Science with TianQin: Preliminary Results on Massive Black Hole Binaries

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We investigate the prospects of detecting gravitational waves from coalescing massive black hole binaries in the Universe with the TianQin observatory, a space-based gravitational wave interferometer proposed to be launched in the 2030s. To frame the scientific scope of the mission, in this work we carry out a preliminary estimation of the signal-to-noise ratio, detection rate and parameter estimation precision of the massive black hole binaries detectable by TianQin. In order to make our results as robust as possible, we consider several models of the growth history of massive black holes, exploring the effect of some key astrophysical prescriptions as well the impact of the employed computational methods. In the most optimistic model, TianQin can detect as many as ~ 60 mergers per year. If TianQin detects a merger at redshift of 15, it will be capable of estimating its luminosity distance to within an accuracy of 10%; for a nearby event at redshift ~ 2, TianQin can issue early warnings 24 hours before coalescence, with a timing accuracy of around an hour and a sky localization ability of ~ 10 square degrees, thus enabling multi-messenger observations.

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