MOA-2011-BLG-293Lb: A Testbed for Pure Survey Microlensing Planet Detections

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Abstract: Microlensing planet searches are transitioning from "survey+followup" mode to "pure survey" mode, wherein events will be monitored without reference to the presence of planets, which will enable a more rigorous statistical interpretation. Such surveys will be able to monitor many more events but at a lower cadence than typical followup observations, meaning that the significance of the planets detected in this manner will be lower. We need a way to test these pure survey detections to ensure that even with sparser data, the planets can be reliably detected. MOA-2011-BLG-293 provides one such test. This planet is robustly detected in survey+followup data (Delta-Chi^2 ~ 4500). The planet/host mass ratio is q=5.1+/- 0.2x10^{-3}. The best fit projected separation is s=0.545+/- 0.005 Einstein radii, which implies a physical projected separation r_{perp} ~ 1.0 AU. However, due to the s --> s^{-1} degeneracy, projected separations of r_{perp} ~ 3.5 AU are only marginally disfavored at Delta-Chi^2=2. A Bayesian estimate of the host mass gives M_L = 0.44^{+0.27}_{-0.17} M_{Sun}, with a sharp upper limit of M_L < 1.2 M_{Sun} from upper limits on the lens flux. Hence, the best estimate of the planet mass is m_p=2.4^{+1.4}_{-0.9}M_{Jup}. We show that survey data alone correctly predict this solution and are able to characterize the planet even though the signal from the planet is close to the limit of detectability (Delta-Chi^2 ~ 500). Analyzing a large sample of events like MOA-2011-BLG-293, which have both followup data and high cadence survey data, will provide a guide for the transition from survey+followup to pure survey microlensing.