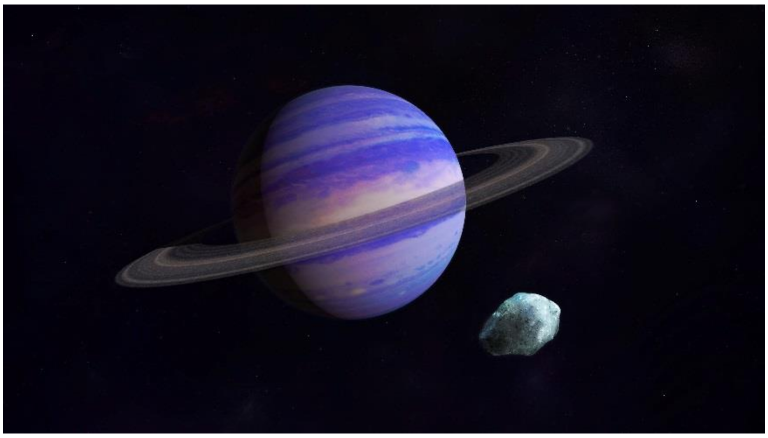
Majority of planets outside the solar system found to be Neptune-mass planets

We report the results of the statistical analysis of planetary signals discovered in MOA-II microlensing survey alert system events from 2007 to 2012. We determine the survey sensitivity as a function of planet–star mass ratio, q, and projected planet–star separation, s, in Einstein radius units. We find that the mass-ratio function is not a single power law, but has a change in slope at $q \sim 10^{-4}$, corresponding to ~20 $M_\oplus$ for the median host-star mass of ~0.6 $M_\odot$. We find significant planetary signals in 23 of the 1474 alert events that are well-characterized by the MOA-II survey data alone. Data from other groups are used only to characterize planetary signals that have been identified in the MOA data alone. The distribution of mass ratios and separations of the planets found in our sample are well fit by a broken power-law model of the form $dN_{\rm pl}/(d\log q\ d\log s) = A(q/q_{\rm br})^n s^m\ {\rm dex}^{-2}$ for $q > q_{br}$ and $dN_{\rm pl}/(d\log q\ d\log s) = A(q/q_{\rm br})^p s^m\ {\rm dex}^{-2}$ for $q < q_{br}$, where q_{br} is the mass ratio of the break. We also combine this analysis with the previous analyses of Gould et al. and Cassan et al., bringing the total sample to 30 planets. This combined analysis yields $A = 0.61^{+0.21}_{-0.16}$, $n = -0.93 \pm 0.13$, $m = 0.49^{+0.47}_{-0.49}$, and $p = 0.6^{+0.5}_{-0.4}$ for $q_{br} \equiv 1.7 \times 10^{-4}$. The unbroken power-law model is disfavored with a p-value of 0.0022, which corresponds to a Bayes factor of 27 favoring the broken power-law model. These results imply that cold Neptunes are likely to be the most common type of planets beyond the snow line.



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