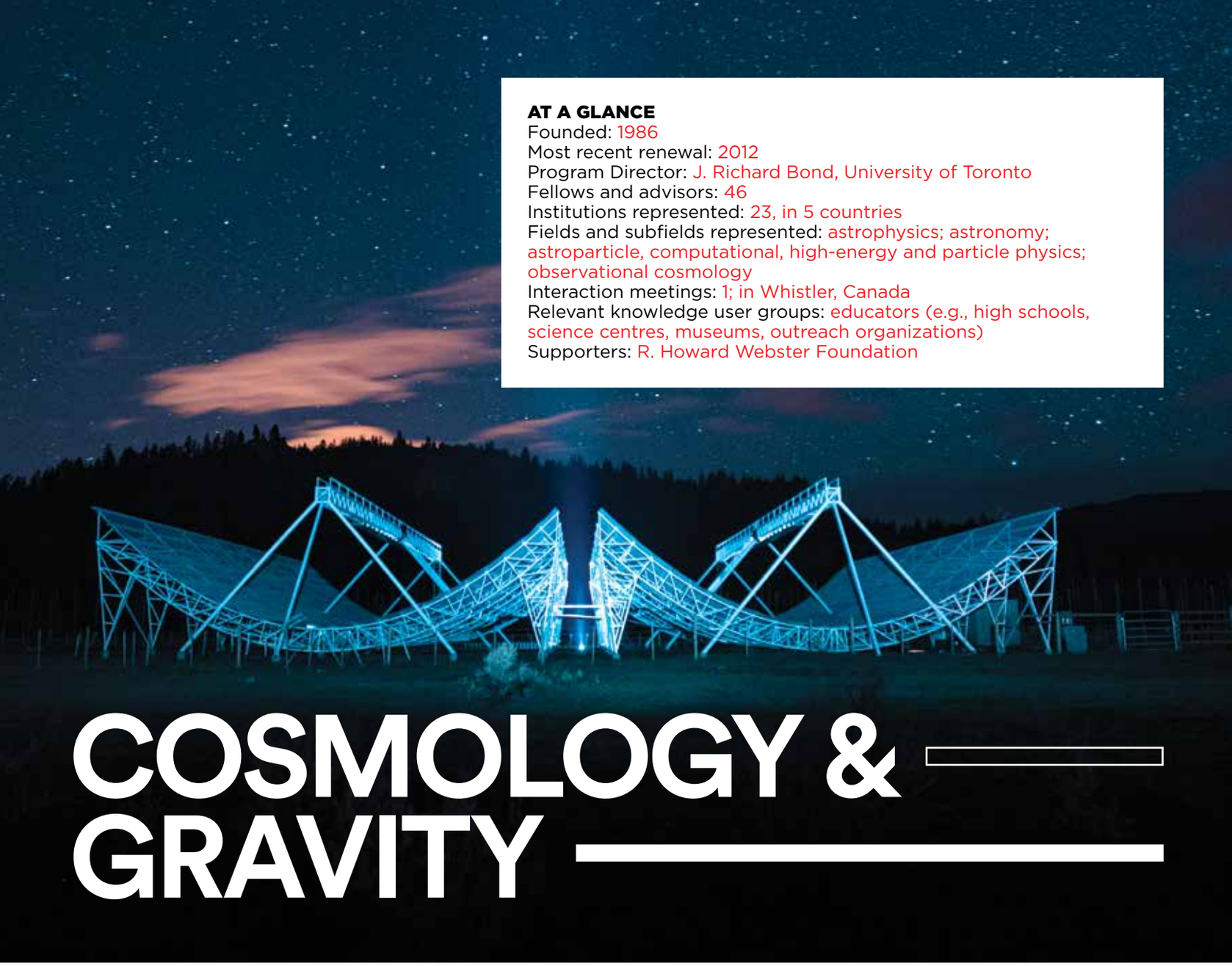


AT A GLANCE
Founded: 1986
Most recent renewal: 2012
Program Director: J. Richard Bond, University of Toronto
Fellows and advisors: 46
Institutions represented: 23, in 5 countries
Fields and subfields represented: astrophysics; astronomy; astroparticle, computational, high-energy and particle physics; observational cosmology
Interaction meetings: 1; in Whistler, Canada
Relevant knowledge user groups: educators (e.g., high schools, science centres, museums, outreach organizations)
Supporters: R. Howard Webster Foundation

COSMOLOGY & GRAVITY

Attempts to tell a comprehensive story of the structure and evolution of the universe, from its first moment of existence to its ultimate fate.

The first direct observation of gravitational waves made earlier this year by the Laser Interferometer Gravitational-wave Observatory (LIGO) collaboration opened up the possibility of understanding fundamental physics and the very early universe through gravitational-wave observations. The program in Cosmology & Gravity capitalized on this recent finding, positioning it as a key focus for its annual program meeting in spring 2016. The meeting engaged scientists from within and outside of the program to explore new opportunities as the field advances into a budding era of gravitational-wave astronomy. Fellows also explored the frontiers of our knowledge of neutron stars, black holes and fast radio bursts, dark matter and galaxies, cosmology and fundamental theory. Discussions focused heavily on identifying key challenges and state-of-the-art science that might serve as the focus for the program's upcoming renewal proposal.

The 2015/2016 year was also notable for the many prestigious honours awarded to program fellows, including some of the highest recognitions bestowed in a field or country. Highlights included the Nobel Prize in Physics to **Arthur McDonald** (Queen's University); the Gerhard Herzberg Canada Gold Medal for Science and Engineering to **Victoria Kaspi** (McGill University); the Crafoord Prize in Astronomy to **Roger Blandford** (Stanford University); and the Friedrich Wilhelm Bessel Research Award to **Harald Pfeiffer** (University of Toronto) and **Ludovic van Waerbeke** (University of British Columbia). A full listing appears in Appendix A.

Research

- Fellow **Harald Pfeiffer** (University of Toronto) contributed to the breakthrough LIGO study, which detected gravitational waves left over from the collision of two black holes more than a billion years ago. This landmark discovery may finally allow physicists to complete the task Einstein set out to do almost a century ago: unify all the fundamental forces into a theory of everything. Dr. Pfeiffer helped to detect and validate the gravitational-wave findings, and is one of several CIFAR fellows in the Cosmology & Gravity program who are approaching the search for gravity waves from different perspectives and disciplines.
  > LIGO Scientific Collaboration and Virgo Collaboration, including Abbott BP, **Pfeiffer HP**. 2016. Observation of gravitational waves from a binary black hole merger. Phys Rev Lett. 116: 061102.

- In a collaboration led by R. Howard Webster Foundation Fellow **Victoria Kaspi** (McGill University), CIFAR fellows obtained a multimillion dollar grant from the Canada Foundation for Innovation to build an instrument that will enable the Canadian Hydrogen Intensity Mapping Experiment (CHIME) telescope, designed for other purposes, to detect fast radio bursts. Only a handful of these seemingly random bursts of radio waves of unknown origin have been discovered, but CHIME's vast sky-scanning capacity may help to detect many more. Contributors to the project include fellows **Matthew Dobbs** (McGill University), **Mark Halpern**, **Ingrid Stairs**, **Gary Hinshaw** (all University of British Columbia), and **J. Richard Bond** and **Ue-Li Pen** (both University of Toronto).

Other notable publication

- The NANOGrav Collaboration, including Arzoumanian Z, **Kaspi VM**, **Ransom SM**, **Stairs IH**. 2015. The NANOGrav nine-year data set: observations, arrival time measurements, and analysis of 37 millisecond pulsars. Astrophys J. 813(1).

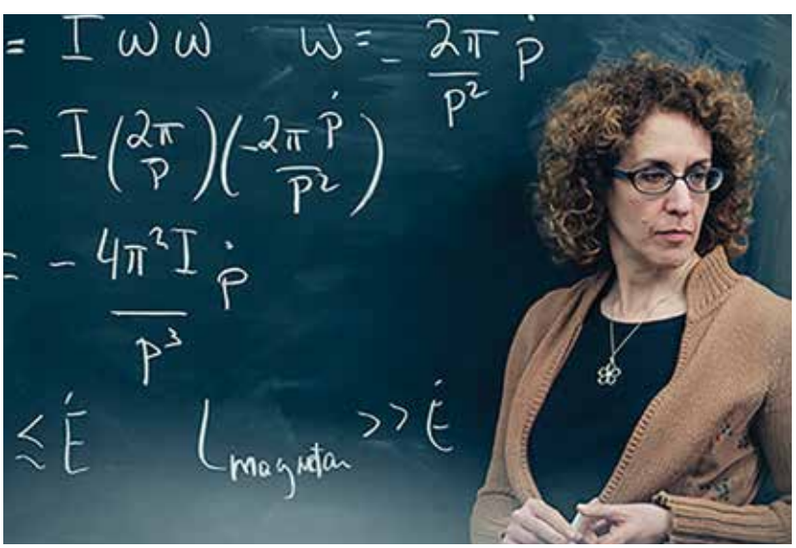
IdeasExchange

- Program fellows regularly engage in outreach activities aimed at the general public and more specialized audiences. The program has identified educators, such as those in schools, planetariums and outreach organizations, as key audiences that can put the knowledge it generates into action, as well as the great potential to broaden its outreach efforts through various media channels. The program has begun to explore new ways to engage with these audiences.

Global Academy

- Fellows in the program collectively supervise nearly 150 highly qualified personnel each year. Fellows engage these early career researchers in the CIFAR model of research in a variety of ways, where possible, including bringing them to program meetings, supporting them on collaborative projects with other fellows, engaging them in discussion with researchers from outside of their traditional research areas, and supporting interaction and movement among other fellows' research groups.

To learn more: **https://www.cifar.ca/research/cosmology-gravity/**



R. Howard Webster Foundation Fellow Victoria Kaspi received the 2016 Gerhard Herzberg Canada Gold Medal for Science and Engineering.