A Population of Planetary Systems on Aligned Orbits with Wide Binary Companions

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The effects of wide binary star systems on the formation and evolution of exoplanets are relatively unknown. A large portion of exoplanets reside in wide binary systems, so fully understanding these effects is critical to having a holistic understanding of exoplanet formation and evolution. I investigated these effects using new data from Gaia EDR3 and the TESS mission to characterize wide binary star systems with transiting exoplanets. Sixty-Seven such systems with well-determined orbital inclinations were identified. The orbital parameters for the 67 systems were then derived and the difference in orbital inclination between the binary and planet orbits measured. There was a statistically significant difference in the inclination distribution of the wide binary stars with transiting planets compared to a control sample ($p=0.0052$). This implies that there is a population of planets in binary systems whose orbits are aligned with those of the binary. The population of aligned systems appears to predominately have semimajor axes less than 700 AU. Potential causes of this alignment were explored. An induced precession of the circumstellar disk around the binary orbit was determined to be the most promising cause of the observed alignment as the preferential alignment was only apparent at plausible timescales over which the precession could occur.

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