

Implications of Space Microlensing Results for Planet Formation Theory

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Abstract: Microlensing offers the possibility to test planet formation theory in a parameter space that is not easily accessible to other detection techniques. In my talk I will present results from a first statistical comparison of planets detected by microlensing observations with a population of synthetic planets obtained by planet formation modeling. The same synthetic population has been previously statistically compared with planets detected by the radial velocity method. The microlensing observations represent new constraints in the form of a distribution of masses and semimajor axes. We find that the observed and the synthetic semimajor axis distribution is in good agreement, while there is some discrepancy in the mass distribution. It seems that the model predicts a lower number of planets in the mass range between 10 to 100 Earth masses than observed by microlensing surveys. There are several possible explanations for this discrepancy. One is that the efficiency of detection in this mass regime is higher than assumed in our synthetic detection bias. Another reason could be an incompleteness in the physical description of planet formation in the model. We see for example that in the synthetic population, there is in principle a very large number of planets with masses up to 30 Earth masses, as found by microlensing. But these synthetic planets are located at larger distances than the region where microlensing is sensitive. This could indicate that the position of the iceline in protoplanetary disks is closer in than assumed in the models, or that type I migration is more efficient than assumed for this synthetic population. Finally, it should be noted that the number of microlensing detections used in this comparison is still rather low. It seems therefore difficult, using microlensing observations available today, to draw definitive conclusions regarding the physics involved in planet formation models. However, such a situation may change dramatically in the future thanks in particular to space-base missions (e.g. the NASA WFIRST project). If they are sensitive, long enough, and their detection bias is well characterized, such future surveys will allow strong constraints on planetary system formation and evolution at a few AU, similar as the KEPLER satellite currently does for close-in planets.