Binary microlensing event OGLE-2009-BLG-020 gives orbit predictions verifiable by follow-up observations.

Jan Skowron

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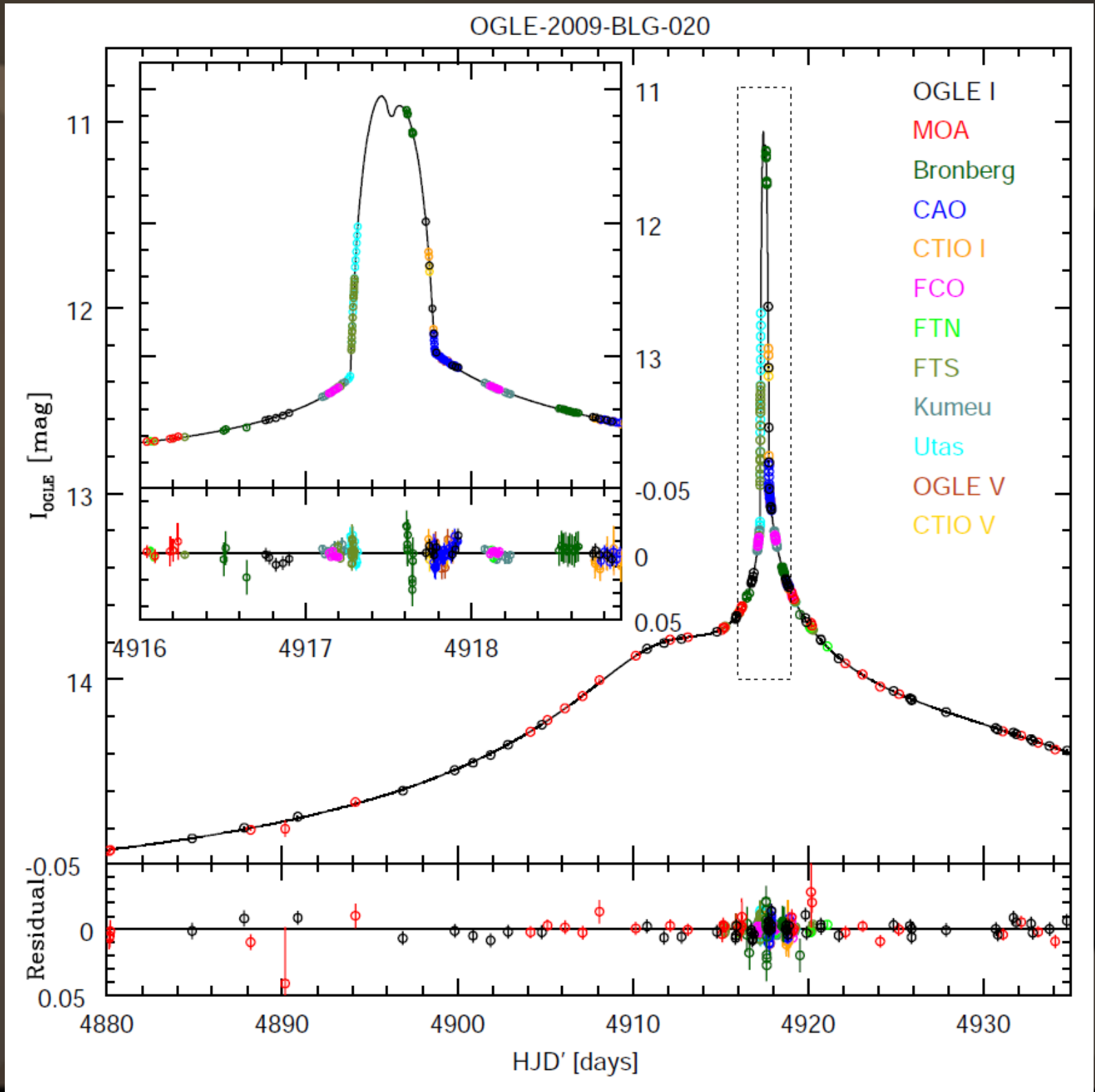
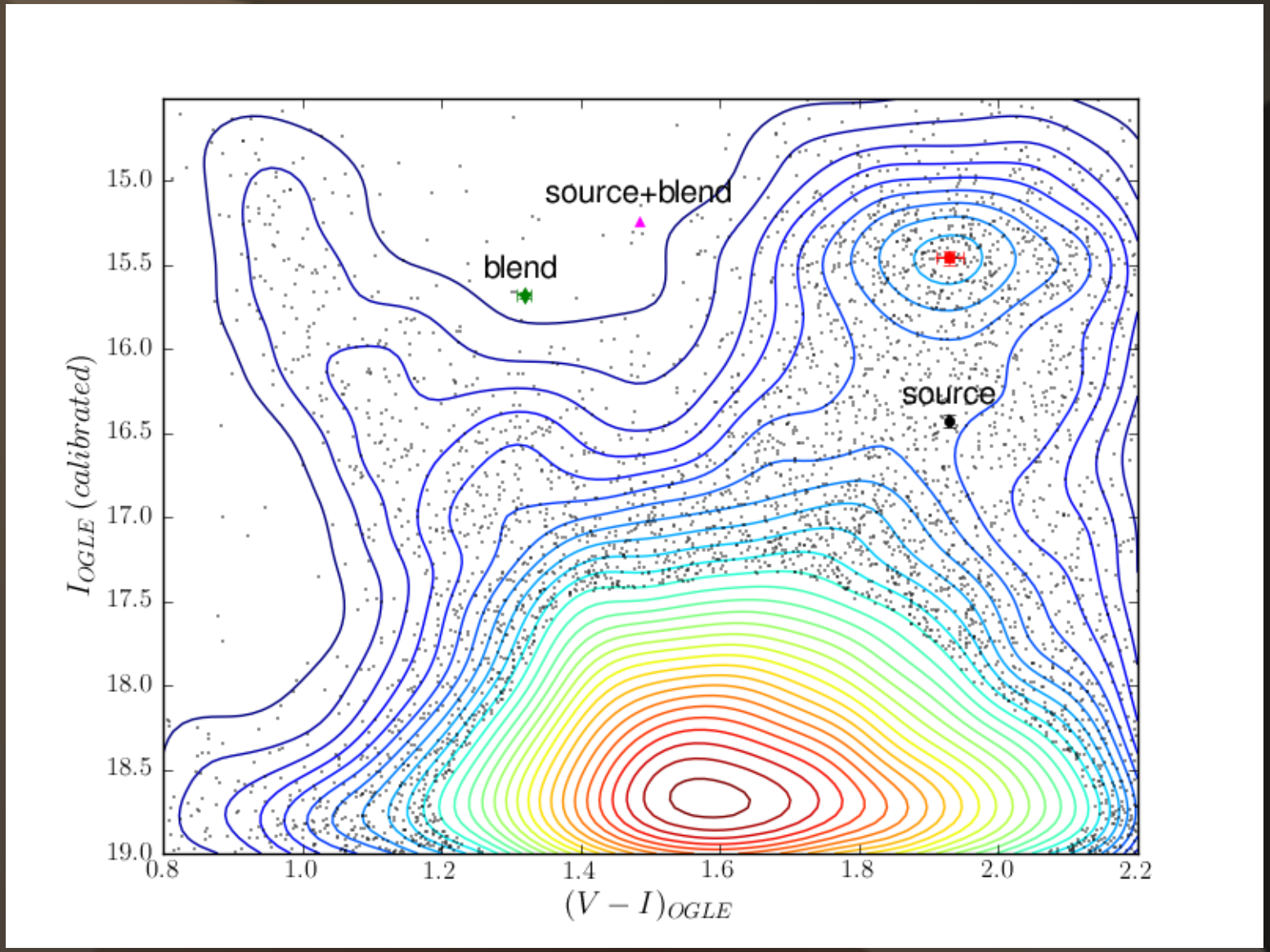
Salerno, 2011

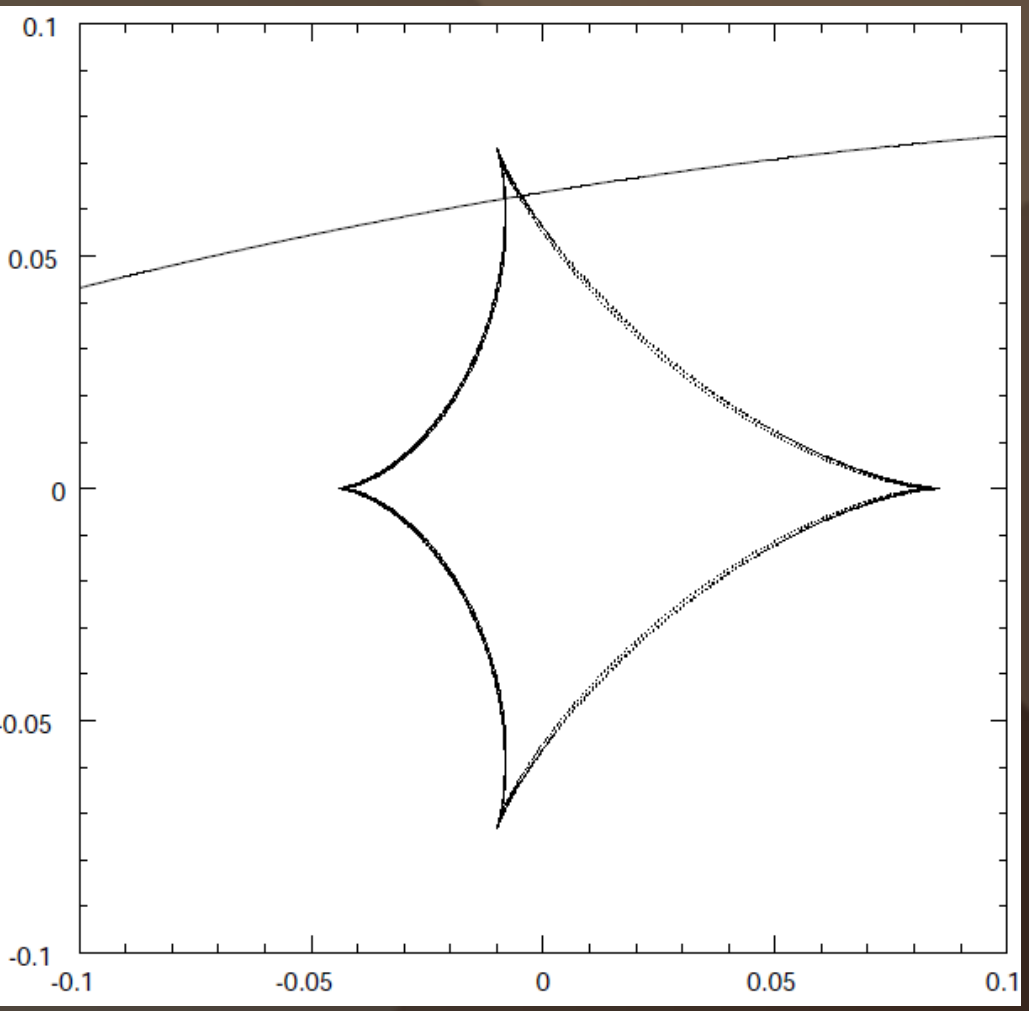

OGLE-2009-BLG-020
OGLE I
MOA
Bronberg
CAO
CTIO I
FCO
FTN
FTS
Kumeu
Utas
OGLE V
CTIO V
I_{OGLE} [mag]
Residual
HJD' [days]
11
12
13
14
-0.05
0
0.05
4880
4890
4900
4910
4920
4930
4916
4917
4918

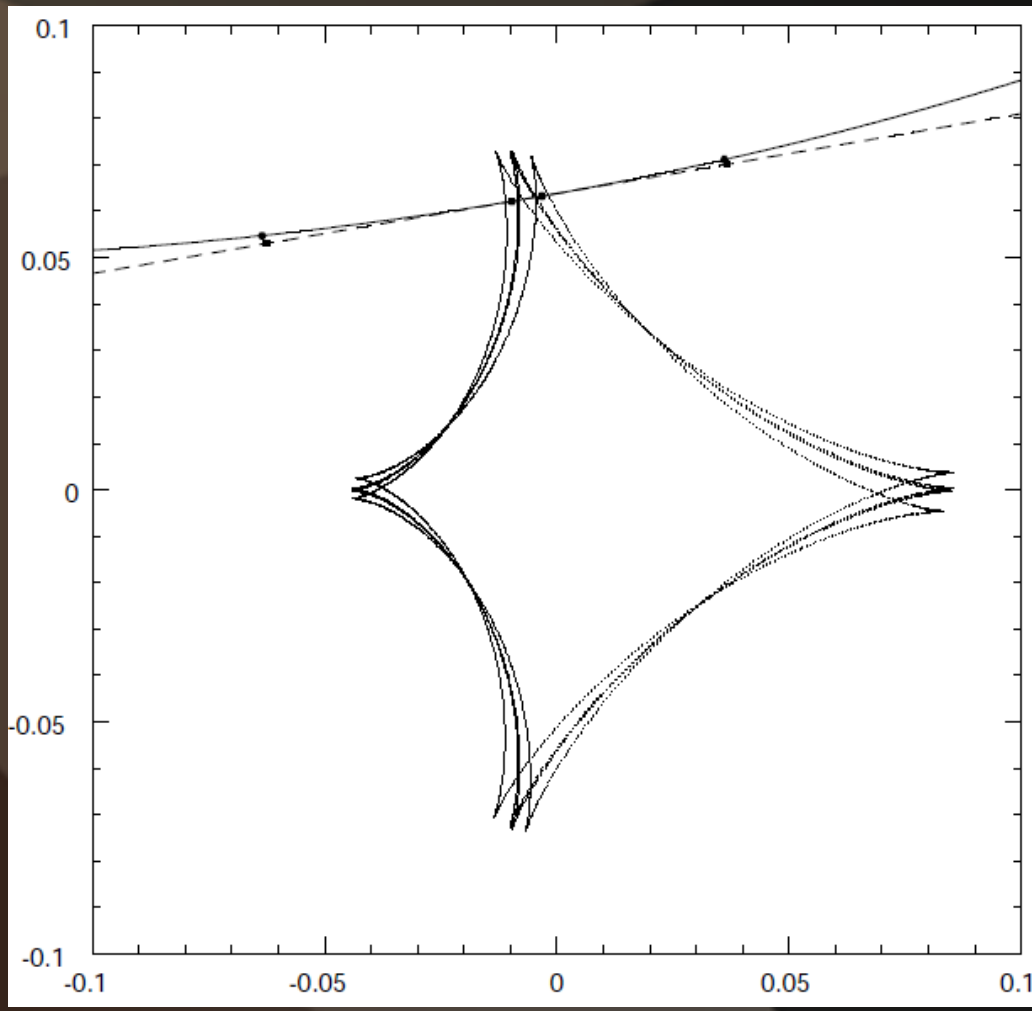
Bright blend



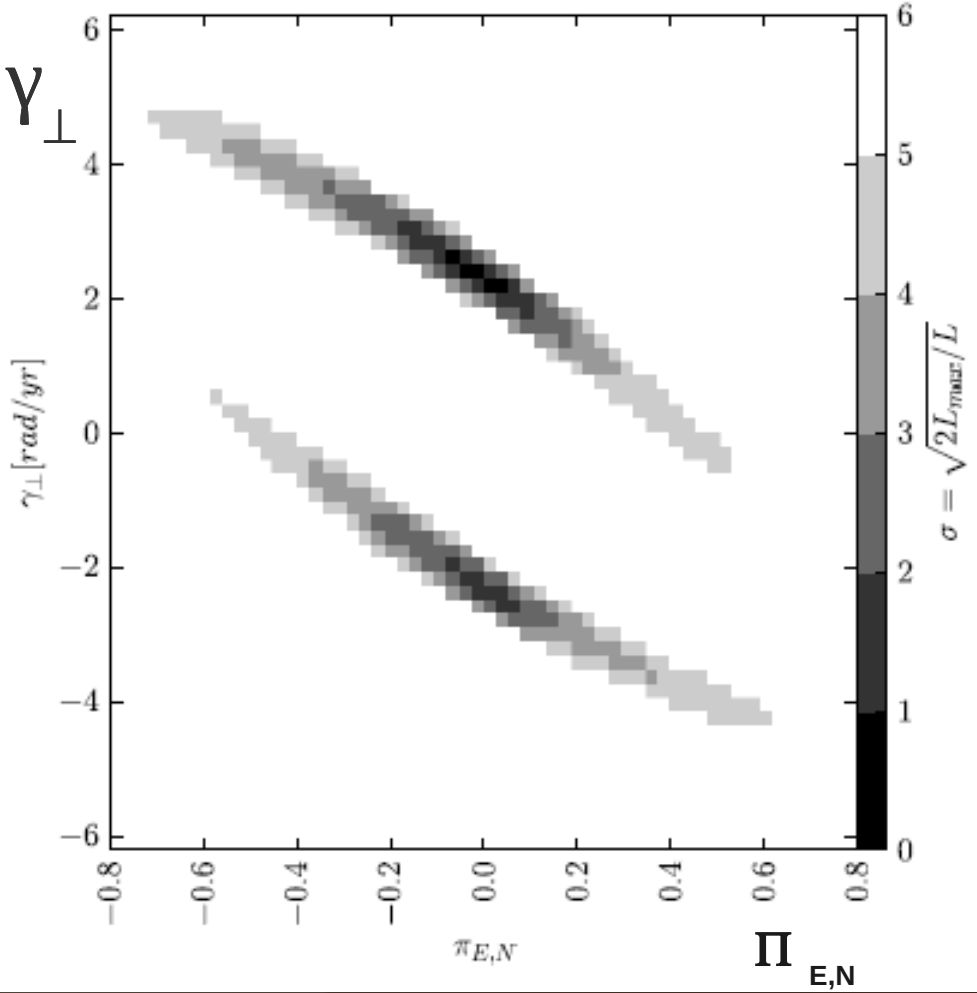
source: V=18.36, I=16.43, H=14.3 (Bulge giant)
blend: V=17.00, I=15.68, H=14.3 (consistent with close by disk dwarf)

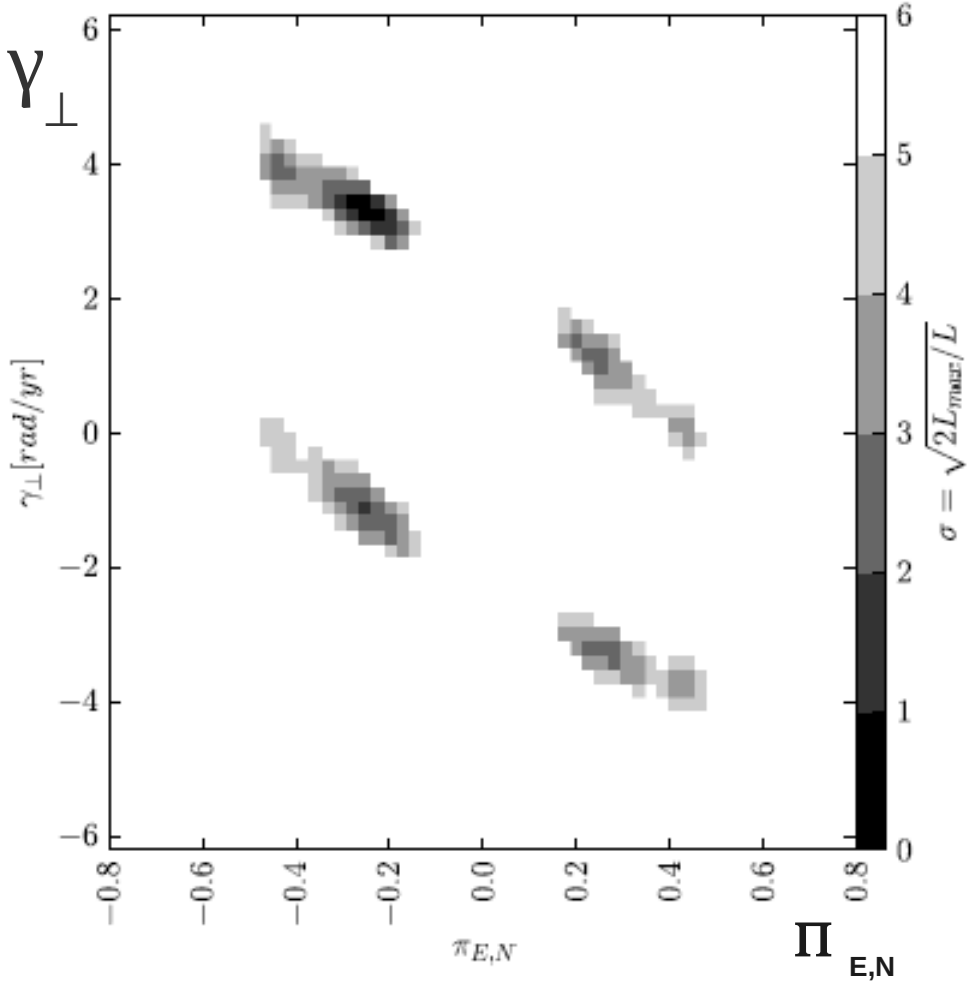
Curvature of the source trajectory





Degeneracy of the parallax and lens orbital motion



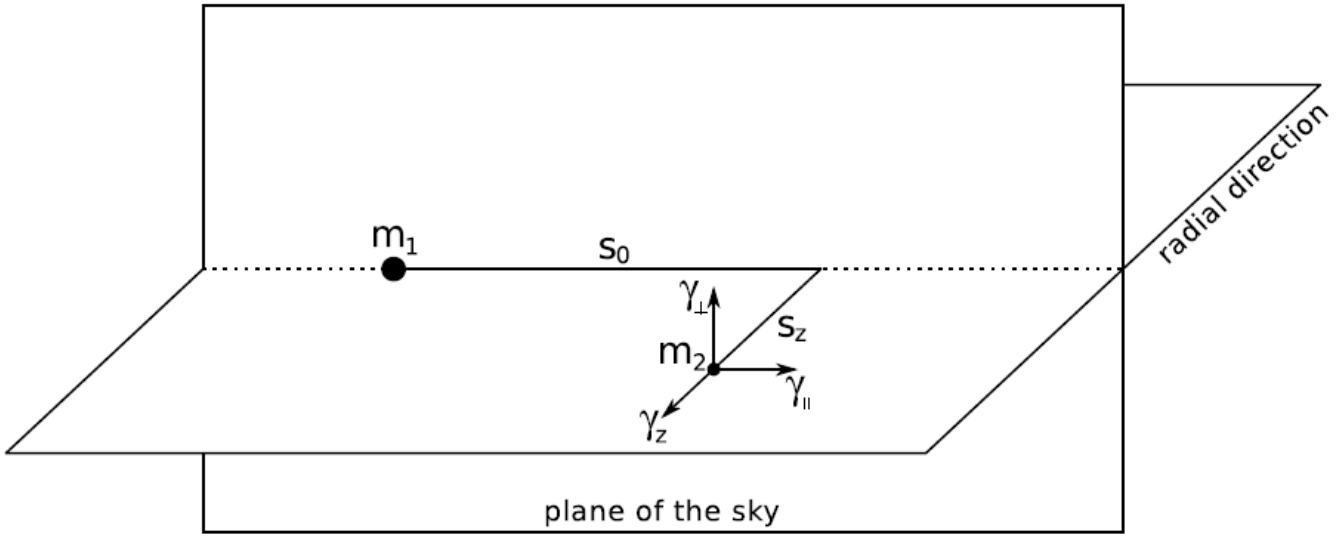


Isochrone matching in 3 bands helps to pick the subset of solutions.

Predicting RV signal

- Microlensing usually measures only 2-dimensional orbital motion velocity in the plane of the sky (parallel and perpendicular to the binary axis)
- To predict RV signal we need to fit the full Keplerian orbit

Two new parameters



Phase-space parameters (at one chosen time)

position: $(s_\parallel,\ s_\perp,\ s_z)$

velocities: $(\gamma_\parallel,\ \gamma_\perp,\ \gamma_z)$

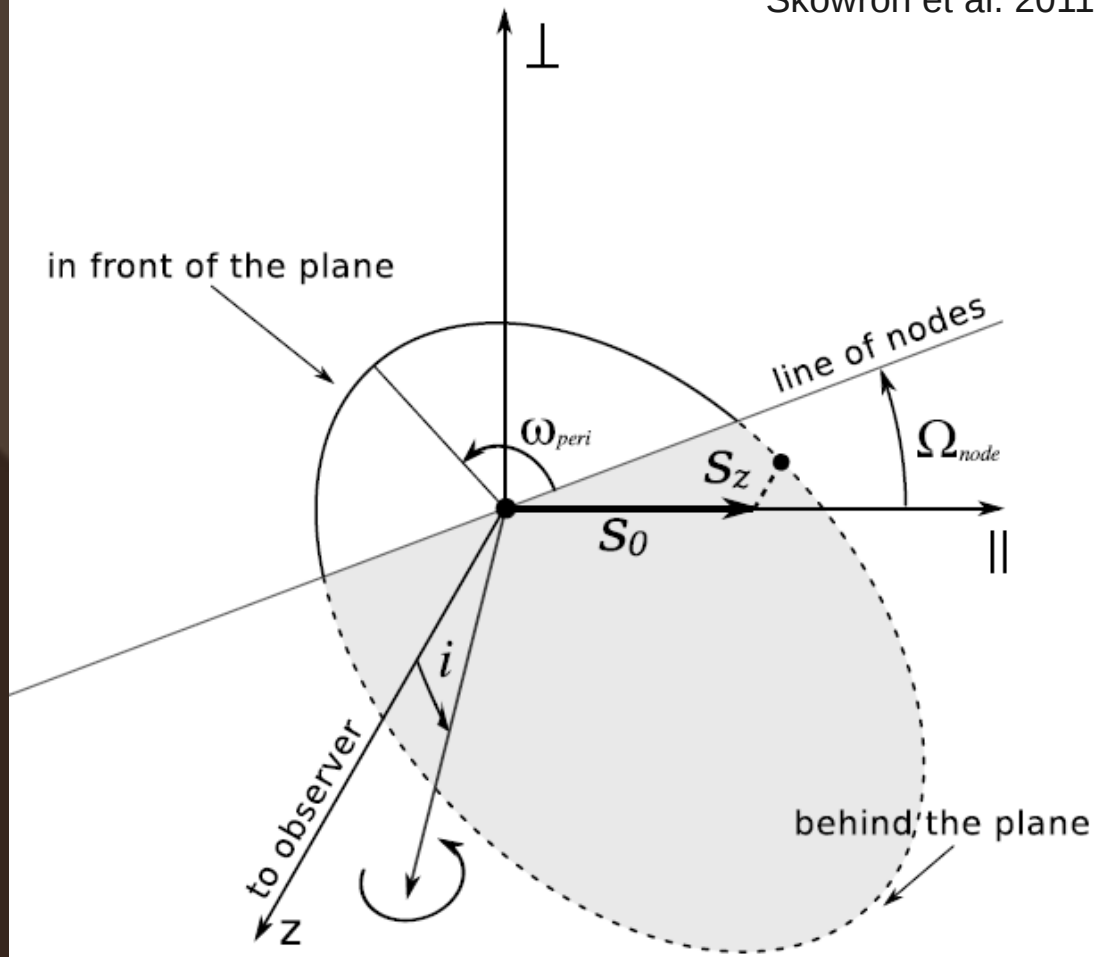
+

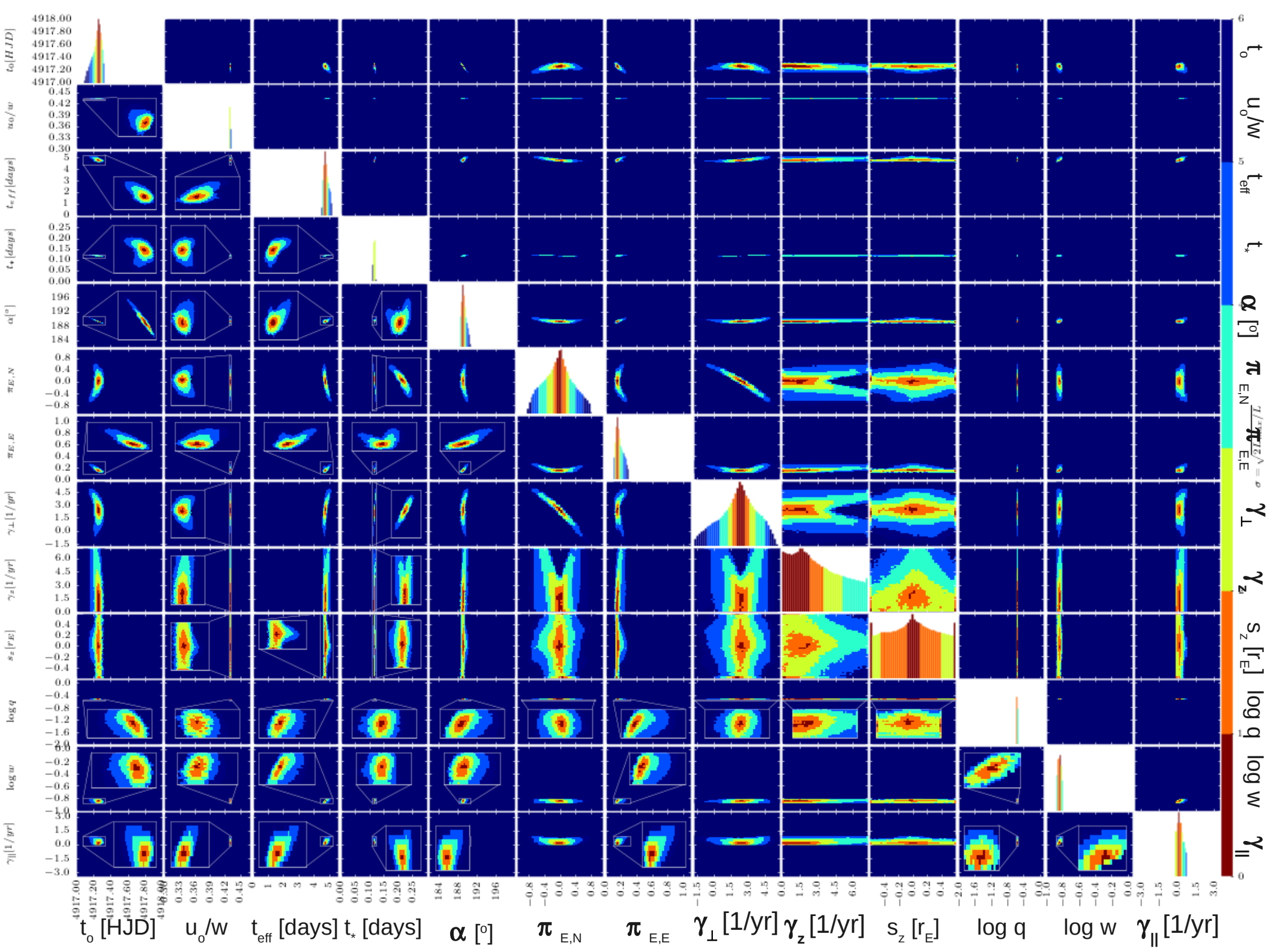
mass and mass ratio

gives

Full orbit description

Skowron et al. 2011

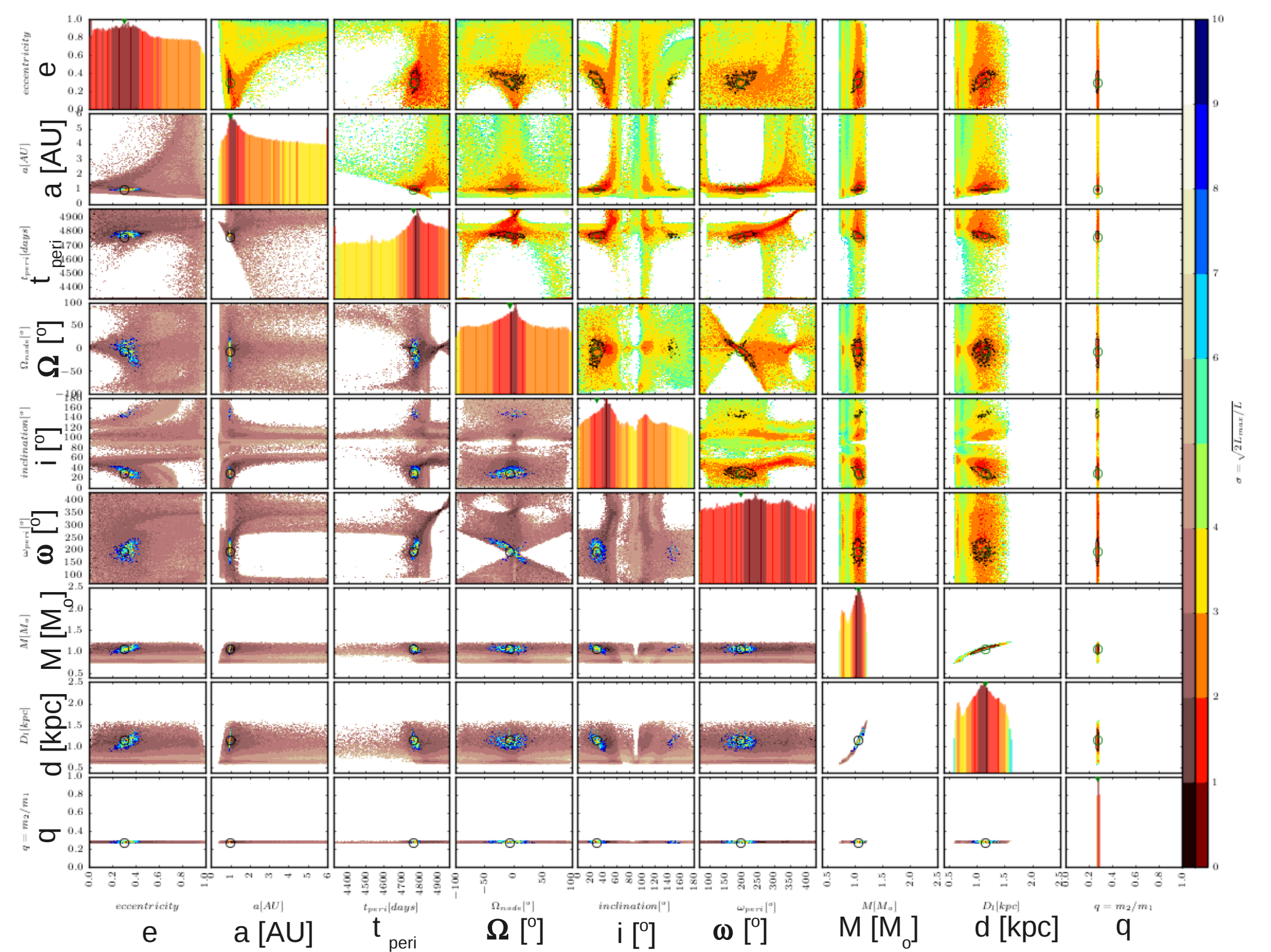



t_0 [HJD]
u_0/w
t_{eff} [days]
t_* [days]
α [°]
$\pi_{E,N}$
$\pi_{E,E}$
$\gamma_\perp$ [1/yr]
γ_z [1/yr]
s_z [r_E]
log q
log w
$\gamma_\parallel$ [1/yr]
$\sigma = \sqrt{\pi_{E,N}^2 + \pi_{E,E}^2}$

Test of microlensing solution

- We measure well 10 out of 13 parameters
- Follow-up spectroscopy will measure 6 parameters
- The system will be over-constrained

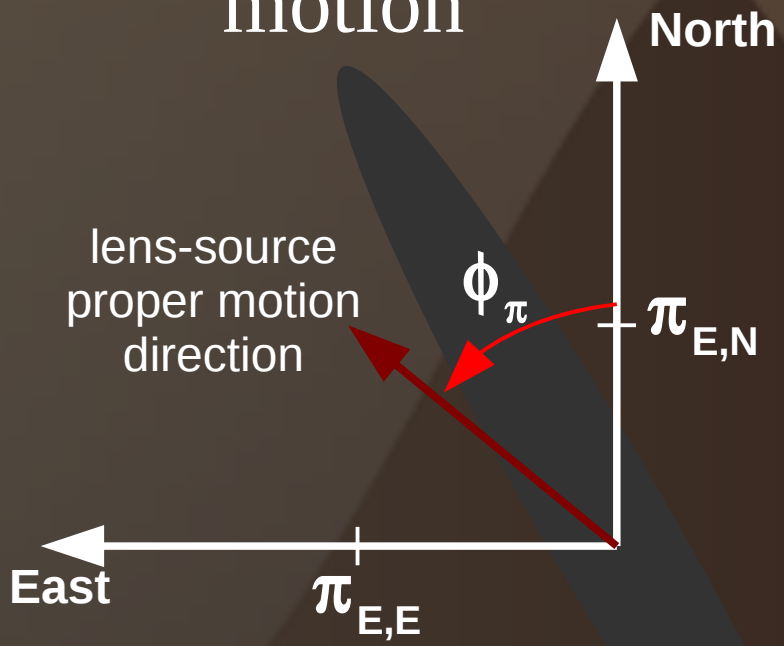
  - test is possible

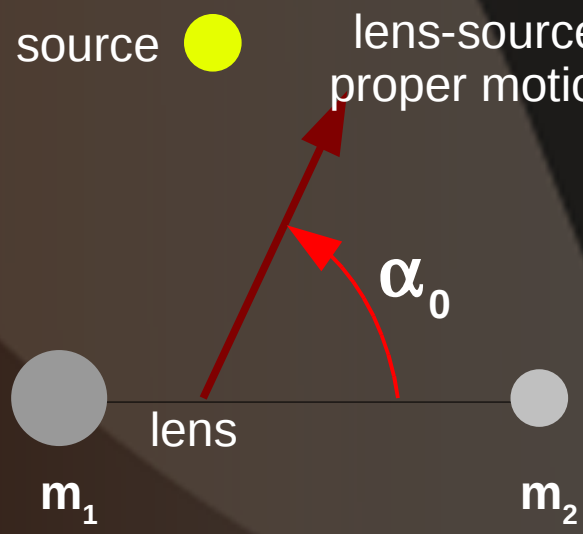

e
a [AU]
t peri
Ω [º]
i [º]
ω [º]
M [M o]
d [kpc]
q
eccentricity
a[AU]
$t_{peri}[days]$
$\Omega_{node}[^o]$
inclination[º]
$\omega_{peri}[^o]$
$M[M_o]$
$D_l[kpc]$
$q = m_2/m_1$
$\sigma = \sqrt{2L_{max}/L}$

Notation, conventions and symmetries

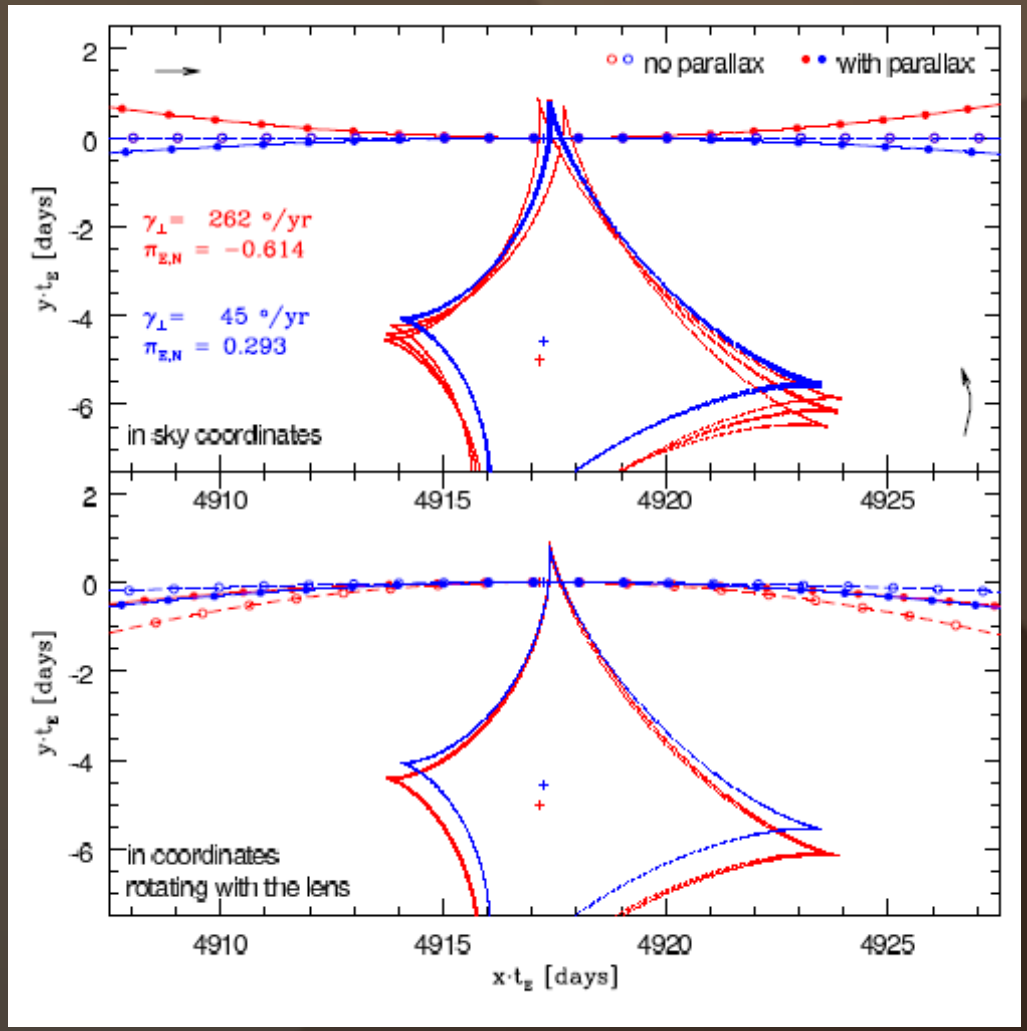
in Appendix A -- Skowron et al. 2011, arXiv/1101.3312

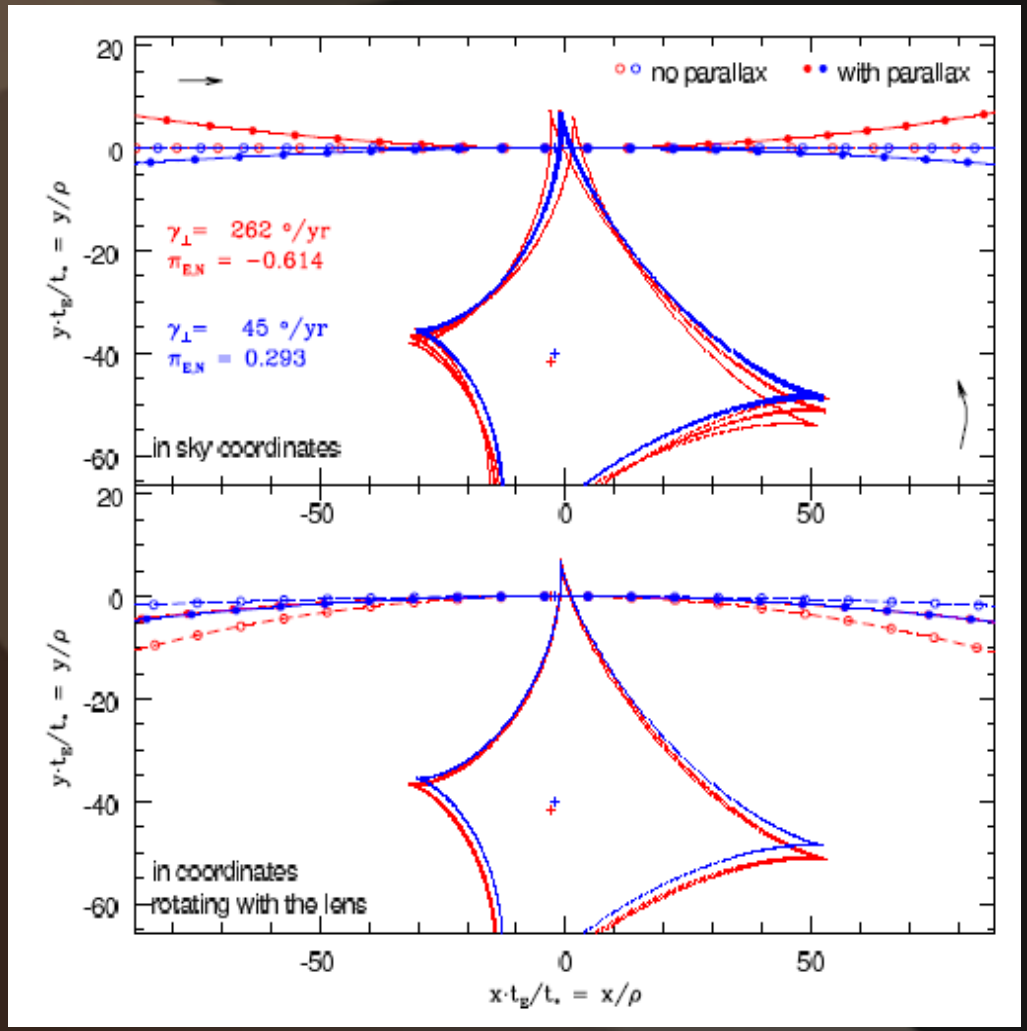
- angles counter-clockwise
- coordinate systems right-handed
- directions as directions of the lens-source proper motion





Grazie per l'attenzione


no parallax
with parallax
$\gamma_\perp$= 262 °/yr
$\pi_{E,N}$ = −0.614
$\gamma_\perp$= 45 °/yr
$\pi_{E,N}$ = 0.293
in sky coordinates
in coordinates
rotating with the lens
y·t_E [days]
x·t_E [days]
2
0
-2
-4
-6
4910
4915
4920
4925


no parallax
with parallax
$\gamma_\perp$= 262 °/yr
$\pi_{E,N}$ = −0.614
$\gamma_\perp$= 45 °/yr
$\pi_{E,N}$ = 0.293
in sky coordinates
in coordinates
rotating with the lens
y·t_E/t_* = y/ρ
x·t_E/t_* = x/ρ
20
0
-20
-40
-60
-50
0
50