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Prospects for Detecting Exoplanets around Double White Dwarfs with LISA and Taiji

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Recently, Tamanini & Danielski discussed the possibility of detecting circumbinary exoplanets (CBPs) orbiting double white dwarfs (DWDs) with the Laser Interferometer Space Antenna (LISA). Extending their methods and criteria, we discuss the prospects for detecting exoplanets around DWDs not only by LISA, but also by Taiji, a Chinese space-borne gravitational-wave (GW) mission. We first explore how different binary masses and mass ratios affect the abilities of LISA and Taiji to detect CBPs. Second, for certain known detached DWDs with high signal-to-noise ratios, we quantify the possibility of CBP detections around them. Third, based on the DWD population obtained from the Mock LISA Data Challenge, we present basic assessments of the CBP detections in our Galaxy during a 4 yr mission time for LISA and Taiji. We discuss the constraints on the detectable zone of each system. With the DWD population, we further inject two different planet distributions with an occurrence rate of 50% and constrain the total detection rates. We briefly discuss the prospects for detecting habitable CBPs around DWDs with a simplified model. These results can provide helpful inputs for upcoming exoplanetary projects and help analyze planetary systems after the common envelope phase.

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