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Fast Radio Bursts as Cosmic Probes: Illuminating the Invisible Universe

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Fast Radio Bursts (FRBs) are millisecond-duration flashes of radio waves originating from extragalactic — and possibly cosmological — distances. While their progenitors remain a subject of active investigation, the propagation of FRBs through cosmic media renders them powerful tools for astrophysical and cosmological inquiry. In this talk, I will introduce the key observational properties of FRBs, and explain how these observables encode information about the matter they traverse. I will then focus on recent advances in using FRBs to probe the large-scale distribution of baryons, test models of cosmic reionization, and constrain the properties of dark matter. In particular, I will discuss how FRBs can be used to search for signatures of compact dark matter through gravitational lensing, and how their dispersion may reveal the presence of exotic dark-sector particles or interactions. With the advent of wide-field radio surveys such as CHIME/FRB, ASKAP, and future facilities like DSA-2000 and SKA, the growing FRB population offers an unprecedented opportunity to turn these cosmic flashes into precise probes of the invisible Universe.

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