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Illuminating dark sirens with CSST

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In recent years, the Hubble tension has emerged as one of the most perplexing enigmas within the realm of cosmology [1]. This incongruity suggests the tantalizing prospect of new physics beyond the standard ΛCDM model, leading to the proposal of diverse extended cosmological models. At the same time, there is a pressing demand for novel cosmological tools to mediate the Hubble tension. The gravitational-wave (GW) standard siren has been put forth as a promising cosmological probe for resolving the Hubble tension, provided that the redshift of the GW source is known, as exemplified in ref. [2].

One method for determining the redshifts of GW sources involves utilizing galaxy catalogs, a technique referred to as the "galaxy catalog dark siren method". At present, 47 dark sirens from the third Gravitational-Wave Transient Catalog (GWTC-3), in conjunction with the GLADE+ galaxy catalog, furnish approximately a 19% measurement for H_0 [3]. Looking ahead to the 2030s, with the deployment of third-generation (3G) GW detectors, millions of GW standard sirens will be detected, characterized by redshifts that extend far beyond the current capacity of galaxy catalogs. To address this, we require next-generation galaxy survey catalogs to serve for dark sirens.

The Chinese Survey Space Telescope (CSST), a cutting-edge space-based telescope, is projected to finalize its optical survey initiative around the year 2034. Prior research has indicated that CSST could advance in the fields of weak lensing, galaxy clustering, cosmic shear, and various other cosmological investigations. Recently, Song et al. [4] underscored another valuable aspect of the CSST: its capability to furnish redshift data for dark sirens, owing to its extensive sky coverage and high precision in redshift measurement. Their findings reveal that an assembly of approximately 300 simulated dark sirens from the 3G GW detectors, in conjunction with the CSST galaxy catalog, can constrain H_0 to a precision level far surpassing that derived from actual observed dark sirens in GWTC-3. The outcomes of their research underscore the considerable potential of the collaborative efforts between CSST and 3G GW detectors in the precise determination of the Hubble constant, offering a promising avenue for resolving the Hubble tension.

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