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Variability Studies and Asteroseismology with the XMM Optical Monitor

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Abstract. It will be possible to make photometric variability studies from space of stars serendipitously falling in the field of view of the Optical Monitor, and to search for asteroseismological phenomena in bright target stars.

1. Optical Monitor

The Optical Monitor (OM) (cf. Horner et al. 1994) is one of three instruments on ESA's XMM observatory (cf. Mason et al. 1995) to be launched in 1999. The OM is a 30 cm aperture Ritchey-Chrétien telescope for UV and optical band observations that is co-aligned with the X-ray telescopes. It has two detectors for photometric and low resolution spectroscopic observations. A beam splitter separates the light into blue (160-550 nm) and a red beams (500-1100 nm) – the blue detector is a Micro-channel plate Intensified CCD (MIC), while the red detector is a frame transfer CCD.

The fields of view of the two detectors are similar, approximately 17 arcmin square. The blue detector (MIC) has a resolution of 1 arcsec, while the red detector has a resolution of 3.4 arcsec. The 11 position filter wheels in each of the beams carry broad and medium band filters, grisms and a magnifier; the red beam filter wheel also carries a defocusing lens.

It will be possible to perform variability studies from space of stars serendipitously falling in the field of view of the Optical Monitor, and to search for asteroseismological phenomena during long observations by XMM to detect the coronal X-ray spectra of bright stars. Monte Carlo simulations using the Guide Star Catalog (Jenkner et al. 1990 & Lasker et al. 1988) predict that if XMM's pointings are randomly distributed on the sky, an average 0.85 stars of $m_V \leq 12$ will fall into the field of view per pointing. If the pointings are randomly distributed within 15° of the galactic plane, an average 1.3 stars of $m_V \leq 12$ will fall into the field of view per pointing.

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2. Photometric precision

The expected differential photometry precision and minimum detectable amplitude for bright stars observed with the red detector are reported in Table 1. The 1σ-precision has been estimated for a source temperature of 5770 K. Owing to the brightness of the stars, the single exposures are assumed very short, 1 s or less, and the star image is spread over many pixels. The estimates have been made for a cumulative number of exposures of 30 s. In general, the effects of readout noise due to the very high cumulative number of exposures are not significant for very bright stars. The precisions have been estimated assuming a perfect stabilization of the images and of CCD temperature. Moreover, no contamination owing to cosmic rays and no degrading of the CCD performances due to radiation have been taken into account. It will be possible to correct for the cosmic ray contamination by means an on board frame comparison technique only for images of faint sources with relatively long exposure times; it will not be possible to apply a similar correction to images with short exposure times. Therefore, we expect an incidence of about a few percent of the time series data to be contaminated by cosmic rays in the case of bright star observations.

Table 1. Differential photometry precision and minimum detectable amplitude (see text)

m_V	precision (1σ)	amplitude
4	9.3E–5	8.9E–6
5	1.5E–4	1.5E–5
6	2.3E–4	2.2E–5
7	3.7E–4	3.5E–5
8	5.9E–4	5.6E–5
9	9.3E–4	8.9E–5
10	1.5E–3	1.5E–5
11	2.3E–3	2.2E–4

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