

# Microensing parameters in `MulensModel`

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Microensing parameters in `MulensModel` class `ModelParameters` are presented on the next page:

Parameter	Name in <code>MulensModel</code>	Unit	Description
$t_0$	<code>t_0</code>		The time of the closest approach between the source and the lens.
$u_0$	<code>u_0</code>		The impact parameter between the source and the lens center of mass.
$t_E$	<code>t_E</code>	d	The Einstein crossing time.
$t_{\text{eff}}$	<code>t_eff</code>	d	The effective timescale, $t_{\text{eff}} \equiv u_0 t_E$ .
$\rho$	<code>rho</code>		The radius of the source as a fraction of the Einstein ring.
$t_\star$	<code>t_star</code>	d	The source self-crossing time, $t_\star \equiv \rho t_E$ .
$\pi_{E,N}$	<code>pi_E_N</code>		The North component of the microlensing parallax vector.
$\pi_{E,E}$	<code>pi_E_E</code>		The East component of the microlensing parallax vector.
$t_{0,\text{par}}$	<code>t_0_par</code>		The reference time for parameters in parallax models. <sup>a</sup>
$K$	<code>convergence_K</code>		External mass sheet convergence.
$G$	<code>shear_G</code>		External mass sheet shear; complex valued to represent both the magnitude and angle relative to the binary axis.
$s$	<code>s</code>		The projected separation between the lens primary and its companion as a fraction of the Einstein ring radius.
$q$	<code>q</code>		The mass ratio between the lens companion and the lens primary $q \equiv m_2/m_1$ .
$\alpha$	<code>alpha</code>	deg.	The angle between the source trajectory and the binary axis.
$ds/dt$	<code>ds_dt</code>	yr <sup>-1</sup>	The rate of change of the separation.
$d\alpha/dt$	<code>dalpha_dt</code>	deg. yr <sup>-1</sup>	The rate of change of $\alpha$ .
$t_{0,\text{kep}}$	<code>t_0_kep</code>		The reference time for lens orbital motion calculations. <sup>a</sup>
$x_{\text{caustic,in}}$	<code>x_caustic_in</code>		Curvilinear coordinate of caustic entrance for a binary lens model. <sup>b</sup>
$x_{\text{caustic,out}}$	<code>x_caustic_out</code>		Curvilinear coordinate of caustic exit for a binary lens model. <sup>b</sup>
$t_{\text{caustic,in}}$	<code>t_caustic_in</code>		Epoch of caustic exit for a binary lens model. <sup>b</sup>
$t_{\text{caustic,out}}$	<code>t_caustic_out</code>		Epoch of caustic exit for a binary lens model. <sup>b</sup>
$\chi_P$	<code>xi_period</code>	d	The orbital period of xallarap.
$\chi_a$	<code>xi_semimajor_axis</code>		The semimajor axis of a xallarap orbit as a fraction of the Einstein ring.
$\chi_i$	<code>xi_inclination</code>	deg	The inclination of a xallarap orbit.
$\chi_\Omega$	<code>xi_0mega_node</code>	deg	The longitude of the ascending node of a xallarap orbit.

$\chi_u$	<code>xi_argument_of_latitude_reference</code>	deg	The argument of latitude at the reference epoch ( $t_{0,\chi}$ ). The argument of latitude is a sum of true anomaly ( $\nu$ , changes with time) and the argument of periapsis ( $\omega$ , orbit parameter, i.e., does not change with time): $u = \nu + \omega$ .
$t_{0,\chi}$	<code>t_0_xi</code>		The reference epoch for parameters in xallarap models. <sup>a</sup>

Table 1: Notes:

<sup>a</sup> –  $t_{0,\text{par}}$ ,  $t_{0,\text{kep}}$ , and  $t_{0,\chi}$  are reference parameters, hence, do not change these during fitting.

<sup>b</sup> – The four parameters of binary lens in Cassan (2008) parameterization ( $x_{\text{caustic,in}}$ ,  $x_{\text{caustic,out}}$ ,  $t_{\text{caustic,in}}$ , and  $t_{\text{caustic,out}}$ ) are used instead of ( $t_0$ ,  $u_0$ ,  $t_E$ , and  $\alpha$ ).

Some of the parameters can be defined separately for each of the sources in binary source models. In that case, add `_1` or `_2` to parameter name. These are:

- `t_0_1`, `t_0_2`,
- `u_0_1`, `u_0_2`,
- `rho_1`, `rho_2`,
- `t_star_1`, `t_star_2`.

Also note that there are properties of the microlensing events that are not considered parameters in the `ModelParameters` class, but are implemented in other parts of the `MulensModel`. The most important are:

- source and blending fluxes – `Event` and `FitData`; also see use case 38,
- sky coordinates – `Model.coords`,
- limb-darkening coefficients – `Model.set_limb_coeff_gamma` and `Model.set_limb_coeff_u`,
- flux ratio for binary source models – `Model.set_source_flux_ratio` and `Model.set_source_flux_ratio_for_band`,
- methods used to calculate magnification – `Model.set_magnification_methods`,
- coordinates of space telescopes – `Model.get_satellite_coords`.