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## Binary compact objects across cosmic history

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Einstein Telescope will possibly observe mergers of binary black holes (BBHs) and binary neutron stars (BNSs) to redshift  $z \sim 10$  and  $z \sim 2$ , respectively. Thus, we will be able to characterize the evolution of binary compact objects through cosmic history. Here, we show that constraining the merger rate density and mass evolution of BBHs across cosmic time is a powerful tool to shed light on their formation scenarios. We predict the merger rate density of stellar-born BBHs in the comoving framework to increase by a factor of  $\sim 10$  between redshift 0 and redshift  $\sim 3$ , where we expect it to reach a peak of  $\sim 500 - 1000 \text{ Gpc}^{-3} \text{ yr}^{-1}$ . This result springs from the dependence of the merger rate from cosmic star formation rate and stellar metallicity. Furthermore, we predict a mild evolution of BBH mass distribution with redshift, if we assume that BBHs form mostly from massive metal-poor stars. We expect a significantly different evolution from scenarios (e.g., primordial black holes) in which the mass of black holes does not depend on the metallicity evolution. Einstein Telescope will probe both the merger rate density and mass evolution, providing constraints on the main paradigms of BBH formation, as well as on the final fate of massive stars across cosmic time.

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