What's the source of binary rogue planets?

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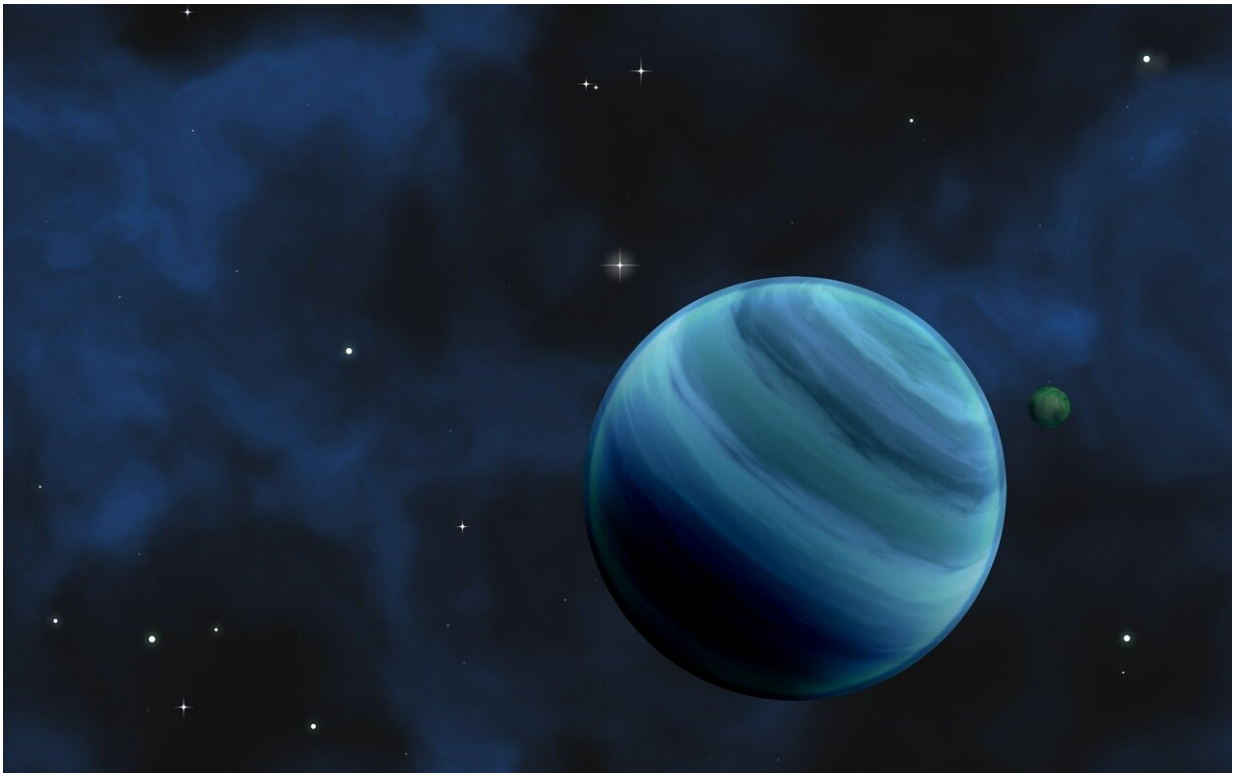

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The James Webb Space Telescope (JWST) is already making great strides in helping us to unravel the mysteries of the universe. Earlier this year, hundreds of rogue planets were discovered in the Orion Nebula. The real surprise to this discovery was that 9% of the planets were paired up in wide binary pairs. To understand how this binary planets formed, astronomers simulated various scenarios for their formation.

As their name suggests, rogue planets are wanderers. They do not orbit around a star, and they are not gravitationally bound to one, they simply wander around the cosmos. The first rogue planets were discovered in 2000 by the UK team Lucas and Roche using the UK InfraRed Telescope (UKIRT). They were discovered in the Orion Nebula but more recently, JWST has been exploring the region too.

Back in December 2021, JWST was launched atop an Ariane 5 rocket from French Guiana. It then coasted off to its destination, a point in solar orbit near one of the Earth-Sun Lagrange point 1.5 million kilometers away. Since then it has been exploring the universe and in particular, taking a look at the rogue planets in the Orion Nebula.

The team led by Simon F. Portegies Zwart, from Netherlands, announced the discovery of 42 Jupiter-Mass Binary Objects (JuMBOs) in the direction of the Trapezium cluster in the heart of the nebula. Among the objects, their masses range from 0.6 times the mass of Jupiter to 14 times and their separations vary between 25 and 380 astronomical units (one astronomical unit is the average distance between the Earth and the sun). They also observed 540 single objects of similar ranging masses. These latter individual objects have been detected previously about 20 years ago but the JuMBO's are new.

Stars form out of the collapse of giant molecular clouds through gravitational instability and during their formation, disks form around their equator. The disks ultimately collapse to form planets with lower mass. There are current theories to suggest Jupiter mass objects may for independently but the consensus is that they are ejected from planetary systems. The team explored just how the JuMBO systems form. The paper is published on the *arXiv* preprint server.

To understand this the team ran simulations of star clusters similar to that found in the Orion Nebula. The model the team considered included

those where planets form around stars and the simulation showed how many free floating planets could be formed but not enough pairs to match observations. When the team ran simulations with planet-moon systems orbiting a star, they found a much better result to match observations. It seems then that the JuMBOs are planet-moon systems that have been ejected from what might be considered a conventional solar system.

More information: Simon Portegies Zwart et al, The origin and evolution of wide Jupiter Mass Binary Objects in young stellar clusters, *arXiv* (2023). DOI: 10.48550/arxiv.2312.04645

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