

# Goddard Tech 12

Each month the Strategic Partnerships Office will tell the story of a renowned innovator at NASA's Goddard Space Flight Center and show how their technological breakthroughs are brought from the labs to our lives. This month features the Modulated X-Ray Source (MXS), a tool originally designed to use X-rays for deep space communication and navigation which is being adapted to advance medical X-ray imaging.

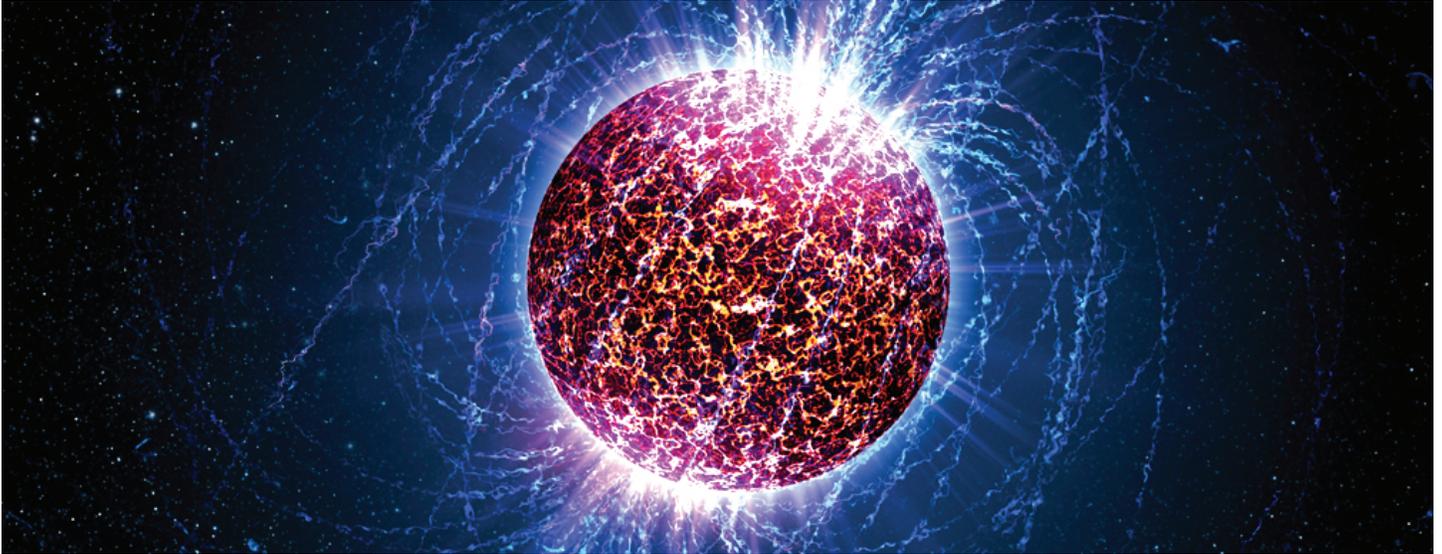


Illustration of a neutron star. Image Credit: Casey Reed - Penn State University

## The Technology

### Modulated X-Ray Source

MXS enabled the two in one Neutron Star Interior Composite Explorer (NICER) and Station Explorer for X-Ray Timing and Navigation (SEXTANT) missions. NICER is currently perched on the International Space Station observing the mysterious neutron stars by measuring X-ray emissions. Neutron stars are the collapsed, burnt-out cores of dead stars. During the collapsing process of stars of a certain size, the outer layer is blown off in a supernova explosion, and a neutron star is left. As the densest observable object in the universe, one teaspoon-sized piece of this star would weigh more than one billion tons on Earth. This unique composition is why there is so much mystery surrounding the stars.

Most neutron stars are seen as pulsars, emitting narrow beams of radiation. NICER studies these pulsars, and SEXTANT uses that information to achieve fully autonomous X-ray navigation in space. SEXTANT showed that millisecond pulsars could be used to accurately determine the location of objects moving at thousands of miles per hour in space. NICER-SEXTANT has revolutionized the future of space exploration. Robotic spacecraft integrating NICER-SEXTANT findings are sure to play an integral role in exploring the far reaches of the solar system and beyond.



Learn more about neutron stars and the NICER-SEXTANT missions

# The Partnership

## Massachusetts General Hospital

The medical field is a constantly changing, innovation filled field. However, over the years X-ray imaging has remained mostly unchanged. Current X-ray machines require a warmup before every session and don't allow significant control over radiation exposure. In an effort to solve this problem, Massachusetts General Hospital is licensing MXS technology from NASA Goddard to improve X-ray processes.

Massachusetts General was founded on innovation in 1811 when the hospital decided to provide care to Boston's sick regardless of socioeconomic status. The hospital continues with innovation over 200 years later by replacing the hot filaments used in X-rays with LED photocathodes and electron multiplier components. This is a move from hot to cold cathodes allowing X-rays to be switched on and off immediately and allows for customized doses to minimize radiation exposure. By bringing X-ray technology to the digital age, Massachusetts General plans on seeing many benefits from this technology.



Photo Credit: NASA Spinoff 2013

# The Innovator

## Keith Gendreau

In 1995 Dr. Gendreau received his Ph.D. in astrophysics at the Massachusetts Institute of Technology while working on X-ray charge-coupled devices.



Keith Gendreau holds an assembly of X-ray focusing mirrors similar to those used on NICER/SEXTANT missions. Photo Credit: Bill Hrybyk/NASA

Gendreau has been at Goddard since graduating in 1995. He now serves as principal investigator for the NICER-SEXTANT missions and has been developing X-ray detectors, optics and other instruments to support various NASA missions. With dozens of publications and Goddard's 2011 Innovator of the Year Award, Keith Gendreau's career has been filled with technological breakthroughs.

## Additional X-Ray Benefits



Easy to manufacture, all Prototypes are based on small, low-cost commercial components



Customizable radiation doses, especially beneficial when treating children and pregnant women



Decreased warm up time increases the devices useable life



MXS allows X-rays to be switched on and off in less than a nanosecond



With millions of medical and dental X-rays performed each year, improvements are substantial

Find out how NASA Goddard's Strategic Partnerships Office connects internal inventors with external partners.

