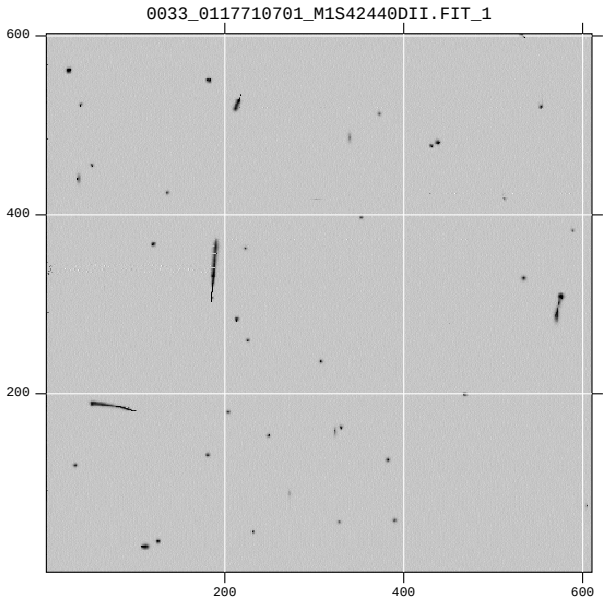

Background particle events (galactic cosmic rays) in an XMM-Newton image. About 60 events were registered on the 2.4 cm×2.4 cm CCD in an integration time of 2.6 s, corresponding to a background rate of 4 events per cm^2 per s.

When operating electronic equipment in space, one of the most important considerations is always the energetic particle radiation environment. For Gaia, which will operate at L2, this environment will be particularly critical because the large astrometric focal plane, carrying 106 CCD detectors, will be very difficult to shield. Radiation damage to the CCDs will degrade their performance and hence the overall performance of Gaia.

There are three main sources of damaging particles:

- *Galactic Cosmic Rays (GCR)*: Very high energy particles (typically hundreds of MeV) trapped in the galactic magnetic field. These are mainly generated by supernovae and are just passing through our Solar System. The rate observed varies between about 4−8 particles per cm^2 per second depending upon the phase of the solar cycle and they comprise approximately 90% protons, 9% He ions and 1% heavier ions. It is not possible to shield against galactic cosmic rays effectively because their energy is high enough to penetrate many centimetres of shielding.
- *Solar particles*: Particles ejected directly from the Sun. The solar particle flux varies from essentially zero during solar quiet times to thousands of particles per cm^2 per second during periods of high solar activity (solar flares). Like galactic cosmic rays, solar particles are predominantly protons and helium ions. However, the peak energy of the solar proton spectrum is several orders of magnitude lower than that of the galactic cosmic ray spectrum, so that shielding can be effective in reducing the dose to sensitive components.
- *Trapped particle environment*: These are protons and electrons trapped in the Earth's magnetic field to form the 'radiation belts'. This environment is not relevant for Gaia which will be situated at L2.

During solar-quiet (observing) periods, there will always be a particle flux of between 4 and 8 galactic cosmic rays per cm^2 per second passing through the Gaia CCDs. There are two main ways in which these background particle events will affect Gaia astrometric observations:

- Astronomical sources are detected autonomously by the Star Mappers. Particle events which are incorrectly identified as sources, will be assigned windows, tracked across the focal plane and transmitted to the ground. This is clearly a waste of resources and a reliable on-board rejection algorithm is required.
- Particle events detected in a CCD, close to a source Point Spread Function (PSF) will introduce PSF distortion and hence centroiding errors. These errors need to be quantified and mitigation techniques assessed (such as the use of PSF matched filters in the centroiding algorithm). Once identified, a PSF contaminated by a particle detection may be corrected or rejected.

Of more concern is the longer term damage caused to the CCDs during solar flares. This effect is considered in the Information Sheet *Radiation Environment and Gaia CCDs*.