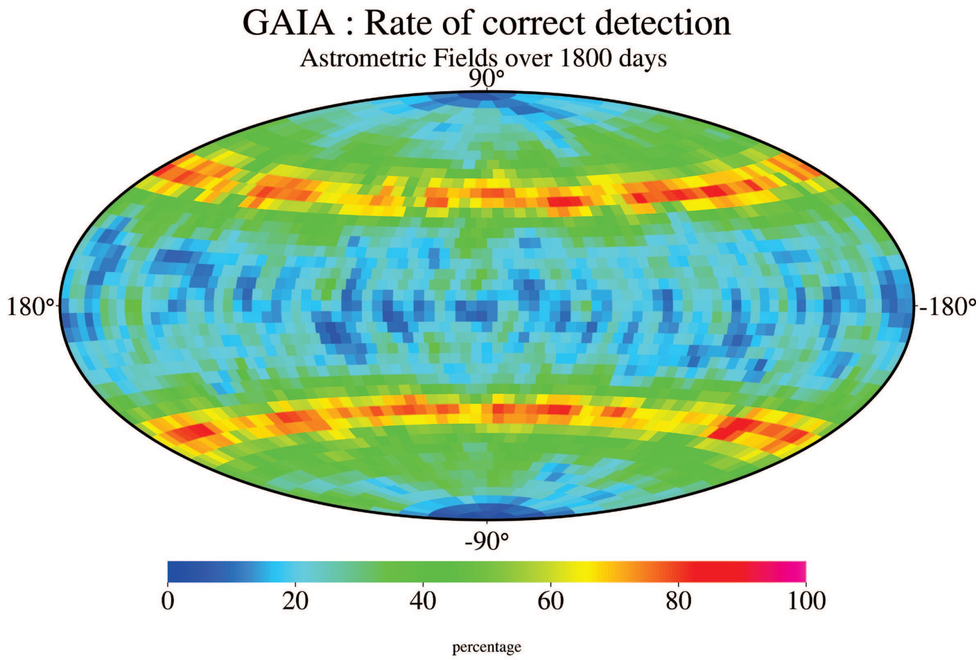

Probability of recovery, in the end-of-mission data, of a sinusoidal G-band-magnitude variation of period 4h50m and signal-to-noise ratio of 0.75 as function of position on the sky in ecliptic coordinates. The recovery probability varies between nearly 0 per cent and 100 per cent. Gaia's scanning law causes the end-of-mission number of observations to vary with position on the sky, explaining the positional dependency.

Gaia will provide multi-epoch, multi-colour photometry for all sources brighter than 20-th magnitude. In addition, high-quality broad-band photometric measurements will be made in the astrometric field. The combined photometric data will have the precision necessary to detect diverse variable phenomena and to describe nearly all types of variability. The photometric data will allow a global description of stellar stability and variability across the Hertzsprung–Russell diagram and will permit the identification of the physical processes causing variability.

For a 5-year mission, a sky-averaged number of 70 photometric measurements is expected from the astrometric field and from the Blue and Red Photometers. Expected numbers of variable objects are difficult to predict, but invariably large, with conservative estimates given by Eyer & Cuypers (2000): about 18 million variable stars in total, including 5 million 'classic' periodic variables, about 3 million eclipsing binaries, 300,000 with rotation-induced variability, 2,000–8,000 Cepheids, 60,000–240,000 Scuti variables, 70,000 RR Lyrae stars, a significant fraction of these in the bulge, and about 250,000 Miras and SR variables.

Precise physical and orbital parameters of eclipsing binaries will be derived for about 10,000 systems (Zwitter 2003). The pulsating stars include key distance calibrators such as Cepheids, RR Lyrae stars, and long-period variables, for which present samples are incomplete already at magnitudes as bright as 10. A complete sample of objects will allow determination of the frequency of peculiar objects, and will accurately calibrate period-luminosity relationships across a wide range of stellar parameters (i.e. mass, age, and metallicity). Variability on short (seconds) to long (of order 5 years) time scales can be detected.

Several dedicated asteroseismologic space missions (e.g., MOST, COROT, and Kepler) have been launched. Asteroseismological predictions have been achieved from the ground in the case of roAp stars from photometric observations (Matthews et al. 1999) and, for solar-like stars, from radial-velocity measurements (Bouchy & Carrier 2002). Parallax determination is a stringent constraint for testing stellar models when used in asteroseismology; on the other hand, absolute luminosities or masses derived from parallaxes can be used as the starting point for seismological models (Baglin 1997, Favata 1999).

In addition to stellar variability, other 'time phenomena' will also be present in the Gaia data: supernovae (estimated at $\sim$ 20,000; Belokurov & Evans 2003), microlensing events (though astrometry will be able to detect $\sim$ 100 events, about 1000 stars will have perturbed photometry; Belokurov & Evans 2002), planetary transits ($\sim$ 5,000 detectable transits are expected; Robichon 2003). Finally, non-stellar variable objects will be observed, including gamma-ray bursts, quasars, active galactic nuclei, and small bodies in the solar system.