Analysis of Candidate Dormant Binary Black Hole Systems Using Asteroseismology of Red Giants

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Dormant black holes (BHs) are believed to be among the most common types of BHs in the Milky Way; despite this, dormant BHs remain largely unstudied due to limitations of current methods of detection. Asteroseismology presents a solution to improving the currently biased population models of BHs, providing a more accurate method of stellar mass estimation than current model calculations, and therefore estimations of unseen companion masses in binaries, leading to the identification of potential BHs. Increased detection of BHs would improve BH population censuses, theoretical models of BH origins and properties, and aid in the development of fundamental physics theories. In this project, public datasets of BH binary candidates from Gaia Data Release 3 were analyzed using asteroseismology. Lightcurves and periodograms of red giants in candidate systems were plotted, numax and deltanu identified, and primary masses estimated. Five promising candidates were selected from the catalogue of 556 systems, with Star IDs 5247135814380603904 and 5163688963500828800 selected as best candidates based on primary mass and lightcurve cleanliness. Using PySyd for improved analysis, more accurate primary mass estimations of 1.3 solMass and 1.35 solMass, respectively, were found. The potential BH masses were unable to be estimated due to lack of published data and issues with code. Further analysis of candidates is necessary to determine true BH binaries, although those identified hold strong probabilities of possessing a BH. Future considerations include increased robust analysis of candidates, code filtration, and companion mass estimations with the future publication of Gaia Data Release 4.

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