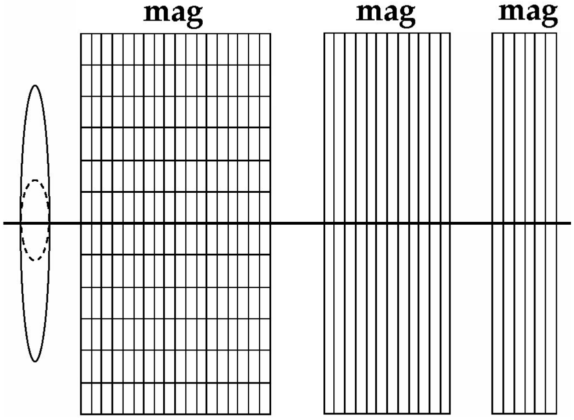

Samples are read from each CCD inside a 'window' centred on each star detected and selected at the beginning of a field transit. The default astrometric field windows are shown here. The dashed ellipse shows the 'Airy diffraction disc' of a single star; the solid ellipse shows the maximum smearing of the 'Airy ellipse' in the across-scan direction, integrated over a single CCD transit, resulting from the precession of the spin axis.

The function of the Sky Mapper (SM) CCDs is to autonomously detect all objects brighter than 20-th magnitude in the Gaia photometric passband (G). After SM, stars traverse the main Astrometric Field (AF), which is composed of 9 CCD strips (AF1–AF9), the Blue and Red Photometers (BP and RP), and the Radial-Velocity Spectrograph (RVS).

The concept of on-board detection of objects allows the active application of 'windows' to them, thereby significantly limiting both the number of CCD pixels that has to be read, hence improving CCD noise performances, and the amount of data that has to be transmitted to ground. The sample and window sizes for the different CCD strips and magnitude intervals have been chosen to give optimal astrometric, photometric, and spectroscopic results for all stars, taking into account the resolution of the star images, the smearing of these images in the across-scan direction due to the continuous precession of the spin axis, the scientific interest in double stars, and the (variable) sky background.

In order to optimise the signal-to-noise ratio of the measurements, pixels that are read from the CCDs are generally binned on-chip in the across-scan direction to form samples. Normally, no on-chip (hardware) binning takes place in the along-scan direction, thus preserving the full angular resolution of the images in this fundamental direction. The collection of samples related to an individual star is refered to as a 'window'. Normally, samples are transmitted to the ground as they are read, although numerical (software) binning of read samples is applied in some cases before transmission to the ground in order to reduce telemetry.

The default AF windows are shown above. For stars with G = 12–20 mag, read samples consist of 1×12 pixels; the sample size across scan (12 pixels) is sufficiently large to contain nearly all star light. AF windows typically contain 12 of these samples for G = 12–16 mag and 6 samples for G = 16–20 mag. In AF2, AF5 and AF8, windows are currently projected to cover 12 samples, allowing the *a posteriori* on-ground measurement of the local sky background and the mapping of the surroundings of each star out to a few arcsec down to $\mathrm{G} \sim 23$ mag. In AF1, read samples are composed of 1×2 pixels; this across-scan resolution is essential for the AOCS feedback loop and for speed measurements of solar-system objects.

It is currently foreseen to avoid saturated pixels and samples for bright stars (G = 6–12 mag) by limiting the CCD integration time for these objects by the use of TDI gates and by sampling the images of these objects with single-pixel-resolution windows (see figure). These windows are also planned to be used for the calibration of the PSF and of CTI effects as function of star colour, time, and position in the focal plane.

Dedicated sampling and windowing schemes similarly exist for BP, RP, and RVS, aimed at optimally covering the spectra and, at the same time, allowing the on-ground determination and subtraction of the sky background.