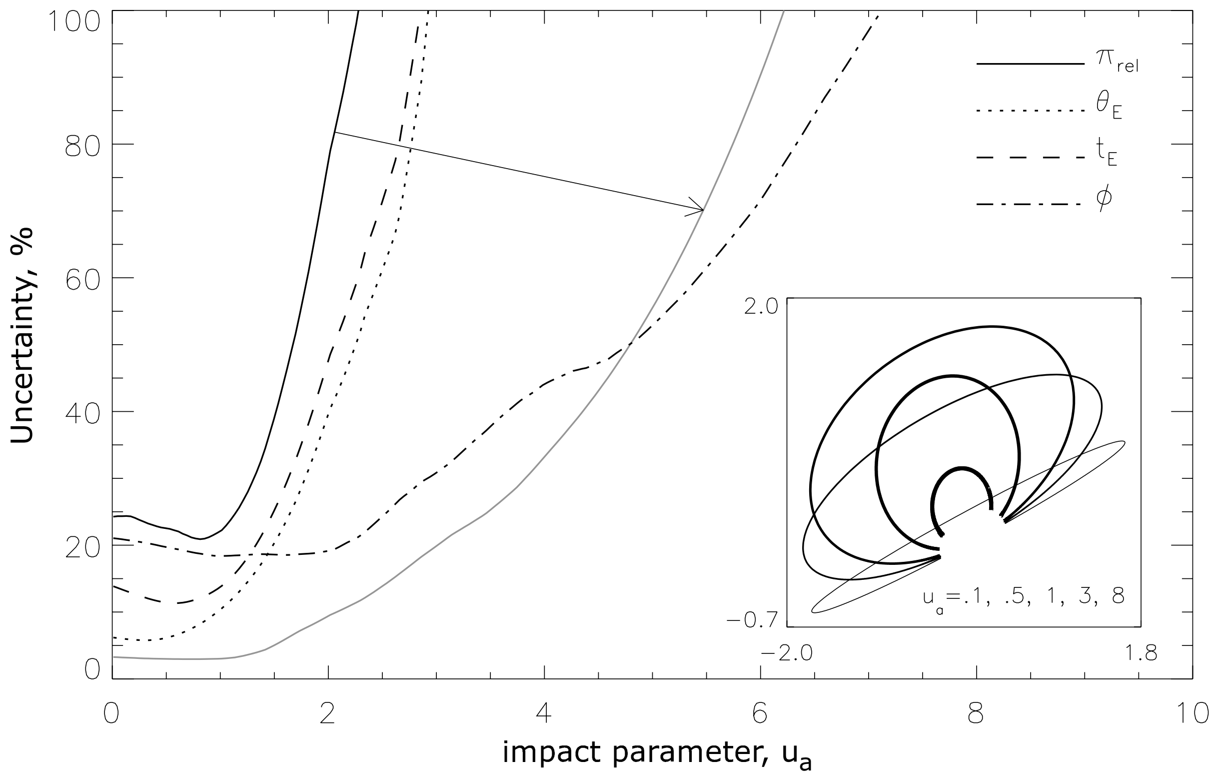

The percentage error in estimation of the microlensing parameters as a function of impact parameter. Accurate recovery of the relative parallax (π_{rel}) is hard, whereas recovery of the angular Einstein radius (θ_E) and the Einstein crossing time (t_E) is easier. (The lens distance is 150 pc, the source distance is 4 kpc, the transverse velocity is 20 km s^{-1}, while the accuracy is 150 μas.) The arrow shows improvement in the relative parallax estimate when photometric follow-up information is available. The inset shows the centroid shift evolution with increasing impact parameter (source parallactic and proper motion removed).

Gaia can observe gravitational microlensing by measuring the photometric amplification of a background source star at epochs when it is coincidentally aligned with a foreground lens. The all-sky averaged photometric optical depth associated with such an alignment is $\sim 5 \times 10^{-7}$, hence there will be ~7500 photometric microlensing events during Gaia's 5-year mission lifetime, most of which will have only a few data points because of the poor sampling.

If photometry is combined with the measurements of the centroid of the two images of a microlensed source, then complete information about the distance and the mass of the lens can be obtained. The all-sky averaged astrometric microlensing optical depth is $\sim 1.5\text{–}2.0 \times 10^{-5}$. This means that between about 15,000 and 20,000 sources will have the variation of centroid shift at least $5\sqrt{2}$ times larger than the typical astrometric accuracy together with a closest approach (source to the lens) during the lifetime of the Gaia mission.

The most valuable events are those for which the Einstein crossing time (t_E), the angular Einstein radius (θ_E), and the relative parallax of the source with respect to the lens (π_{rel}) can all be inferred from Gaia's data stream. The mass of the lens then follows directly. Gaia measurements alone will provide a sample of at least 500 stars with accurately determined masses. However, the numbers can be improved still further if Gaia observations are supplemented with ground-based photometry. A total of 1000 masses will be measured with the help of dedicated telescopes on the ground.

Astrometry can provide direct estimates of the angular Einstein radius (θ_E) and the lens proper motion angle. However, the values of impact parameter (u_a) and Einstein crossing time (t_E) are more difficult to obtain with astrometry alone. On the other hand, just a few data points on the light curve of a microlensed star will allow the time scale and the maximum amplification (and hence impact parameter) to be determined. A further increase in the number of mass measurements is possible if ground-based photometry is supplied.

One of the major scientific contributions of microlensing studies with Gaia will be the determination of the mass function in the solar neighbourhood. Microlensing is the only known technique which can measure the masses of objects irrespective of whether they happen to be components of a binary system or emit electromagnetic radiation.