Discovery of Two Potentially Habitable Super-Earths! StealthPlanetFinder: Innovative & Computationally Efficient Algorithms to Detect Exoplanets Overcoming Low Signal-to-Noise Ratio

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Since 2010, astronomers have utilized automated algorithms to detect numerous exoplanets that primarily exhibit Medium to High Signal-to-Noise Ratio (SNR) transits. About 60% of potential habitable exoplanets have low SNR (<10) transits, but identifying them has been challenging. To address this challenge, I designed and developed StealthPlanetFinder (SPF). This innovative signal processing pipeline employs the GPU Transit Least Squares (GTLS) algorithm and Periodogram analysis to identify exoplanets with low-SNR transits efficiently. Making judicious use of GPU resources, SPF efficiently processed the first 1000 KOI Catalog light curves, identifying 116 new Threshold Crossing Events (TCEs) within a few hours in the specified period range of interest (100 to 125 days). Subsequently, SPF detected seven validated exoplanets, with notably one potentially habitable Super-Earth candidate estimated at a radius of 1.75 $R_{\oplus}$ around an M dwarf. Among our remaining six findings are three potential Sub-Neptunes with orbital periods of 114, 108, and 114 days around G-type stars, a super-Earth candidate around an M dwarf with a period of 102 days, and two rare Neptune size planet candidates around a K dwarf and a G-type star with a period of 109 and 117 days respectively. SPF scored 99% completeness and reliability on synthetic transits with low SNRs and on transits of confirmed candidates (100-125d period) in the KOI Catalog. Four validated candidates exhibited very low SNRs (<5.0) - the lowest for this period range in the Kepler database and two with False Alarm Probability <1.0%, showcasing SPF's heightened efficiency and sensitivity compared to contemporary processing pipelines and paving the way for breakthroughs in low SNR exoplanet exploration. Details will be reported.