Discovery of the First Double Exocomet Using an Automated Deep Learning Convolutional Neural Network

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The formation of planetary orbits and star systems remains one of the greatest mysteries in astronomy. Exocomets, with their unique geological and molecular compositions, may hold the key to understanding planetary disc formation and the origins of life, potentially through cometary impacts. However, detecting exocomets has proven challenging. Despite analyzing data from over 300,000 stars with Kepler, K2, and TESS, less than 50 exocomets have been discovered by transit photometry, most from just two stars. These discoveries were made through time-consuming manual searches, and traditional signal amplification methods have struggled to detect exocomets reliably. A convolutional neural network (CNN) was applied to analyze light curve data in iterative chunks. The model successfully identified most previously known exocomets from Kepler light curve data. Additionally, five new exocomet candidates were identified after analyzing KIC 3542116, one of which is a never-before-seen double exocomet candidate, consisting of two exocomet transits on top of each other. The star is young with short rotation periods, suggesting that it is in the early stages of planetary disc formation, aligning with current theories of exocomets. The candidates were confirmed with a rigorous 4-step validation process. This breakthrough in automated detection holds great promise for discovering more exocomets and has potential applications in fields such as heart rate monitoring and weather anomaly detection.

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