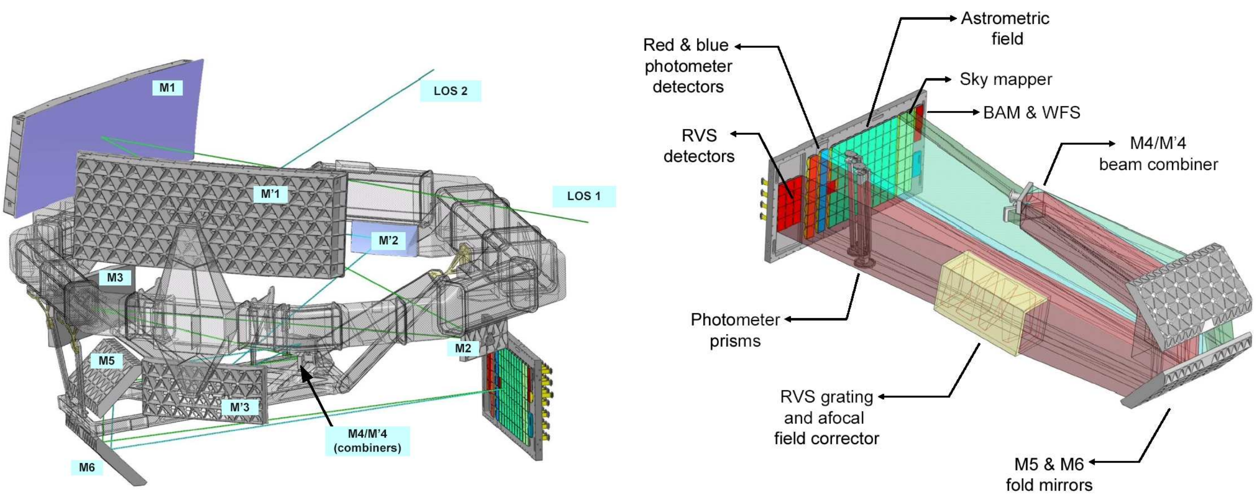

Schematic of the adopted design for the Gaia payload. Left: Two telescope system sharing the same focal plane; right: detail illustrating the radial velocity and photometry functions. Images courtesy of EADS Astrium.

The spacecraft and payload configuration was re-optimised by the industrial teams in their Phase B2/C/D proposal in response to the mission requirements document issued by the ESA project team in 2005. As a result, from early 2006, the final Gaia payload looks somewhat different from the previous design, although all functionality is preserved. The previous design had two separate telescopes, with one comprising the two astrometric viewing directions with a combined focal plane with broad-band photometric filters; the other comprising the medium-band photometry and radial velocity spectrometer. The 'new' Gaia payload combines all functions into a single telescope structure. The photometric measurement concept has also been substantially revised: in place of a series of broad- and medium-band filters, two dispersive prisms now provide full spectral coverage over the entire optical wavelength. The new (post-2006) payload concept is now characterised as follows:

- a dual telescope, with a common structure and common focal plane. Each telescope is based on a three-mirror anastigmatic design with three flat-folding mirrors, the two viewing directions separated by a 106.5 degrees basic angle. Beam combination is achived in image space with a small beam combiner rather than in object space (saving mass, simplifying accommodation, and eliminating the directional ambiguity of the star transits). The primary mirrors are of dimension 1.45×0.5 m^2, the telescope focal length is 35 m, and the astrometric field of view is 0.7° (along scan) by 0.7° (across scan);
- the use of silicon-carbide ultra-stable material for the mirrors and telescope structure, providing low mass, isotropy, thermo-elastic stability, and stability in moving from ground to space. Basic angle stability requirements are largely met with passive thermal control, and a highly robust basic angle measurement system is in place to measure any variations down to 0.5 μas per 5-minute interval;
- the radial velocity spectrometer is an integral field spectrograph with a resolving power of 11 500. It uses a grating plate and an afocal field-corrector lens located close to the focal plane;
- the common focal plane is shared by all instruments, with the astrometric and photometric fields all having the same angular scale. Object detection is carried out using two strips of sky-mapper CCDs, with one pass of object detection applying to all three instruments;
- the same type of CCD (pixel size and format) is used for all three instruments. A total of just over 100 CCDs and accompanying video chains are used, with a pixel size of 10 μm along scan and 30 μm across scan, TDI (time-delayed integration) mode operation, and an integration time of $\sim$4.4 s per CCD.

These primary instruments are supported by the opto-mechanical-thermal assembly comprising: (i) the single structural torus supporting all mirrors and focal planes; (ii) a deployable sunshield to avoid direct Sun illumination and rotating shadows on the payload module, combined with the solar array assembly; (iii) control of the heat injection from the service module into the payload module, and control of the focal plane assembly power dissipation in order to provide an ultra-stable internal thermal environment; (iv) an alignment mechanism on the secondary mirror for each astrometric instrument, with micron-level positional accuracy to correct for telescope aberration and mirror misalignment at the beginning of life.