High-energy transient sources in the era of next-generation radio observatories.

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Abstract

The emergence of powerful new radio facilities, including e.g. MeerKAT, ASKAP, and the first phases of the Square Kilometre Array (SKA), has transformed our view of the transient radio sky. Their combination of high sensitivity, wide fields of view, rapid response, and broad frequency coverage now provide an unprecedented opportunity to investigate the most energetic transient phenomena in the Universe. In this review, I will discuss the growing role of radio observations in understanding transient high-energy sources, including X-ray binaries, gamma-ray bursts, tidal disruption events, magnetars, fast radio bursts, and compact-object mergers. Radio observations uniquely probe relativistic outflows, shocks, and particle acceleration, while complementing X-ray and gamma-ray observations to reveal the physical connection between accretion, ejection, and high-energy emission. I will highlight recent advances enabled by next-generation radio observatories, including real-time transient discovery, broadband spectral studies, polarimetry, and high-resolution imaging, and discuss their synergy with current and future high-energy missions. These developments are ushering in a new era of time-domain and multi-messenger astrophysics, where coordinated radio and high-energy observations provide key insights into the physics of the dynamic Universe.

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