Measuring the Galactic Distribution of Exoplanets

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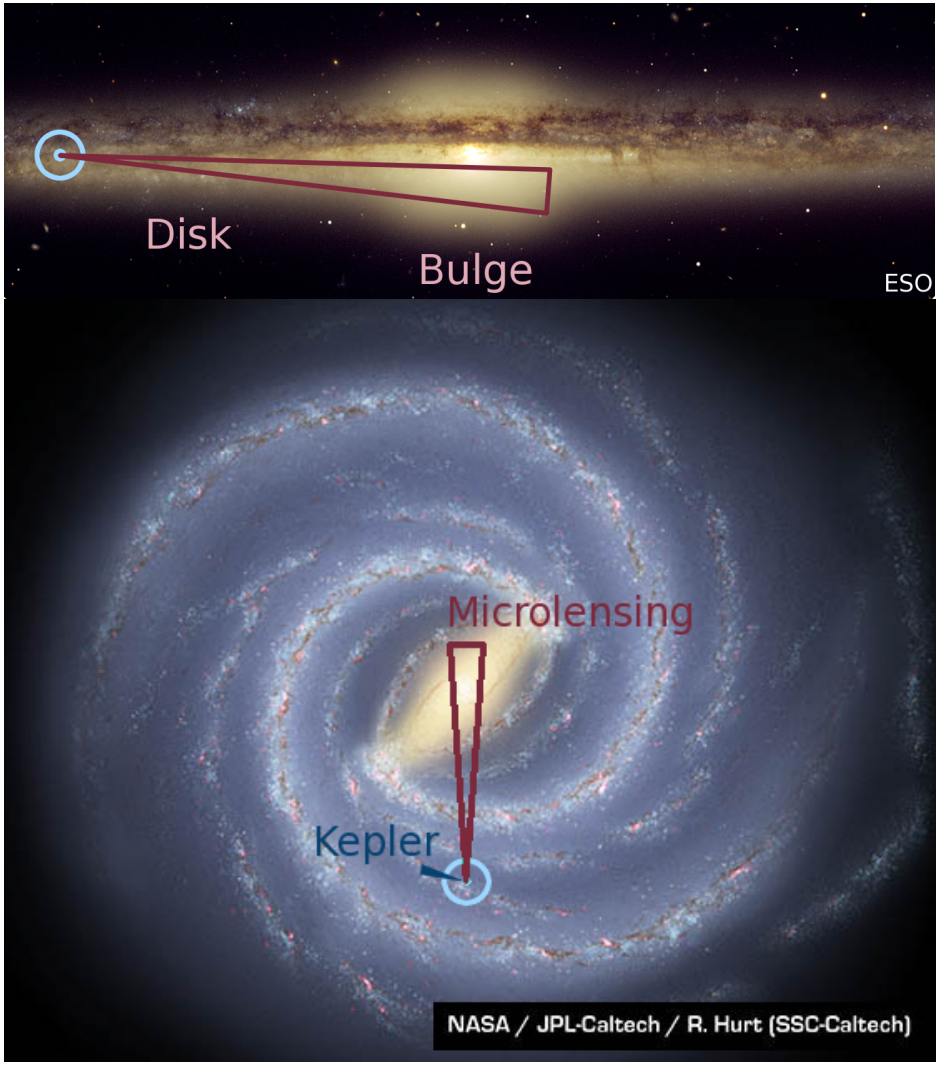
Where to look



Microlensing:

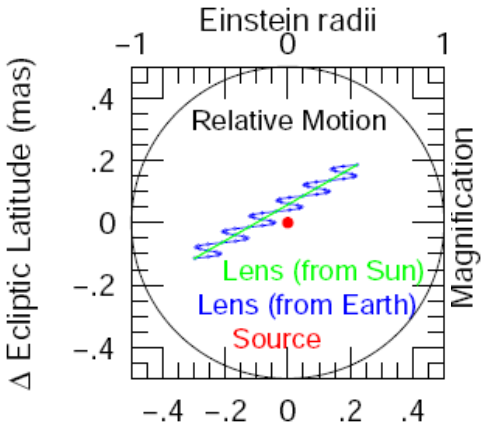
- *does not* rely on the planet host's light,
- *does* rely on a high density of stars,

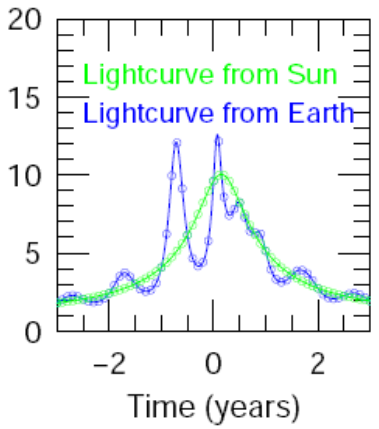
therefore is uniquely suited to finding planets in the crowded bulge *and* disk of our Galaxy, many kiloparsecs from Earth.

Measuring the Distance to Microlenses

Parallax

The Earth's motion during a microlensing event causes subtle deviations to its lightcurve, which can be used as a ruler to measure the size of the projected Einstein ring. In planetary microlensing events where the angular size of the Einstein ring can be measured as well, the distance to the planetary system can be directly measured.

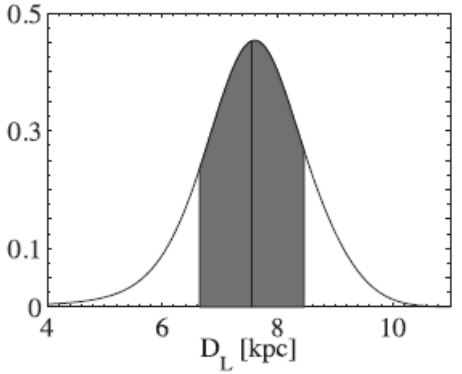




Gould & Horne (2013)

Bayesian Estimates

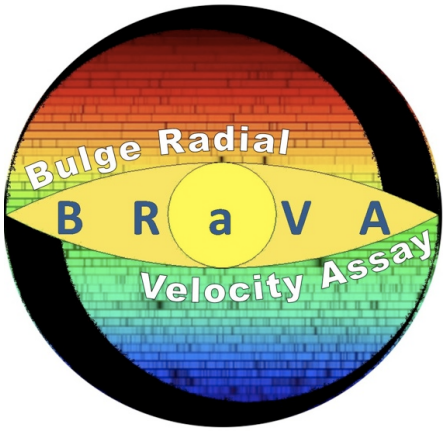
For lenses where it is not possible to directly measure a distance, it is still possible to estimate the distance statistically. This is done by assuming a Galactic model *prior* and incorporating constraints from measurements (e.g. the event timescale, high-resolution imaging, proper motions etc.) to estimate the *posterior* probability distribution of lens distances. However, this approach is limited by the Galactic model, and recently observations of the Galactic bulge have surpassed current models' ability to predict them.



Shvartzvald et al (2014)

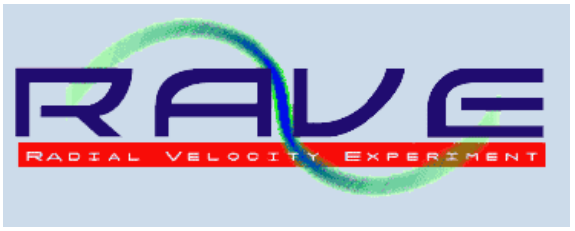
Measuring the Galactic Planet Distribution

SWEEPS



BDBS

GIBS



Estimating the distance to microlenses therefore requires a detailed knowledge of the structure and kinematics of both the bulge and disk in the direction of microlensing surveys. With this knowledge it is possible to assign a lens the probability of belonging to the disk or the bulge.

I will update models of the Galaxy using a host of new photometric, spectroscopic, astrometric and microlensing data from large-scale surveys in and around the Galactic bulge. This will allow a more accurate understanding of the frequency of microlensing events and how distant the lenses are.

I will use the updated models to improve estimates of distance and bulge/disk membership for all the microlensing planet hosts, and with these estimate the relative abundance of planets in the bulge and disk.