

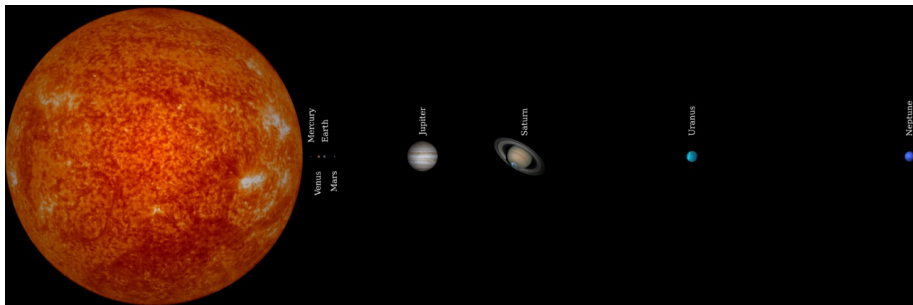
Exoplanets sharing origin with Uranus

Radek Poleski

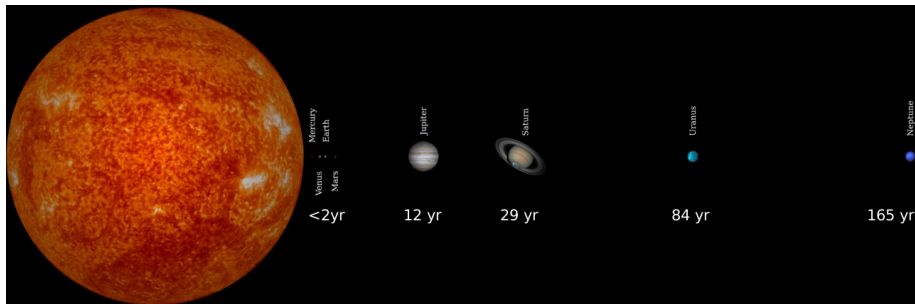
Ohio State University
University of Warsaw

29.06.2015

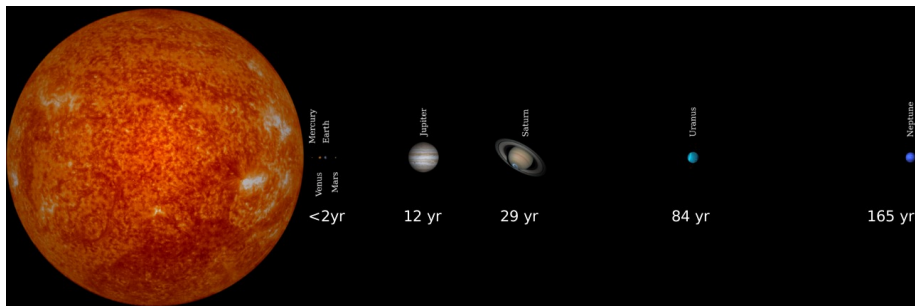
Solar System



Solar System

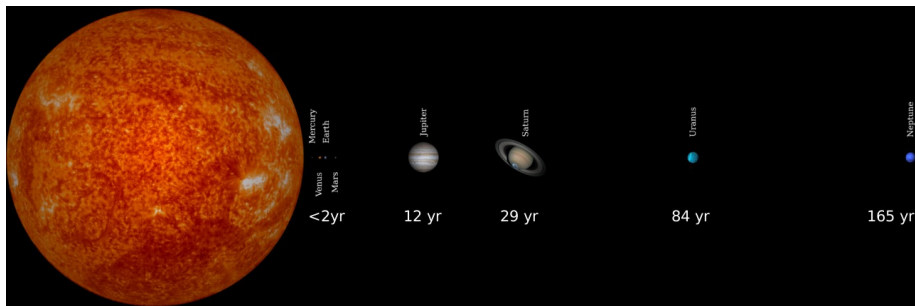


Solar System



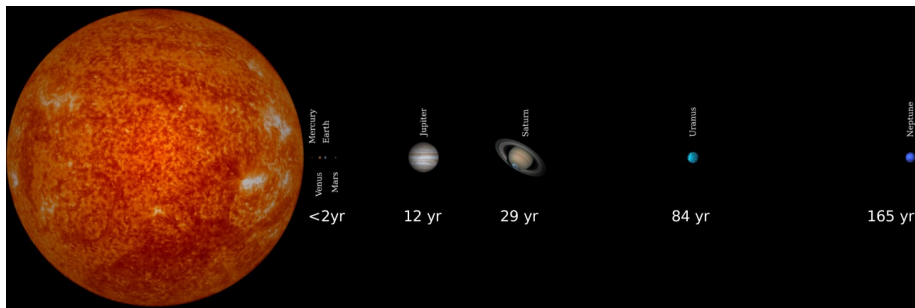
Radial velocity, transit, imaging, microlensing.

Solar System



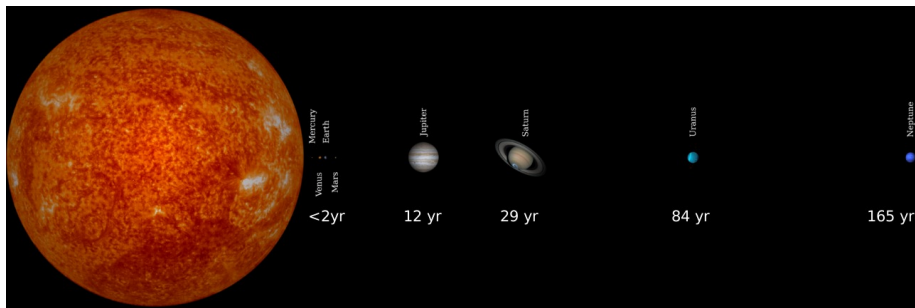
~~Radial velocity~~, transit, imaging, microlensing.

Solar System



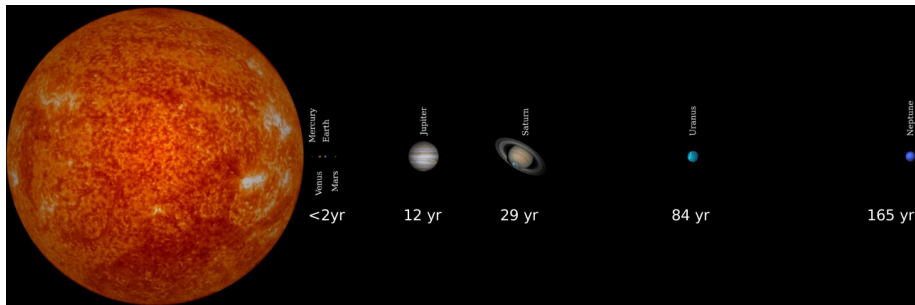
~~Radial velocity, transit, imaging, microlensing.~~

Solar System



~~Radial velocity~~, ~~transit~~, ~~imaging~~, microlensing.

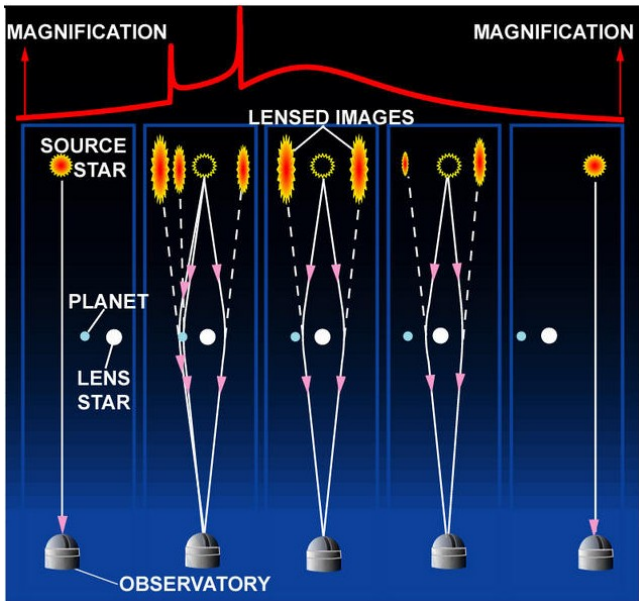
Solar System



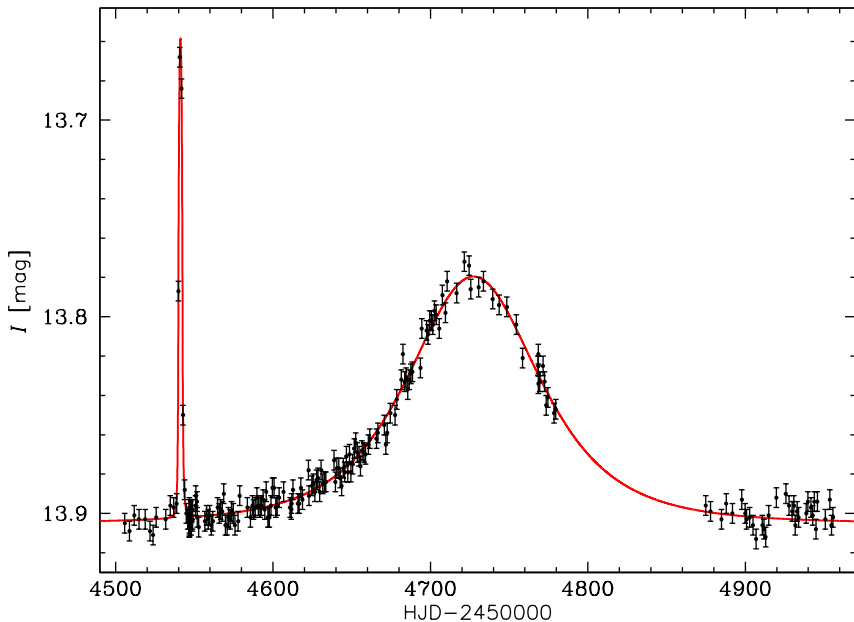
~~Radial velocity, transit, imaging,~~ microlensing.

Microlensing is unique technique to study ice giants.

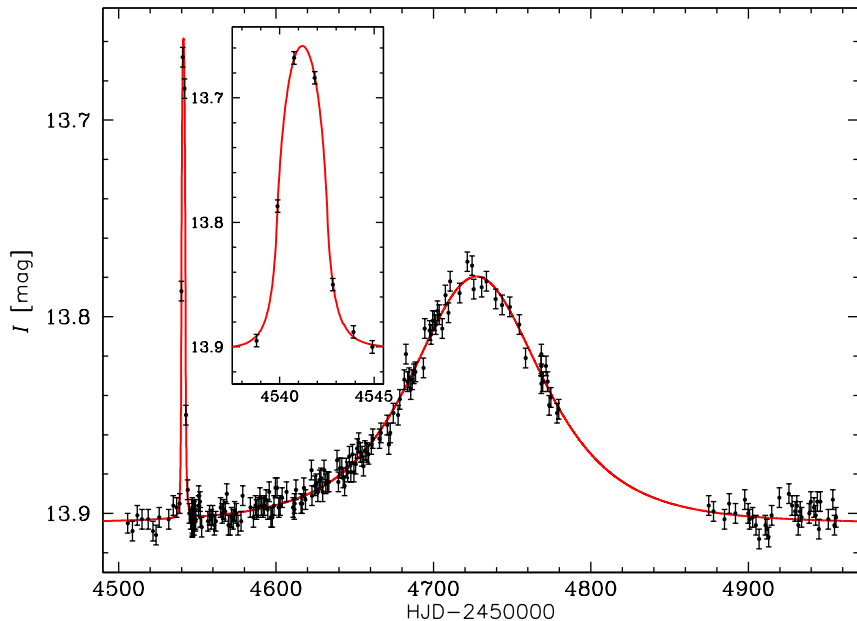
Planetary Gravitational Microlensing – typical case



Planetary Gravitational Microlensing – rare case



Planetary Gravitational Microlensing – rare case



- Planet-star projected separation: 5.3 Einstein ring radius,

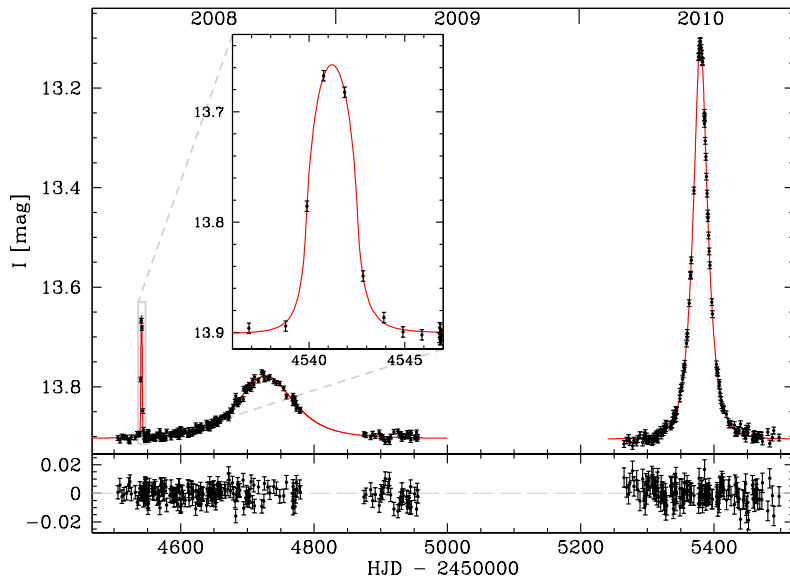
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- Planet-star mass ratio: 2.4×10^{-4} ,

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- Host mass: $0.71 M_{\odot}$ (derived using bulge model),

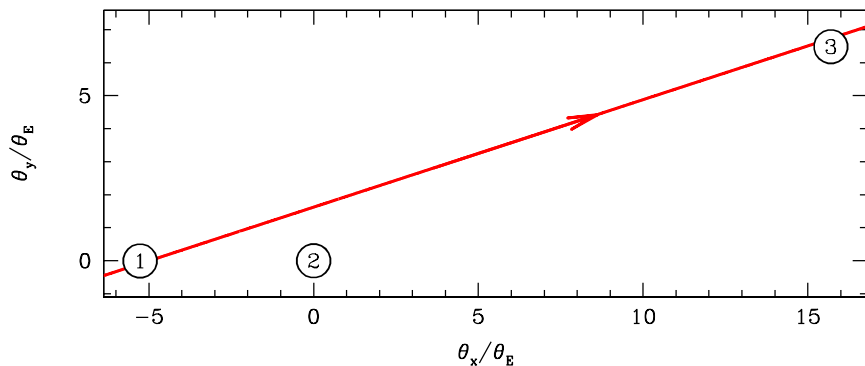
- Planet-star projected separation: 5.3 Einstein ring radius,
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- Planet mass: $3.9 M_{\text{Uranus}}$,

- Planet-star projected separation: 5.3 Einstein ring radius, or 15 AU,
- Planet-star mass ratio: 2.4×10^{-4} ,
- Host mass: $0.71 M_{\odot}$ (derived using bulge model),
- Planet mass: $3.9 M_{\text{Uranus}}$,
- Lens distance: 8.1 kpc.

OGLE-2008-BLG-092 surprise



OGLE-2008-BLG-092 source trajectory

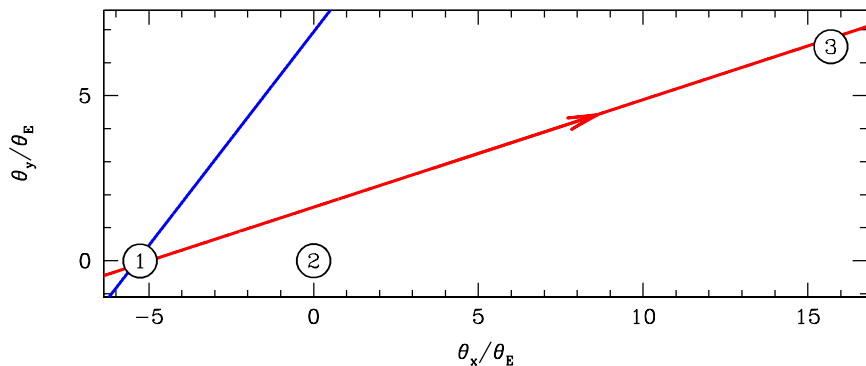


Poleski et al. 2014

Secondary mass: $0.15 M_{\odot}$.

Primary-secondary projected separation: 48 AU.

OGLE-2008-BLG-092 source trajectory

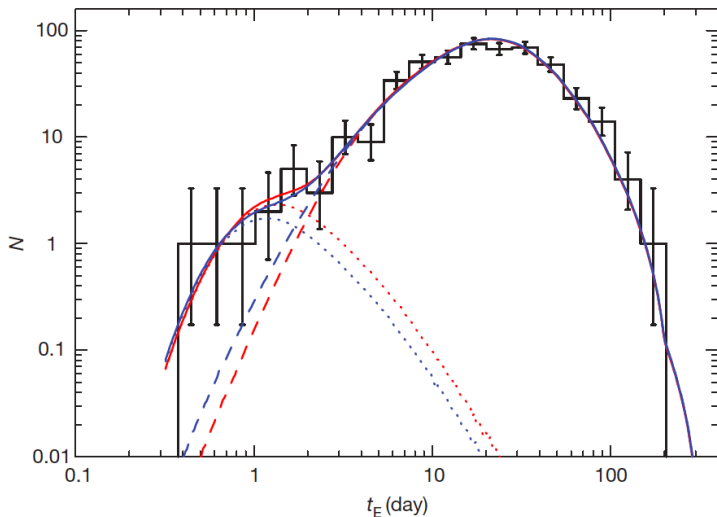


Poleski et al. 2014

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Connection with free-floating planets



Distribution of Einstein timescales (Sumi et al. 2011).

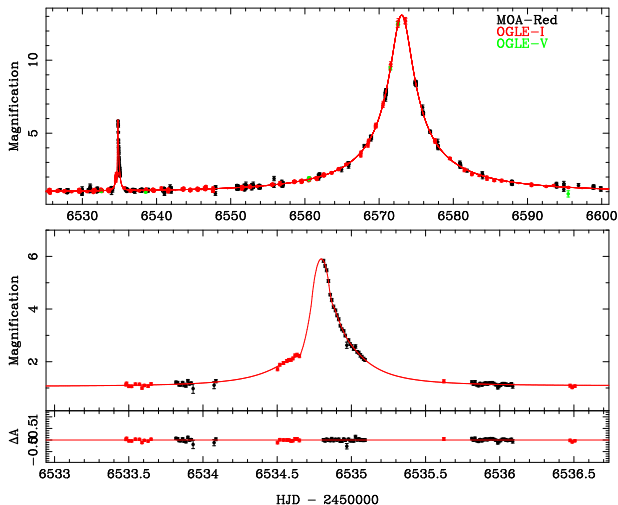
Free-floating planets abundance



$1.8^{+1.7}_{-0.8}$ times more than MS stars.

MOA-2013-BLG-605 = OGLE-2013-BLG-1835

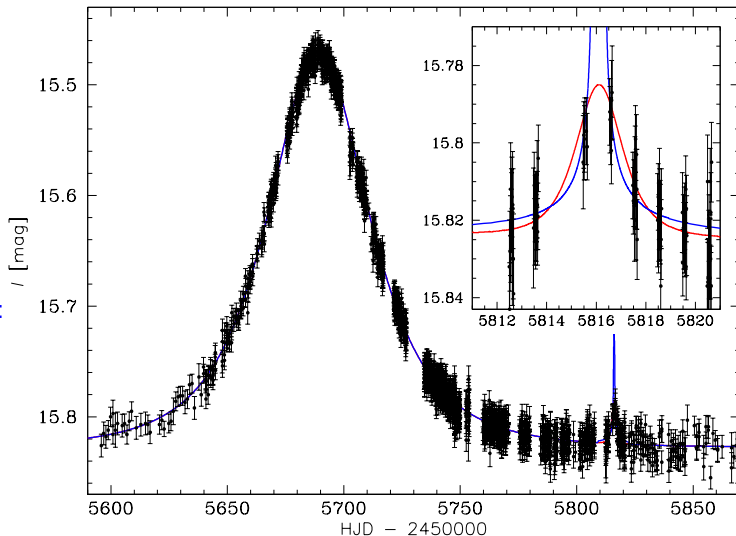
$$s = 2.4$$
$$q = 3.5 \times 10^{-4}$$



Sumi et al. in preparation

double lens:
 $q = 5 \times 10^{-4}$
 $s = 4.7$

double source:
 $F_2/F_1 =$
 6×10^{-4}



- Microlensing is the only method to find analogs of Uranus and Neptune.
- First Uranus analog is OGLE-2008-BLG-092LAb.
- Other similar exoplanets were detected.
- Estimating the rate of free-floating planets requires the rate of wide orbit planets to be known.