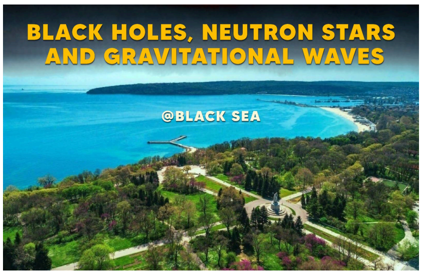

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Testing general relativity using binary black hole orbital frequency evolution on time-frequency plane

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The orbital evolution of binary black hole (BBH) systems is determined by the component masses and spins of the black holes and the governing gravity theory. General relativity (GR) is the simplest theory of gravity that lays the foundation for successfully explaining the current gravitational wave (GW) observations. We present a method of stacking up the time-frequency pixel energies through the orbital frequency (OF) evolution with the flexibility of gradually shifting the OF curve along the frequency axis. The time-frequency spectrogram is obtained using a high-resolution Synchroextraction method. We observe a distinct energy peak corresponding to the GW signal's quadrupole mode. If an alternative theory of gravity is considered and the analysis of the BBH orbital evolution is executed following GR, the energy distribution on the time-frequency plane will be significantly different. We propose a new consistency test to check whether GR explains the BBH orbital evolution. Finally, through the numerical simulation of beyond-GR theory of gravity and utilizing the framework of second-generation interferometers, we demonstrate the efficiency of this new method in detecting any possible departure from GR.

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