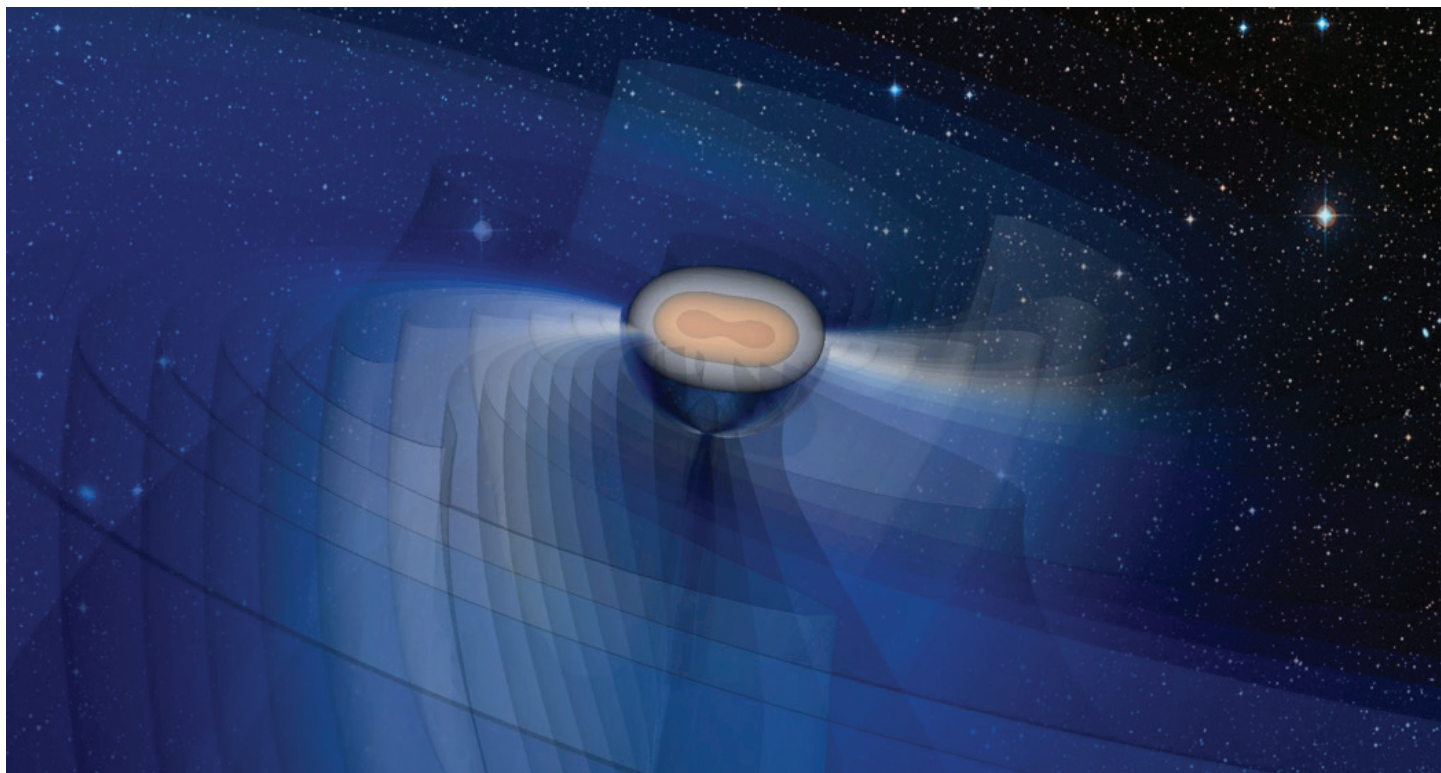


# WE WILL.

The Campaign for Northwestern

Astronomy and CIERA



This image, created by CIERA, shows gravitational waves produced by two black holes merging.

## Exploring the Universe

Looking to the stars to study the universe around us has been one of humankind's eternal endeavors. Starting with the naked eye, and now using advanced telescopes or ultra-sensitive laser instruments, astronomers have observed and improved our understanding of the cosmos. Each generation of scientists has built on the work of its predecessors, leading to the current moment where the field is once again at the dawn of a new era of discovery.

At Northwestern, our astronomers are driven by a passion to not only push those frontiers of discovery, but to seek out colleagues in other departments to break new ground in astronomy research, and to communicate those discoveries to Northwestern students and the public. A recent major astronomical breakthrough in which Northwestern faculty played key roles presents an opportunity to advance astronomy research and education at the University.

“It’s been an honor to contribute to the expansion of our horizons towards the brand new field of gravitational-wave astronomy. I believe that additional philanthropic support will lead to more breakthroughs with my Northwestern colleagues.”

—Vicky Kalogera, Director of CIERA and Erastus O. Haven Professor of Physics and Astronomy

## Gravitational-Wave Astrophysics

The existence of gravitational waves—ripples in the fabric of spacetime created by the merger of two black holes—had long been theorized but never observed. On September 14, 2015, the Laser Interferometer Gravitational-Wave Observatory (LIGO) detectors located in Louisiana and Washington identified, for the first time, gravitational waves that were generated from the collision of two heavy black holes approximately 1.4 billion years ago. The information carried by gravitational waves offers insights into the nature of gravity that cannot otherwise be observed, and their existence confirms a prediction of Albert Einstein's general theory of relativity that was published in 1915, 100 years before the LIGO discovery.

The LIGO experiment is a collaboration of more than 1,000 scientists and engineers, including two Northwestern astrophysicists, Vicky Kalogera, Erastus O. Haven Professor of Physics and Astronomy, and Shane L. Larson, a research associate professor who holds a joint appointment at the Adler Planetarium. Kalogera made key contributions to the discovery, including interpreting and analyzing the gravitational waves using data science. Larson's research will make possible the first-ever space-based gravitational-wave observatory. Their leadership roles present an opportunity to build on existing strengths and lead in this new, exciting field of gravitational-wave astrophysics.

## CIERA

One of Northwestern's greatest assets in astronomy is the Center for Interdisciplinary Exploration and Research in Astrophysics (CIERA). Under the leadership of Kalogera, the center 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. Together, their goals are to pursue new astrophysics research that builds on the recent gravitational wave discovery and to innovate in new telescope detectors, high-performance computing, and data science. CIERA is also committed to training the next generation of astrophysicists. About 50 postdoctoral fellows, graduate researchers, and undergraduate students are advancing research under the direction of distinguished CIERA faculty.

## PUBLIC EDUCATION AND OUTREACH

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 and events at the Dearborn Observatory on Northwestern's Evanston campus. Since its founding in 2007, the center has impacted:

- 21,000 members of the public
- 4,900 students at 190 schools in the Chicago metropolitan area
- 490 school teachers



## VICKY KALOGERA

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 Erastus O. Haven Professor of Physics and Astronomy in 2009. 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. Within the LIGO Scientific Collaboration, Kalogera led the work on astrophysical implications of the historic gravitational-wave discovery announced in early 2016. She has received numerous awards, including the Hans A. Bethe Prize from the American Physical Society, and, as a member of the LIGO discovery team, the Special Breakthrough Prize in Fundamental Physics and the Gruber Cosmology Prize.

## Vision for Astronomy

Northwestern is eager to capitalize on CIERA's unique strengths by focusing on the following strategies:

- Leverage LIGO discoveries and lead in the new fields of gravitational-wave astrophysics, multi-messenger astronomy, and data science
- Build a top research group that utilizes both gravitational-wave and electromagnetic observations, from the ground and space
- Spearhead the development of imaging instrumentation for the next generation of ground-based telescopes
- Use next-generation space telescopes that have the potential to unlock the secrets of mysterious explosions and dark energy

## Philanthropic Opportunities

CIERA is well positioned to lead as an international center for astrophysics research, but substantial private funding is needed to realize this vision. Northwestern seeks gifts to support the following initiatives:

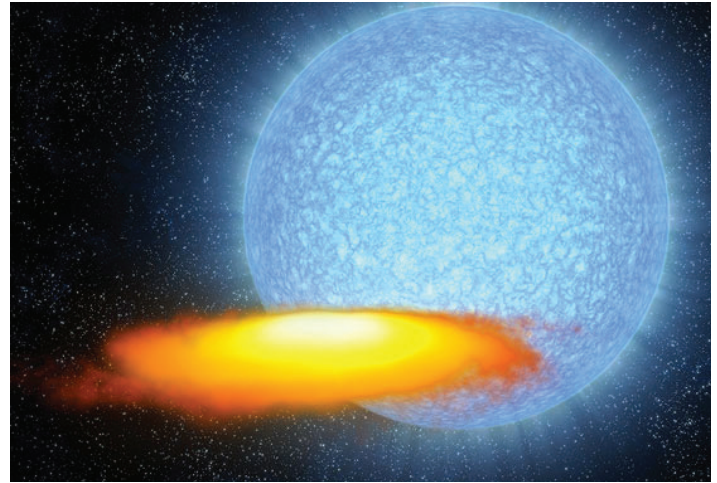
- Purchase a long-term share in a large optical telescope for pioneering observations of unexplained explosions in the universe and for advancing the frontier of multi-messenger astronomy
- Establish a new endowed professorship in the field of astronomy instrumentation
- Create endowed postdoctoral fellowships in computational astrophysics and data science
- Fund an endowment to sustain a named postdoctoral prize fellowship
- Invest in state-of-the-art high-performance computing facilities for CIERA researchers
- Expand education and outreach programs to reach more members of the public

## Naming Option

For a philanthropist who is committed to CIERA's longevity and helping it fulfill its promise, there is an opportunity to name the center in your honor or in recognition of someone else.

To support CIERA, contact Kim Buckley at 847-491-4985 or [kim-buckley@northwestern.edu](mailto:kim-buckley@northwestern.edu).

*Updated September 2016*



Hidden at the center of the orange disk is a black hole that is pulling in mass from the blue companion star. This image, created in collaboration with Northwestern Visualization Services, allows astronomers to better understand the life cycle of stars.

## For More on CIERA and LIGO

Additional information on CIERA's mission and research is available at [ciera.northwestern.edu](http://ciera.northwestern.edu). To learn about the LIGO gravitational wave discovery, follow the News and Highlights link on the CIERA home page.