Analyzing fast radio bursts

CAC

Project description

Fast radio bursts or FRBs are very rare, very brief blasts of radio waves originating billions of light years away. Astronomers sift through mountains of data from the Parkes Observatory (Australia), Arecibo Observatory (Puerto Rico), Green Bank Telescope (West Virginia), and other observatories to identify FRBs. Over two dozen have been discovered in the past decade. Each was considered a singular event until Laura Spitler, Cornell Ph.D., (now at Max Planck Institute for Radio Astronomy) discovered FRB 121102 and Paul Scholz, McGill University, sifted through new PALFA (Pulsar Arecibo L-Band Feed Array) observations and found recurring pulses at the same sky position. The burst properties were then measured and counterparts searched for at other wavelengths by Cornell senior research associate Shami Chatterjee, professor James Cordes, and their global collaborators.

CLIENTS
Shami Chatterjee,
James Cordes, and
the PALFA consortium

SERVICES
- Data Pipeline/Database
- Web Interface
- Data Storage
- Data Management

The 305-meter Arecibo radio telescope and its suspended support platform on a starry night. A flash from FRB 121102 is seen originating from beyond the Milky Way, from deep in extragalactic space. The radio burst is highly polarized, and the polarized signal gets twisted as a function of radio frequency because there is an extreme region of magnetized plasma between us and the source of the radio bursts. Credit: Danielle Futselaar

CAC services

Chatterjee and Cordes performed their FRB analyses using PALFA data centrally stored at CAC. Over half a petabyte of PALFA data is managed by CAC consultant Adam Brazier who also created and maintains the data management infrastructure. CAC SQL Server and cross platform tool expertise were used to build the storage system.

"CAC data management and archival storage services provide value not only to Cornell researchers, but to astronomers and astrophysicists worldwide. Well designed pipelines and web interfaces enable scientists to quickly and efficiently explore large scale, multidimensional data sets."

Shami Chatterjee
Dept. of Astronomy

Results

The Spitler discovery showed for the first time that there can be multiple FRB bursts from the same place in the sky. An international research team including Chatterjee and Cordes then took new measurements and found that FRB 121102 passes through a veil of dense magnetized plasma that causes the cosmic blasts to "shout and twist." This enabled scientists to probe the immediate surroundings of the FRB source, which they now believe is located close to a massive black hole in its own galaxy, or a young neutron star embedded in a powerful nebula. This research was featured on the cover of the journal *Nature.* Future PALFA survey observations and analyses will be required to better understand the properties and sources of FRBs. Apart from supporting FRB analyses, PALFA survey data is also used to discover new pulsars and Galactic transient sources; over 160 have been discovered to date.