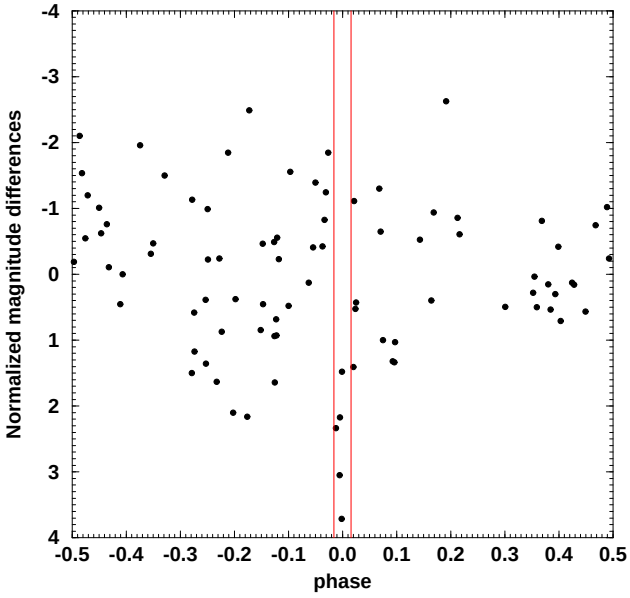

Transits of the star HD 209458 = HIP 108859 as seen in Hipparcos photometric observations, with the transit duration indicated by two vertical lines. The transits were predicted from ground-based observations after the Hipparcos mission.

In the search for extra-solar planets, three complementary techniques can be employed: *Radial-velocity* measurements can find planets in close orbits around their stars, but give no information about the inclination angle of the orbit, and therefore only the minimum mass of the planet can be established. *Astrometry* is suitable for detecting long-period planets, but requires precise measurements and long time spans. *Planetary transits* only occur in those systems with proper alignment of the orbit relative to Earth, but a transit reveals the planet's radius, if the exact inclination angle of the orbit can be determined. Detection or measurement both by astrometric and transit methods are feasible with Gaia; the astrometric method is described elsewhere.

The transit of an extra-solar planet across its parental stellar disc will often occur in Gaia observations and is of interest for detection or measurement for stars brighter than about 16-th mag. The photometric effect of a transit will be most significant in the measurements made in the 9 astrometric CCD strips (AF1–9). A precision of about 1 milli-magnitude per field crossing of Gaia's focal plane is expected for stars brighter than 14-th mag, much more accurate than from Hipparcos. This corresponds to a signal-to-noise ratio of 10 for a Jupiter-size planet around a Sun-like star. For 'known planets' around bright stars, Gaia photometry may yield significant additional information.

A photometric measurement for only one transit of the field in principle suffices to determine the radius of the planet when the stellar radius is known. However, the secure identification of a photometric dimming as being due to a planetary transit requires additional information, e.g. from astrometry or radial velocities or from other transits. Stars with surface spots may be recognised as such and may not be suited for detection of transits.

	F	G	K	M	Sum
$0 < a < 2$AU:	3000	2000	1500	15	6500
$a > 2$AU:	50	30	20	0	100

The predicted number of planetary transits with Gaia for the four spectral types F, G, K, and M, for small and large orbital radii. A signal-to-noise ratio of at least 10 has been assumed.

The number of detected planets (see table) is highly sensitive to the assumed distribution of planetary orbit sizes. From the distribution of currently detected extra-solar planets, it is possible to give a qualified estimate of the distribution for planets in small orbits. For larger orbits, the assumed distribution is an estimate based on our knowledge of the solar system and considering theories of planetary formation.

The advantage of Gaia observations over other surveys, either from space or from the ground, is that all sufficiently bright stars will be observed many times during the mission, thus providing a complete all-sky survey with a well-known selection function.