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Probing the expansion of the Universe using gravitational wave standard sirens at eLISA

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We investigate the capability of various configurations of the space interferometer eLISA to probe the late-time background expansion of the universe using gravitational wave standard sirens. We simulate catalogues of standard sirens composed by massive black hole binaries whose gravitational radiation is detectable by eLISA, and which are likely to produce an electromagnetic counterpart observable by future surveys. The main issue for the identification of a counterpart resides in the capability of obtaining an accurate enough sky localisation with eLISA. This seriously challenges the capability of four-link (2 arm) configurations to successfully constrain the cosmological parameters. Conversely, six-link (3 arm) configurations have the potential to provide a test of the expansion of the universe up to z~8 which is complementary to other cosmological probes based on electromagnetic observations only. In particular, in the most favourable scenarios, they can provide a significant constraint on H0 at the level of 0.5%. Furthermore, (ΩM,$\Omega\Lambda$) can be constrained to a level competitive with present SNIa results. On the other hand, the lack of massive black hole binary standard sirens at low redshift allows to constrain dark energy only at the level of few percent.

Summary

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