Candidate of the microlensing planet not toward the bulge ~ AT2021uey (Gaia21dnc) ~

- Team OAUW : M. Ban, R. Poleski, L. Wyrzykowski, P. Zielinski
- Team Fink : P. Voloshyn, E. Bachelet, J. Peloton

Makiko Ban
Astronomical Observatory, University of Warsaw

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Microlensing Event Alert

Date of alert	Telescope	Anormary detection
7 July 2021	ASAS-SN (21mc)	Yes
~7 July 2021	ZTF	Yes
27 July 2021	Gaia EDR3	No

Facility code	Telescope name and location	Longitude [deg] + for E	Latitude [deg] + for N	Mirror size [m]	Instrument	Pixel scale [arcsec/pixel]
ASAS-SN	The All Sky Automated Survey for SuperNovae global network of telescopes	–	–	24x0.14	FLI ProLine PL230	7.80
LCO-1m	Las Cumbres Observatory, global network of 1-m telescopes	–	–	1.00	Sinistro	0.39
Gaia	ESA space mission	–	–	1.4×0.5	CCD 4500×1966	0.20
ZTF	The Zwicky Transient Facility, Samuel Oschin telescope, Palomar Observatory, California, US	−116.86	33.36	1.22	CCD 16x6144x6160	1.00
ZAO	Znith Astronomy Observatory, Malta	14.47	35.91	0.20	Moravian G2-1600	0.99
Slooh	network of 10 telescopes, Tenerife, Canary Islands, Spain	-16.64	28.27	0.36, 0.50	CCD	0.63, 0.73
HAO68	Horten telescope, Horten Videregaende Skole, Norway	10.39	59.43	0.68	Moravian G2-1600	0.79
AstroLAB-IRIS	AstroLAB IRIS, Ypres, Belgium	02.91	50.82	0.68	SBIG STL 6303E	0.62
Maidenhead	Commercial telescopes, Maidenhead, UK	-0.78	51.53	various	various	various
Loiano	Cassini telescope, Loiano Observatory, Italy	11.33	44.26	1.52	BFOSC	0.58
Flarestar	Meade SSC-10, Flarestar Observatory, Malta	14.47	35.91	0.25	Moravian G2-1600	0.99
Tacande	Tacande Observatory, La Palma, Canary Islands, Spain	−17.87	28.64	0.40	SX814 CCD	0.29

Source is not toward the Bulge

Source properties (Gaia ERD3):

RA, Dec = 21:38:10.81, +26:27:59.65

Baseline G-mag = 15.47

Parallax = 0.438 ± 0.047 mas

μ_{RA} = -7.912 ± 0.045 mas/yr

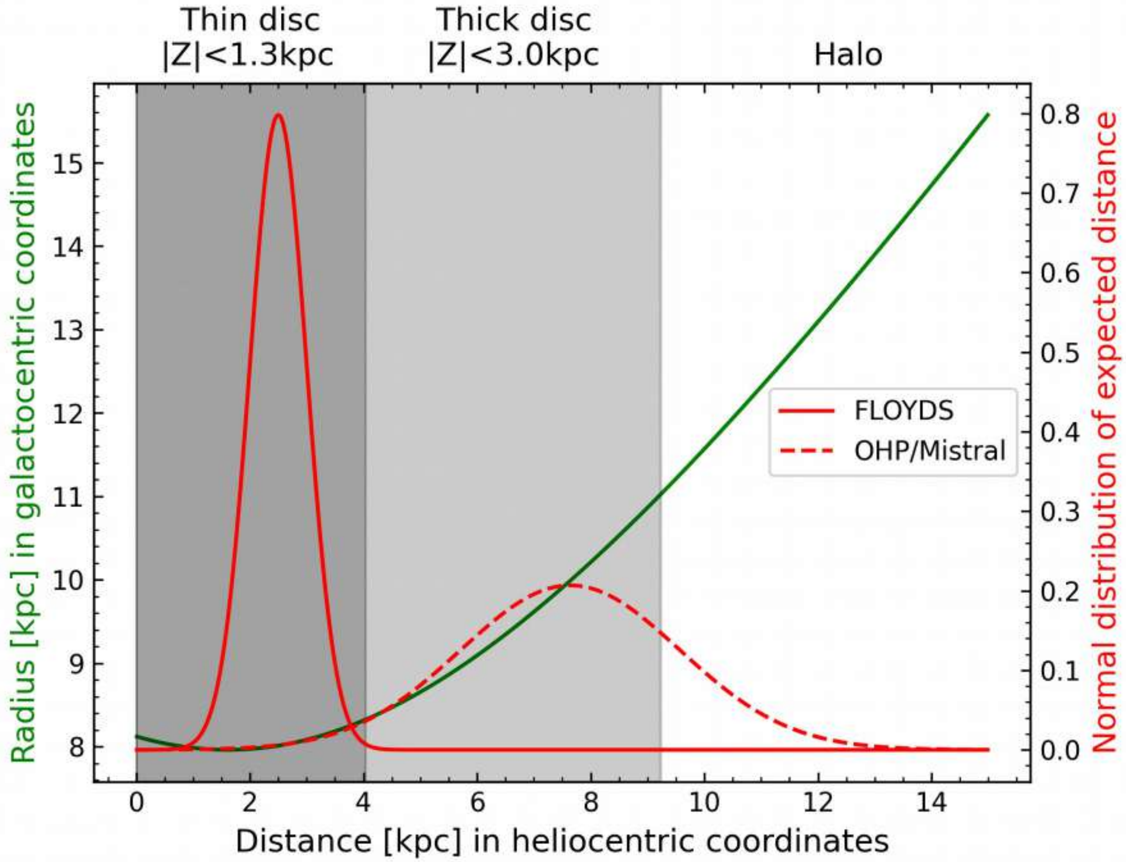
μ_{dec} = -0.527 ± 0.029 mas/yr

ruwe = 1.478

Distance = 2.15 ± 0.08 kpc

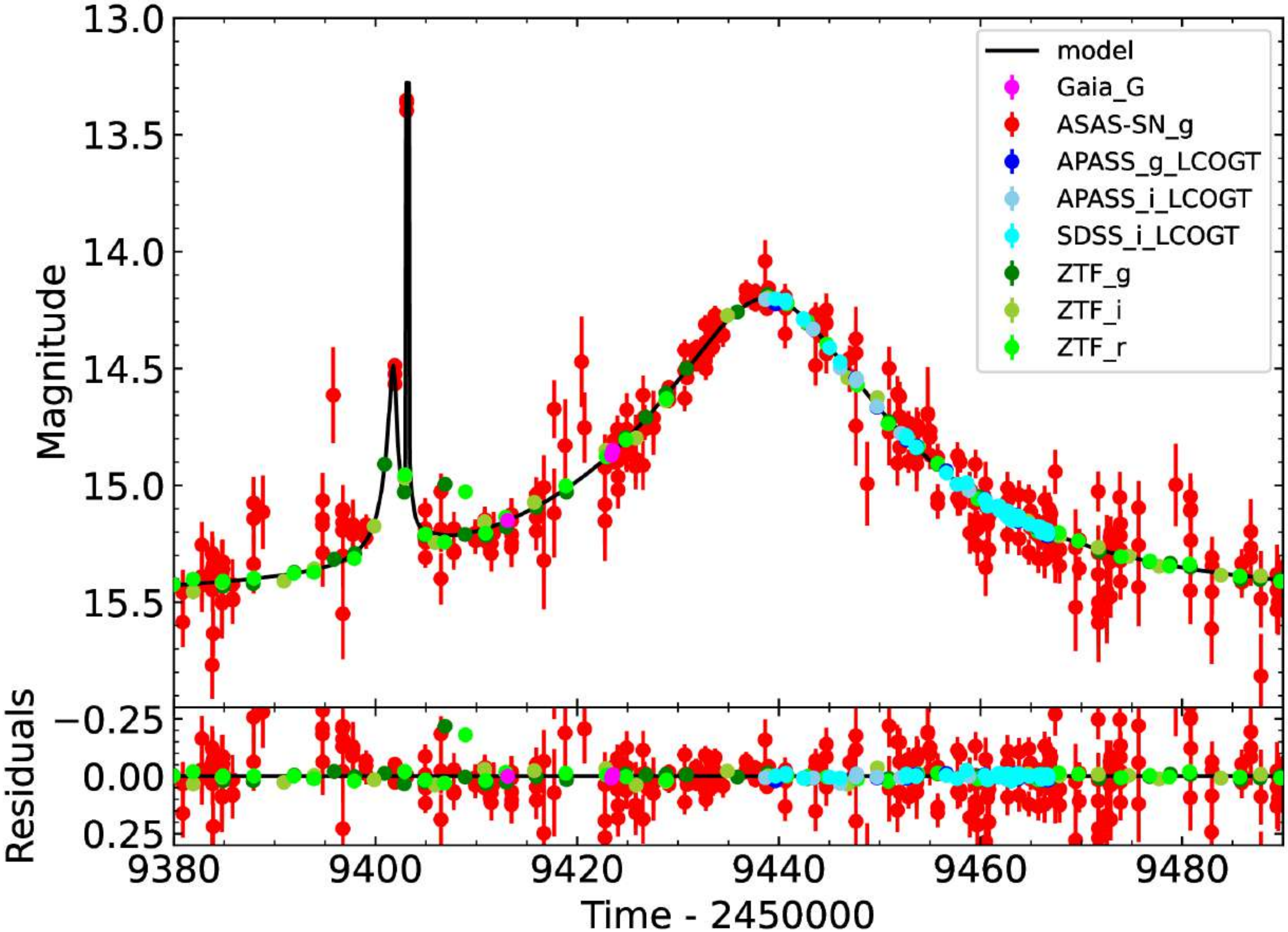
☹

Spectra data	FLOYDS	OHP/Mistral
Type	sub giant	red giant
T_{eff} [K]	6035 ± 1200	5440 ± 300
logg	3.02 ± 0.60	2.50 ± 0.50
A_v	0.26	0.21
Distance [kpc]	2.50 ± 0.50	7.64 ± 1.93



Fitting the Light Curve

by MulensModel (Poleski and Yee 2018) & pyLIMA (Bachelet, et al., 2017)



Best fit:

t_0 = 2459438.690
u_0 = 0.303
t_E = 27.945 [day]
q = 2.589e-3
s = 1.849 [θ_E]
α = 192.717 [deg]
ρ = 1.544e-3 [θ_E]

X^2/dof ~ 1.12-1.62

Fitting the Light Curve

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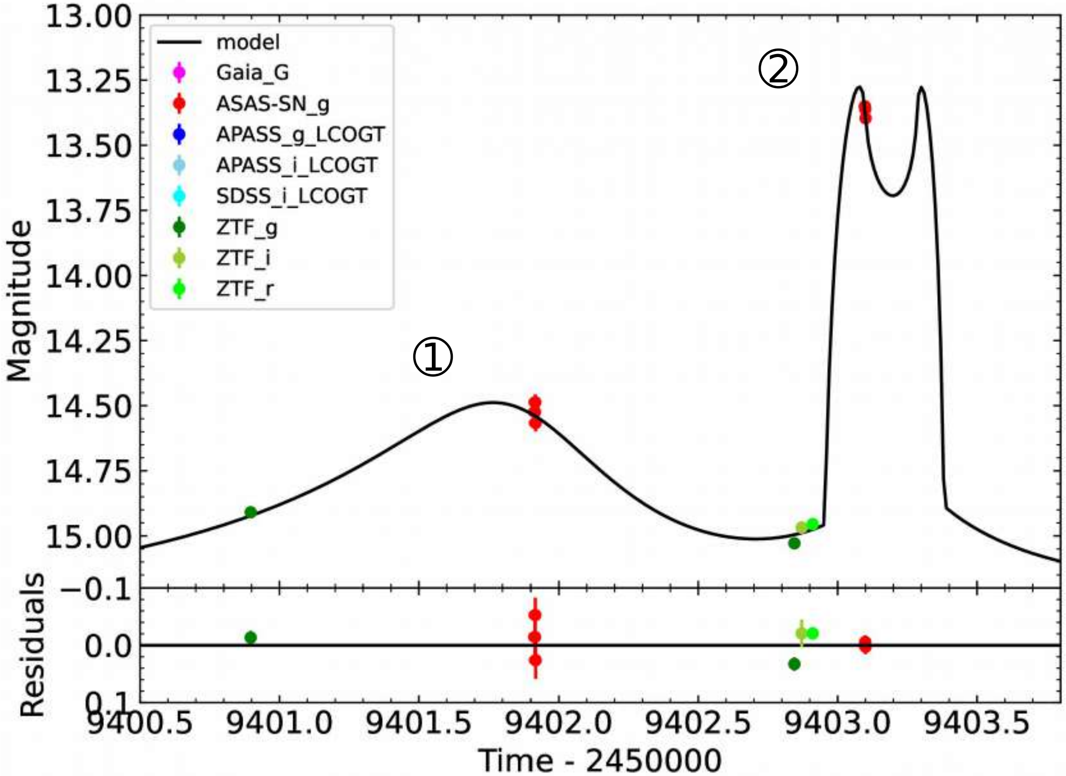
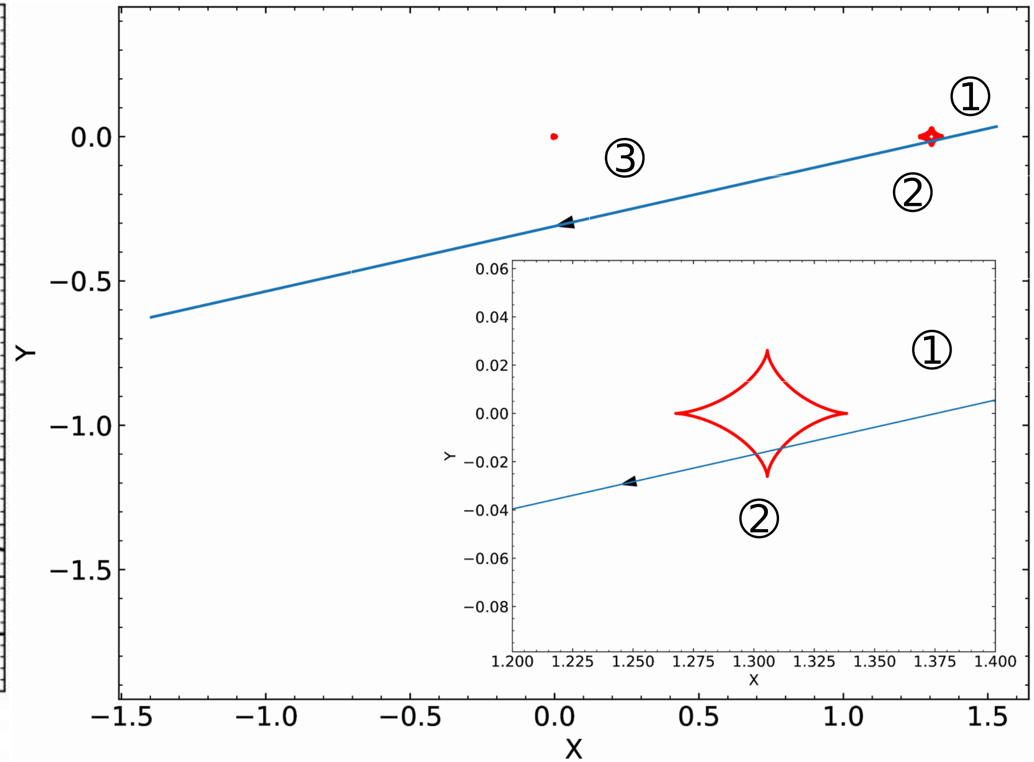
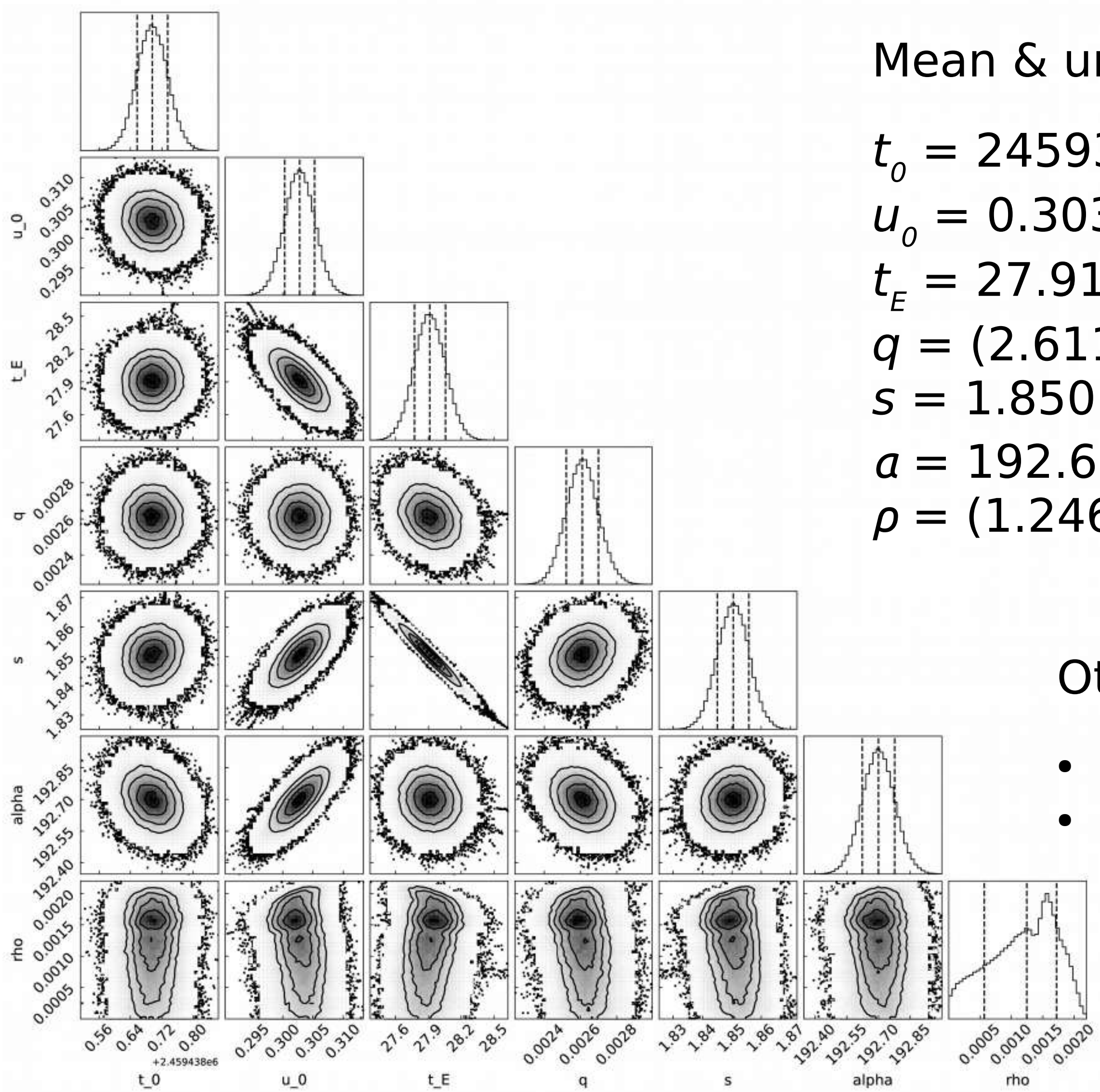




① Approaching to a planet lens
② Crossing caustics
③ Approaching to a host lens → Main peak of the curve

Fitting the Light Curve

by MulensModel (Poleski and Yee 2018) & pyLIMA (Bachelet, et al., 2017)



Mean & uncertainty of parameters:

t_0 = 245938.696 ± 0.039
u_0 = 0.303 ± 0.002
t_E = 27.912 ± 0.142 [day]
q = (2.611 ± 0.088)e-3
s = 1.850 ± 0.005 [θ_E]
α = 192.670 ± 0.077 [deg]
ρ = (1.246 ± 0.575)e-3 [θ_E]

Other facts:

- No clear microlensing parallax
- Blending <10.6% of the source flux

Lens properties

Event simulation using Besançon Galactic Model (Robin, et al. 2003, 2014, 2017)

Data

- V=15-16 for source, V=20-99 for lenses
- Distance = 0.01-15.00 kpc with 0.01 interval
- Population is treated as the solid angle

Sampling

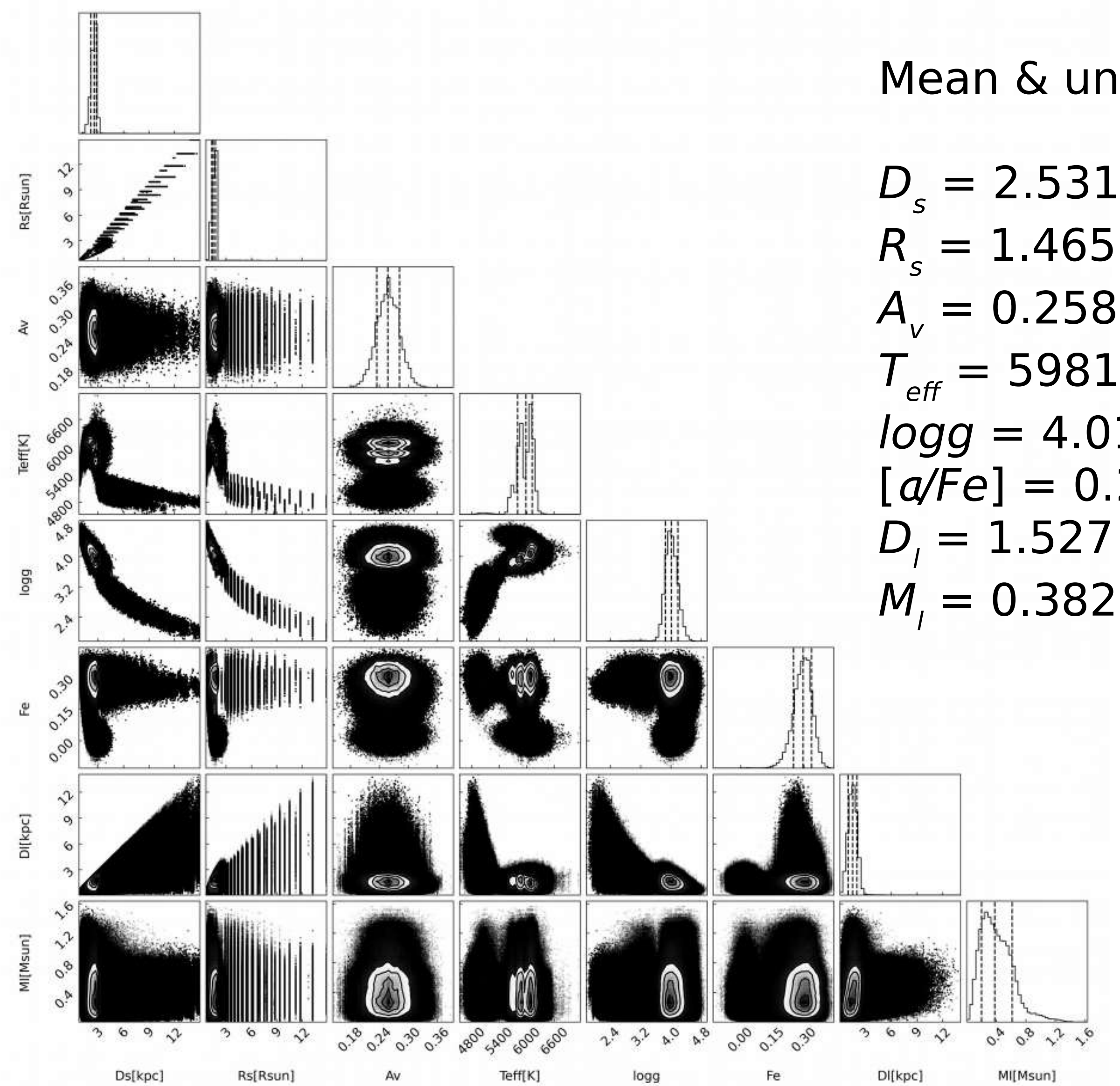
- Source probability : D_s, A_v, M_v, T_{eff}, $logg$, Metallicity
- Lens probability : solid angle of the data
- Other constraints : t_E, ρ

} Each event probability

Two D_s candidates

- Close source case (FLOYDS)
- Distant source case (OHP/Mistral)

Lens properties (Close source case)



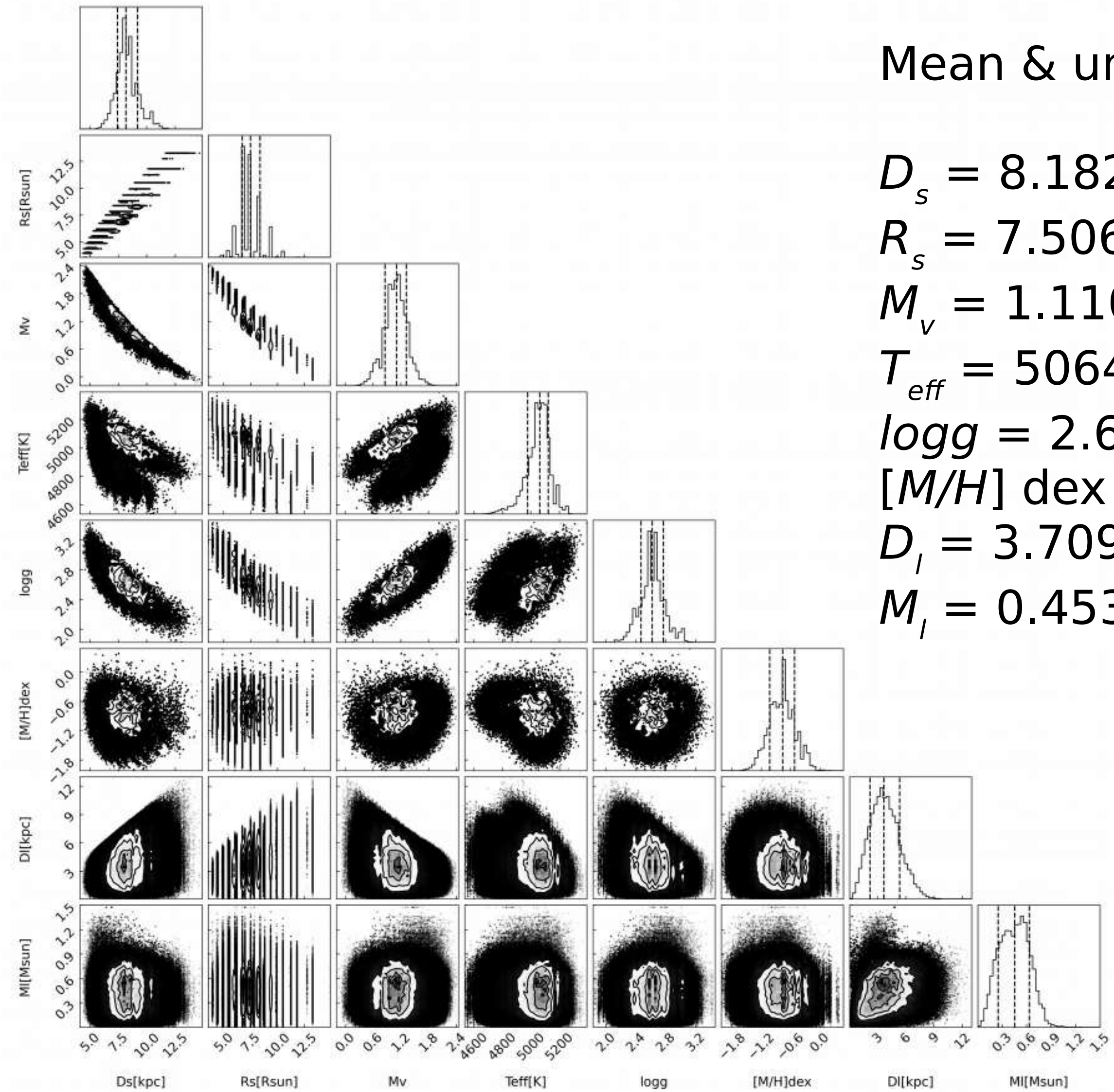
Mean & uncertainty of sample parameters:

D_s = 2.531 ± 0.328
R_s = 1.465 ± 0.218
A_v = 0.258 ± 0.0235
T_{eff} = 5981 ± 160
logg = 4.010 ± 0.165
[*α/Fe*] = 0.296 ± 0.043
D_l = 1.527 ± 0.515
M_l = 0.382 ± 0.208

Lens system parameters:

M_* = 0.381 ± 0.207 M_{sun}
M_{pl} = 1.045 ± 0.569 $M_{jupiter}$
s_{AU} = 7.283 ± 3.196 AU

Lens properties (Distant source case)



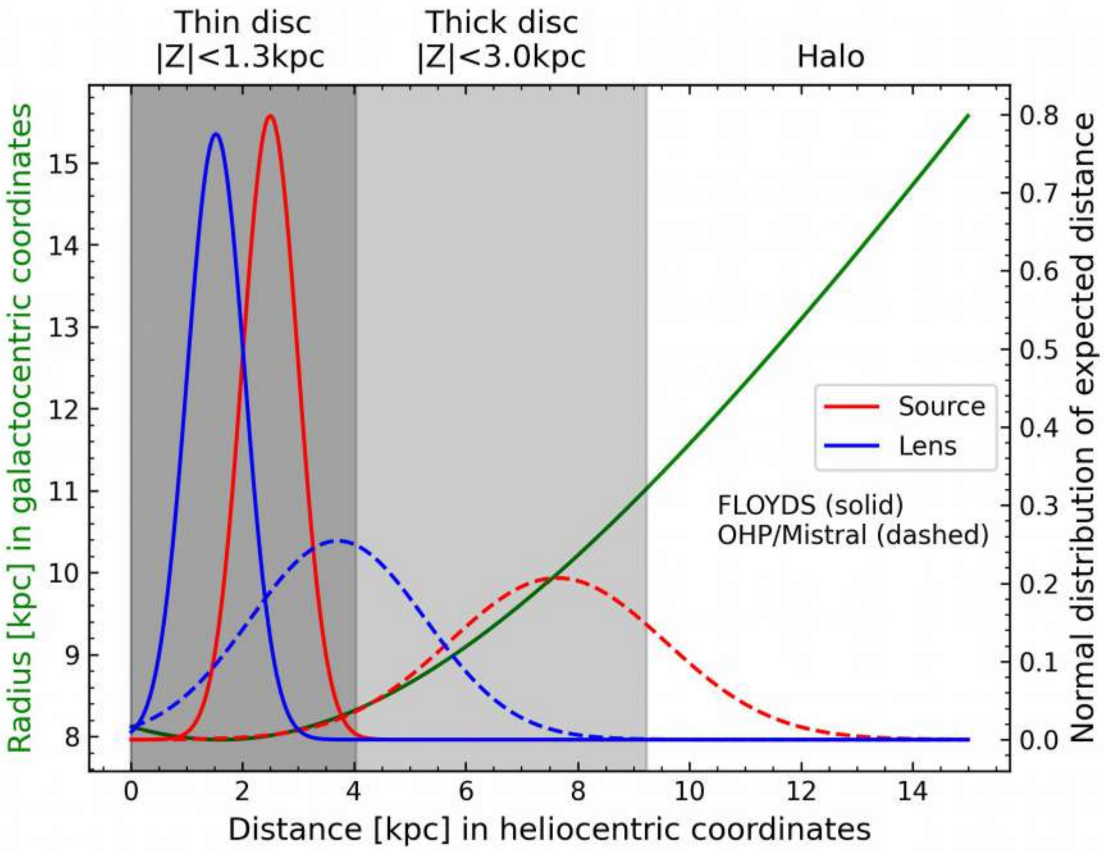
Mean & uncertainty of sample parameters:

D_s = 8.182 ± 0.883
R_s = 7.506 ± 0.826
M_v = 1.110 ± 0.230
T_{eff} = 5064 ± 73
logg = 2.620 ± 0.150
[*M/H*] dex = -0.758 ± 0.256
D_l = 3.709 ± 1.569
M_l = 0.453 ± 0.192

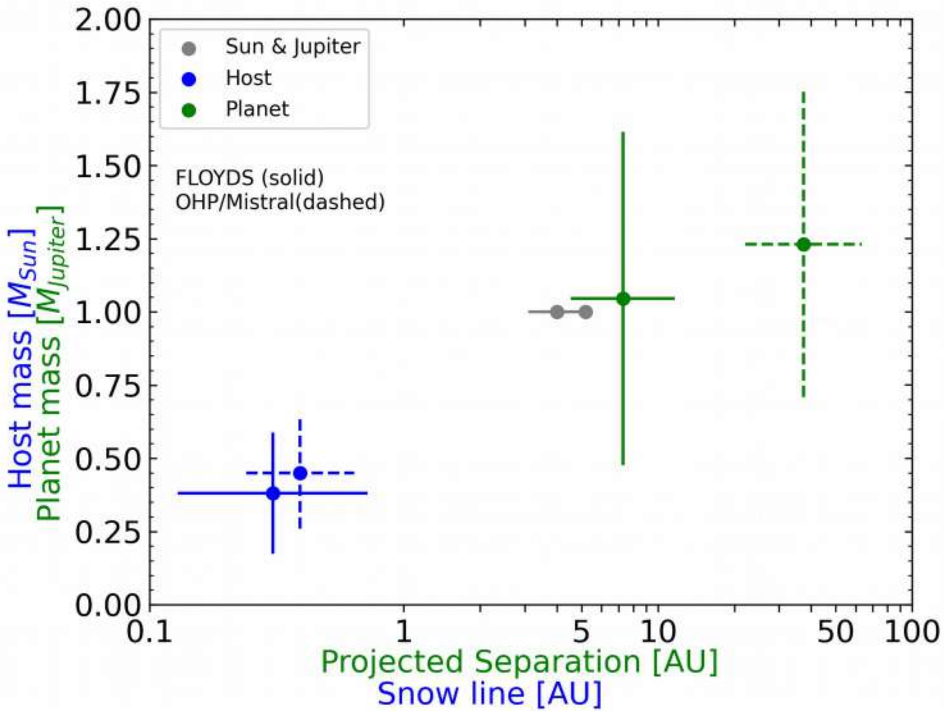
Lens system parameters:

$M_* = 0.449 \pm 0.190\ M_{sun}$
$M_{pl} = 1.231 \pm 0.522\ M_{jupiter}$
$s_{AU} = 37.422 \pm 18.045$ AU

Summary



Snow line is assumed from Mulders, et al. (2015)



The lens of the event (AT2021uey) possibly be ...

- M-dwarf → In thin or thick disc?
- Jupiter-mass planet beyond the snow line → At 5 - 50 AU?

Reference

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