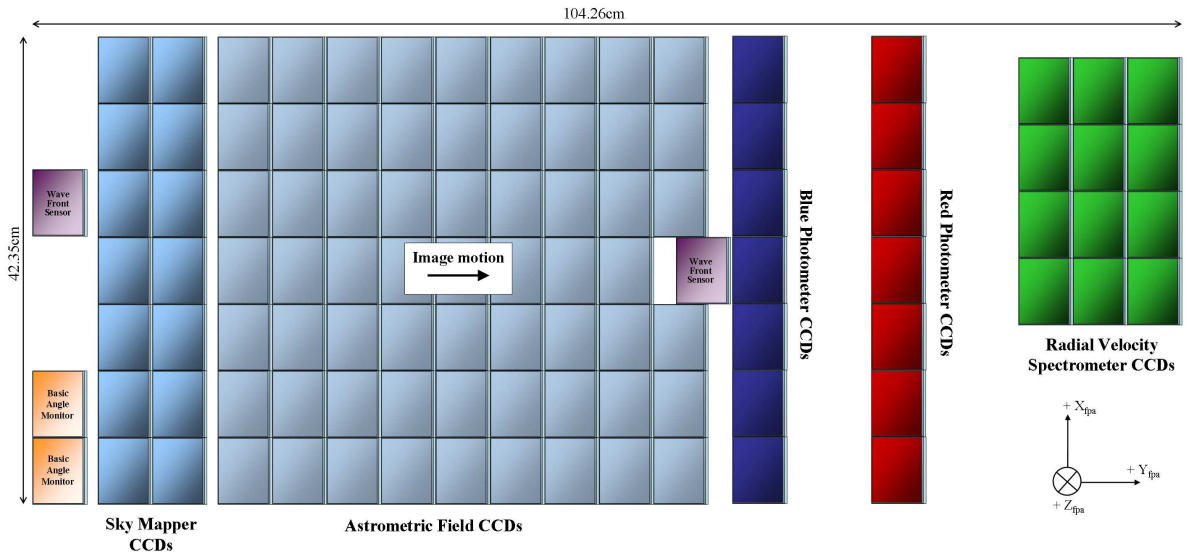

The Gaia focal plane. The viewing directions of both telescopes are superimposed on this common focal plane which features 7 CCD rows, 17 CCD strips, and 106 large-format CCDs, each with 4500 TDI lines, 1966 pixel columns, and pixels of size 10 μm along scan $\times$ 30 μm across scan (59 mas $\times$ 177 mas). Star images cross the focal plane in the direction indicated by the arrow. Figure courtesy of ESA - A. Short.

Given the concept of Gaia as a scanning instrument, the payload focal plane assembly (FPA) is designed around a mosaic of CCD chips operating in TDI (time-delayed integration) mode. During nominal operations, the satellite spin rate, and thus the speed with which objects traverse the focal plane, is continuously synchronised with the fixed TDI period of the CCDs. As a result, stars cross the focal plane at a constant speed (60 arcsec s^{-1}) and star images are progressively built up as objects cross the CCDs. At the end of each CCD crossing, the generated charge packets are transferred to the serial register for read out and, subsequently, digital processing, temporary on-board storage, and transmission to the ground.

The detailed design of the focal plane is the result of many, often competing, requirements. For example, the FPA-mosaic dimension has been selected large enough to offer a large field of view, and thus a sufficiently large observing time for each object to meet the end-of-mission scientific performance requirements, while keeping the total number of CCDs manageable in the light of manufacturing, testing, integration, power requirements, thermal-stability characteristics, launch schedule, cost, etc. Similarly, the chosen (along-scan) CCD pixel size is small enough to offer sufficient spatial resolution to allow extraction of the centroid position of diffraction images with adequate precision, yet large enough to be feasible with currently available CCD technology in terms of quantum efficiency, modulation-transfer function, noise characteristics at the required read-out rates, manufacturing yield, etc. The number of TDI lines per CCD has been chosen large enough to yield sufficient signal-to-noise for faint stars at the CCD-transit level, yet small enough to avoid performance degradation due to 'image smearing' caused by attitude disturbances, scanning-law effects, distortion, radiation-damage driven charge trapping and de-trapping, etc.

The focal-plane assembly is common to both telescopes. It serves five main functions: (i) the wave-front sensor (WFS) and basic-angle monitor (BAM); (ii) the Sky Mapper (SM), autonomously detecting objects entering the fields of view and communicating details of the star transits to the subsequent CCDs; (iii) the main Astrometric Field (AF), devoted to astrometric measurements; (iv) the Blue and Red Photometers (BP and RP), providing low resolution spectrophotometric measurements for each object over the wavelength ranges 330–680 and 640–1000 nm, respectively; and (v) the Radial-Velocity Spectrograph (RVS), registering spectra of all objects brighter than about 17-th magnitude.