The quest to understand the nature and origins of the universe has inspired some of the greatest minds in science. The curiosity that drove Galileo, Einstein, and Hawking has led to an era where we now stand on the brink of answering some of the most fundamental questions ever posed by scientists, philosophers, poets, and anyone who has looked at a star-filled sky.

Within the next decade, the world will see new activity from the Large Hadron Collider, the most powerful particle collider and the largest machine in existence; a deluge of data from the Large Synoptic Survey Telescope, the most powerful optical telescope ever built; the launch of the James Webb Space Telescope, successor to NASA’s Hubble; and a new generation of astrophysical surveys of the universe.

This vast stream of observational data will answer many questions about the origins and evolution of the universe and the nature of matter and energy. But at the same time, it will give rise to many new ones. Evidence of dark energy—a mysterious anti-gravity that appears to be accelerating the expansion of space—is just one compelling example of new challenges to our basic understanding of the forces at work in the universe.

“I want to know why the universe exists, why there is something greater than nothing.”

Stephen Hawking
Penn’s Center for Particle Cosmology seeks to answer such fundamental questions about the cosmos. The center brings together theorists and experimentalists, two traditionally separate types of scientists, in an environment distinguished by unfettered interaction and collaboration. Based in the Department of Physics and Astronomy, the Center is a site of excellence in cutting-edge research. Its theorists have made significant contributions to the field, particularly in the study of dark matter, dark energy, string theory, and alternatives to Einstein’s general theory of relativity. Its experimentalists are leaders in national and international cosmology projects that have detected and measured never-before-seen phenomena, including the subtle properties of dark energy and the polarization of the cosmic radiation dating from the Big Bang. Together, these discoveries advance a more nuanced understanding of the early universe and its evolution.

With its emphasis on collaboration, the center offers a novel model for physics and astronomy. It serves as an incubator that supports research and education at all levels, from faculty and postdocs to graduate and undergraduate students, while also engaging members of the community surrounding Penn.

The center brings eminent scholars from around the world to campus, while also collaborating with local schools and organizations, including the Franklin Institute, to facilitate knowledge-sharing and communicate the exciting pace of discovery in the field today.

As the window to exciting new information opens, the center needs resources to expand on their existing work as well as build innovative experimental programs and computational initiatives. In particular, the center is eager to capitalize on three new developments. The first is the nascent field of multi-messenger cosmology, which has emerged from the discovery of gravitational waves. The second is the intriguing possibility of a breakdown of the standard model of cosmology, suggested by new data and requiring innovative theoretical work.

The giving opportunities listed here support the center’s research mission and will help to cement Penn’s reputation as the home of advancements in particle cosmology.

“Over the last 30 years we’ve learned a remarkable amount about the universe. Many of the research questions that interest me now didn’t exist at the start of my career—what we know and the nature of the questions we can ask are evolving at a breathtaking rate.”

MarkTrodden
Fay R. and Eugene L. Langberg Professor of Physics; Chair of the Department of Physics and Astronomy; and Co-Director, Center for Particle Cosmology
Endow the Center for Particle Cosmology with a gift of $10 million
A gift to endow the Center would provide a perpetual funding stream and enable strategic investments in faculty, postdoctoral, and graduate student recruitment. Through ongoing workshops and visitor programs it would foster the incubation and development of innovative ideas.

Fund a postdoctoral fellowship with an endowed gift of $2 million or a term gift of $500,000
A named postdoctoral fellowship would support an extraordinarily promising junior scholar during a transformative period in his or her career. The competition for postdoctoral fellows is fierce; a named fellowship would ensure that the Center for Particle Cosmology is the destination of choice for top candidates from around the world.

Support cross-disciplinary research with an endowed gift of $1 million
Bold ideas can be difficult to fund through traditional sources. A special fund for innovative, cross-disciplinary projects from distinct fields such as string theory and astronomy would support faculty and postdoctoral fellows and prime Penn researchers for major discoveries.

Support seed funding with an endowed gift of $1 million
Matching seed funds for new experiments would allow faculty to demonstrate the feasibility of their ideas and, in turn, attract external funding for major experiments.

Support an International Visitor Program with an endowed gift of $800,000 or a term gift of $200,000
This fund would attract eminent scholars, from senior scientists to postdocs, to Penn and increase the Center’s global visibility.
From Basic Science to Transformative Technologies

From the earliest days of space travel to today’s explorations with the Large Hadron Collider, the process of studying the universe has fueled advances that ripple across the sciences and society, resulting in countless technologies we now take for granted.

- GPS
- Camera phones
- Medical imaging including CAT scans and MRI
- LEDs
- Water purification systems
- Baby formula
- Artificial limbs
- Solar panels
- Advances in cancer therapy
- Advances in sustainable agriculture
- Improvements to power grids
- Visualization and navigation software for large, complex data sets

Doctoral candidate Marina Carrillo Gonzalez, GR’20; Masao Sako, Professor of Physics and Astronomy; Robyn Sanderson, Assistant Professor of Physics and Astronomy; and Justin Khoury, Professor of Physics and Astronomy.

Mark Devlin, Reese W. Flower Professor of Astronomy and Astrophysics, and students in his lab.

For more information on how to support Center for Particle Cosmology at all levels, please contact Deb Rhebergen, Vice Dean for Advancement, at 215-898-9942 or drheberg@sas.upenn.edu.