Advances in Astronomy

Hindawi

Special Issue on

Recent Progress in Multiwavelength Observations of Pulsars

CALL FOR PAPERS

Pulsars are rapidly spinning neutron stars that emit electromagnetic radiation (mostly) at the expenses of their rotational energy, hence also referred to as rotation-powered pulsars. Apart from the radio band, where the first of the over 2500 radio pulsars known to date was originally discovered back in 1967, pulsars have now been detected across the entire electromagnetic spectrum. More than 200 were detected by Fermi at >100 MeV gamma-rays, but numerous pulsars are also seen in X-rays, very high energies (VHE), optical, infrared (IR), AND ultraviolet (UV) and now also in the sub-mm range with the Atacama Large Millimeter Array which detected the Vela pulsar.

About 50 pulsars are not detected in radio, like the prototype Geminga, and are hence dubbed "radio-quiet". They have been primarily spotted through their pulsed gamma-ray emission. Even more surprisingly, the vast majority of gamma-ray pulsars belong to the class of milli-second pulsars (MSPs), old and less energetic pulsars that have been spun up by accretion of matter from a companion star. Some of them are still in a binary system. Others turned into solitary pulsars either by disruption of a previous binary system in the course of stellar evolution or after the companion has been fully ablated by the pulsar wind, a process that we witness in the so-called Black Widow and Redback systems. These two discoveries have important implications on the pulsar high-energy emission models, on the determination of the pulsar emission geometry, and on the efficiency of particle acceleration mechanisms.

This uniquely large and diverse sample is the starting point to characterize the pulsar emission properties, from the gamma-rays to the radio, and understand how the complex radiative processes in pulsar magnetospheres work. This paves the way to understanding the behavior of particles and radiation under extreme magnetic fields, a major goal in pulsar electrodynamics and in fundamental physics. In particular, open issues are whether the emission at different energies originates from different populations of particles and different regions (and altitudes) and at which frequencies the radiation emission processes turn from coherent to incoherent. Only now are we starting to decode the information that the study of the pulsar multiwavelength emission brings, which is key to build a unified radiation emission model of pulsar magnetospheres.

In this special issue, we will publish original research papers about some of the most recent and exciting results in pulsar multiwavelength astronomy, together with specific reviews to set the state of the art.

Potential topics include but are not limited to the following:

- The pulsar populations in the Galaxy and their life cycle
- Diagnostics on pulsar physics: timing (glitches and breaking index), spectra, and polarimetry (phase dependence) radiation efficiency and beaming characteristics
- Observations of pulsars at radio frequencies and in the sub-mm, future prospects with LOFAR, SKA
- Gamma-ray emission models in MSPs: wind shock emission in Black Widow and Redback systems
- Observations of Transitional MSPs
- Pulsar observations at very low energy (optical, UV, and IR)
- Pulsar observations at high energies (X-rays and gamma-rays)
- Pulsar observations at VHE and future prospects with CTA
- Observational inputs to pulsar magnetosphere models
- The interplay between low- and high-energy emission in pulsars
- Giant pulses, nulling, and state change in pulsars

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Papers are published upon acceptance, regardless of the Special Issue publication date.

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