esac

European Space Astronomy Centre
P.O. Box 78
28691 Villanueva de la Cañada
Madrid
Spain
T +34 91 8131 100
F +34 91 8131 139
www.esa.int

MEMO

Date 18 December 2012	**Ref**
From N. Schartel - SRE-SA	**Visa**
To	**Copy**

Subject: Estimate of the scientific impact of the MOS-1 event from 11/12/2012

At the time of writing this memo it seems likely that the MOS-1 event from 11/12/2012 will have three lasting effects:

1. CCD-3 will not be usable for scientific observations in future
2. The peripheral CCD-4 shows four new hot columns, of which three columns are immediate neighbours of each other, and an area of enhanced noise. This area is at the CCD-border towards large off-axis angles and contains <13% of the sky-exposed pixels of CCD-4.
3. A number of new hot and bad pixels have developed, which will be flagged in the standard way. The central CCD-1 shows only nine new pixels far off the nominal bore sight position. (For comparison CCD-1 has 3.6 x 10^5 pixels).

Investigations are currently underway to fully characterize the effect of the impact. In the following, an estimate of the scientific impact is provided. PIs of accepted observations are asked to read carefully the 'Detailed impact for specific source classes' and should follow the recommendations provided.

General evaluation:

1. The probable loss of CCD-3, one out of the five peripheral CCDs of MOS-1 (six peripheral CCDs before the 2005 event), will have no major impact on the overall scientific output of the mission.
2. New hot columns, area of enhanced noise and hot pixels have developed, but they impact only a small fraction of peripheral CCDs, meaning that there is basically no impact on the expected scientific output.

Detailed evaluation of the impact of CCD-3 on the scientific output:

CCD-3 covers, to a first order approximation, 1/7 (14%) of the geometrical area of MOS-1. MOS-1, in turn, only contains some 22% of the total effective area of the EPIC instrument (MOS-1, MOS-2 and pn). This number (14%) is an upper limit because:

a. not all of the geometrical area of the peripheral CCDs is illuminated
b. due to the specific properties of X-ray telescopes, the image performance decreases with increasing off-axis angle. Therefore, the scientific value decreases for the peripheral CCDs with increasing off-axis angle.

For the scientific output of the mission it is important to see, as indicated above, that MOS-1 is operated in parallel with the MOS-2 camera and the pn camera. All three cameras are sharing the same field of view. Therefore the sky area, which is no longer covered by CCD-3, is still covered by the remaining two cameras. The ratio of the effective areas between pn, MOS-1 and MOS-2 can, to first order, be described as 1:0.4:0.4. Therefore, the loss of a MOS-1 CCD translates into a total EPIC effective area decrease of 22% (0.4 / (1.0 + 0.4 + 0.4) for 14% of the field of view which corresponds to a loss of 12% in signal-to-noise.

Detailed scientific impact for specific source classes:

In the following we consider the combined impact of the two events from March 2005 and December 2012, which affected MOS-1 CCD-6 and CCD-3, respectively.

1. Point sources (on axis): no impact
2. Extended sources (r < 5.5 arcmin): no impact
3. Extended sources (r > 5.5 arcmin): the impact depends on the scientific question to be addressed:
    a. Analysis of point sources in the field: about 12% reduction of the signal-to-noise in about 28% of the off-axis field of view. This must be treated by the calculation of the effective area and exposure map, which will be fully supported by the SAS.
    b. Analysis of extended emission: about 12% reduction of the signal-to-noise in about 28% of the off-axis field of view. This must be treated by the calculation of the effective area and exposure map, which will be fully supported by the SAS.
    c. Extended emission with specific focus on soft X-ray emission lines: In this case the signal-to-noise ratio might decrease by up to 30% in 28% of the off-axis field of view as the pn camera might not provide the required spectral resolution. (The number of such observations is expected to be extremely small).
4. Field observations: see 3.a
5. Serendipitous sources: see 3.a
6. Specific areas:

a. Elongated extended sources (d > 5.5 arcmin): It might be that by defining a specific position angle, an elongated extended source can be placed on the detector in such a way that the source falls on a MOS-1 CCD different from CCD-3 and CCD-6. PIs of accepted proposals are asked to check carefully the visibility and the position angle constraints for their targets (http://xmm2.esac.esa.int/external/xmm_sched/vischeck/) to see whether such a possibility exists. In this case they are kindly asked to inform immediately the XMM-Newton SOC at xmmpi@sciops.esa.int with the proposal number in the subject line.
b. Secondary source in the field of view at a distance > 5.5 arcmin: Besides the primary target, an accepted observation might contain a second (off-axis) source of specific scientific interest at a distance > 5.5 arcmin. Also here the possibility might exist to place the secondary source such that it falls in a MOS-1 CCD different from CCD-3 and CCD-6. PIs of accepted observations falling in this category are kindly asked to follow the recommendation provided in 6.a

Norbert Schartel
XMM-Newton Project Scientist