment. Northwestern is currently one of the few universities in the world with expertise in both of these areas.

Advances in multi-messenger astronomy have put Northwestern in an enviable position to pursue pioneering research, train the next generation of astronomers, introduce more young people to STEM fields, and strengthen its already thriving environment for women scientists. With the right support, Northwestern's Center for Interdisciplinary Exploration and Research in Astrophysics (CIERA) can lead this field and establish the University as a top 10 program in astronomy.

"Northwestern astronomers are at the forefront of multi-messenger astronomy and are blazing new trails in the field."
—Vicky Kalogera, CIERA Director

Research and Training

The Northwestern astronomers who helped detect the collision of the neutron stars are affiliated with CIERA. Under the leadership of Vicky Kalogera, Daniel I. Linzer Distinguished University Professor of Physics and Astronomy, CIERA brings together more than 60 faculty from across the University representing a number of fields, including computer science, applied math, statistics, biology, chemistry, planetary science, electrical engineering, materials science, and mechanical engineering.

CIERA's goals are to pursue new research and to innovate in new telescope detectors, high-performance computing, and data science. The center also is committed to training the next generation of astrophysicists. About 50 postdoctoral fellows, graduate students, and undergraduates are advancing research under the direction of CIERA faculty. Northwestern is capitalizing on its strengths by:

- Leading in the new fields of gravitational-wave astrophysics, multi-messenger astronomy, and big data
- Spearheading the development of imaging instrumentation for the next generation of ground-based telescopes
- Using advanced space telescopes that have the potential to unlock the secrets of mysterious explosions and dark energy

Promoting STEM Learning

Looking at the stars is great way to introduce young people to astronomy as well as the broader STEM fields. CIERA inspires future generations of STEM scientists and cultivates public interest in astronomy with an education and outreach program that includes a public lecture series, partnerships with K–12 schools, and events at the Dearborn Observatory on Northwestern's Evanston campus. Since its founding in 2007, the center has impacted:

- 25,000 members of the public
- 5,000 students and 500 teachers at 200 schools

Women in Science

CIERA is committed to advancing women's contributions and leadership in astrophysics and data science. From partnering with organizations for girls to recruiting exceptional female faculty members who are role models inside and outside of the classroom, CIERA creates an environment where women scientists thrive. The center is at or above national averages for the representation of women in astronomy, including:

- 50% of incoming graduate students
- 67% of incoming postdoctoral researchers

LEADERSHIP

Vicky Kalogera received an undergraduate degree in physics from the University of Thessaloniki in Greece and a doctorate in astronomy from the University of Illinois at Urbana-Champaign. She then completed a prize postdoctoral fellowship at the Harvard-Smithsonian Center for Astrophysics. Kalogera came to Northwestern in 2001 and was named the Daniel I. Linzer Distinguished University Professor of Physics and Astronomy in 2017. She is a cofounder and current director of CIERA. Kalogera's research interests are in the astrophysics of compact objects and in particular their formation and evolution in multiple stellar systems. She has expanded into projects in gravitational-wave data analysis and astrophysical modeling involving methods from applied mathematics, statistics, and computer science, with extensive use of high-performance computing. She has received the Hans A. Bethe Prize from the American Physical Society, the Special Breakthrough Prize in Fundamental Physics, the Gruber Cosmology Prize, and the Dannie Heineman Prize for Astrophysics. She is a member of the National Academy of Sciences.

To learn more about CIERA, contact Michael Kelley at 847-467-2335 or mhkelley@northwestern.edu.

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