XMM-Newton
Radiation Workshop

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Summary

- **History of past strategy since launch up to Nov. 2000**
- **Radiation alert: current strategy**

History of past radiation strategy (1)

- **At launch:**
  - monitoring based on: **RM only**
    - Warning Flag parameter M5012 for both MOS's & PN
  - thresholds: 100 cps for both LE0 & HE0

- **end of January 2000:**
  - RM thresholds: lowered to 30 cps for both LE0 & HE0

- **beginning of February 2000:**
  - RM thresholds: lowered to 10 cps for LE0 (HE0 remains to 30cps)

- **March 2000:**
  - monitoring based on: **RM only**
    - WF parameter M5012 for MOS's
    - WF parameter MD027 (derived parameter) for EPIC-PN
  - introduced an independent parameter. for EPIC-PN (MD027)
  - thresholds for MD027: 50 cps for LE0, 20 cps for HE0

History of past radiation strategy (2)

- **June 2000:**
  - monitoring based on: **RM & RGS**
  - RM thresholds: increased by 40 % for both M5012 (MOS's) and MD027 (PN) i.e.: LE0 MOS : 14 cps, HE0 MOS: 42 cps; LE0 PN : 70 cps, HE0 PN: 28 cps;
  - Added monitoring of RGS parameters (R1SUD9, L1SUD9) for detection of low energy protons (requires RGS in Spectroscopy mode)
  - Defined new DP's for EPIC's (not linked yet to radiation procedures):
    - for EPIC-PN based on Discarded Line TM
    - for EPIC-MOS based on sum of count rates on peripheral CCD's

- **End of August 2000:**
  - monitoring based on: **RM & RGS**
  - Replaced the RGS parameters R1SUD9, L1SUD9 with derived parameters executing a running average over 2 minutes (GDS005, LDS005) for spike filtering

- **Mid September 2000:**
  - monitoring based on: **RM, RGS, MOS & PN**
  - After the RGS-1 CCD-7 failure and subsequent change in RGS operational strategy: introduced check on MOS and PN parameters to complement the RGS TM

- **October 2000:** redefinition of the radiation strategy (see following viewgraphs)

Radiation Alert: current strategy (1)

- **Principles:**
  - limits applied on RM outputs were over-conservative (waste of science time) and meaningless (low energy protons were not detected)
  - protection from high energy radiation from 1mm of filter wheel is negligible
  - with exception of “big flares” the RM info can be totally replaced by information provided directly by the instruments (MOS, PN, RGS)
  - Full set of DP’s have been implemented in the past for this purpose
  - PN is much more robust than MOS and needs less stringent criteria
  - RGS needs to be “saved” as well (go to SETUP), in case of “big flare”

- **Implementation:**
  - RM thresholds increased to 500 cps: detection of “big” flares
  - If RM WF = ACTIVE, then EPIC’s are closed, RGS commanded to SETUP

  - Protection against low energy protons is implemented as follows:
    - MOS: MOS info based on counts on peripheral CCD’s (EDS001, KDS001)
      PN info based on Discarded line and limit set to 250, 800, 2400 (FD103)
      RGS info based on CCD-9 TM and limit set to 80 (GDS005, LDS005)

    - PN: PN info based on Discarded line and limit set to 400, 1200, 3200 (FD131)
      RGS info based on CCD-9 TM and limit set to 230 (GDS007, LDS007)

Radiation Alert: current strategy (2)

- **Procedures:**
  - 3 procedures are now available:
    - **CRP_SYS_0025** for saving the MOS instruments: triggered by RGS output (lower limit) / MOS output / PN output (lower limit)
    - **CRP_SYS_0023** for saving the PN instruments: triggered by RGS output (higher limit) / PN output (higher limit)
    - **CRP_ERM_0021** for all instruments, except OM (i.e. including RGS): triggered by RM Warning Flag (500 cps / 15 minutes)

- **Restrictions:**
  - PN information is only available when in LW, FF or ext. FF mode
  - PN information is only available when actual exposure starts (up to 1 h after start of Observation)
  - RGS information is only available if in Spectroscopy mode (could be in SETUP the whole revolution)
  - MOS information is available in all modes, about 10 minutes after exposure start (this delay will be reduced with next DB release)
  - No information is available at the beginning of the revolution (first Obs.) except from RM, to decide if first Obs. can safely start.
  - MOS & RGS information is only visible at the SOC (INSCON / SPACON can not back-up each other when off-console)

Radiation Alert: current strategy (3)

- **Precautions to cope with above restrictions:**
  - If PN not in LW / FF / ext. FF and RGS not in Spectroscopy, then any action on MOS (based on “peripherals”) also implies action on PN
  - At the beginning of Rev. all instruments disabled if WF = ACTIVE at the time of first observation. When WF goes INACTIVE start all instruments and apply CRP_SYS_0023 / 0025 afterwards, if required.
  - If no info from instruments and **PN was in LW / FF / ext. FF** when stopped, and WF = INACTIVE, then re-open PN every 0.5 h and inspect radiation level. If OK restart MOS’s as well.
  - If no info from instruments and **PN was not in LW / FF / ext. FF** when stopped, then restart all instruments at next exposure (if WF = INACTIVE) and apply CRP_SYS_0023 / 0025 afterwards, if required
  - procedure in place to back-up the INSCON (Computer Operator) when off-console; additional protection: if SOC System or MOC-SOC link unavailable for more than one hour during observations, then the MOC will save all EPIC’s

Radiation Alert: current strategy (4)

- **Considerations on current strategy:**
  - All instruments radiation sensitive parameters are influenced by bright pixels
  - MOS parameters almost only sensitive to soft protons, while RGS and p-n parameters also strongly influenced by high energy radiation
  - Very often the soft protons come in “thin layers”

- **Future improvements:**
  - Introduction of yet another parameter for p-n when in Small Window/Timing/Burst to count number of events above 3000ADU

- **Possible (but complex) improvements:**
  - realtime measurement of integrated dose
  - differential measurements between RGS CCD1 and CCD9
  - correlated measurements on RADMON and X-ray instruments to discriminate soft protons from less harmful radiation

Radiation Alert: current strategy (4)

GDS005	LDS005	EDS001	KDS001	FD103	GDS007	LDS007	FD131	M5012	Procedure / actions to safe instruments
any	any	any	any	any	any	any	any	ACTIVE	CRP_ERM_0021: Close EPIC's + RGS to SETUP
OOL	any	any	any	any	any	any	any	INACTIVE	CRP_SYS_5025: Close MOS 1 & 2
any	OOL	any	any	any	any	any	any	INACTIVE	CRP_SYS_5025: Close MOS 1 & 2
any	any	OOL	any	any	any	any	any	INACTIVE	CRP_SYS_5025: Close MOS 1 & 2
any	any	any	OOL	any	any	any	any	INACTIVE	CRP_SYS_5025: Close MOS 1 & 2
any	any	any	any	OOL	any	any	any	INACTIVE	CRP_SYS_5025: Close MOS 1 & 2
any	any	any	any	invalid	OOL	any	invalid	INACTIVE	CRP_SYS_5023: Close PN
any	any	any	any	invalid	any	OOL	invalid	INACTIVE	CRP_SYS_5023: Close PN
any	any	any	any	any	any	any	OOL	INACTIVE	CRP_SYS_5023: Close PN
invalid	invalid	OOL	any	invalid	invalid	invalid	invalid	INACTIVE	CRP_SYS_5025: Close MOS 1 & 2 + PN
invalid	invalid	any	OOL	invalid	invalid	invalid	invalid	INACTIVE	CRP_SYS_5025: Close MOS 1 & 2 + PN

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Radiation Alert: current strategy (5)

GDS005	LDS005	EDS001	KDS001	FD103	GDS007	LDS007	FD131	M5012	Procedure / actions to restart
in limit (if valid)	in limit (if valid)	invalid (because MOS-1 has been stopped)	invalid (because MOS-2 has been stopped)	in limit (if valid)	any	any	any	INACTIVE	CRP_SYS_5025: restart MOS 1 & 2
in limit (if valid)	in limit (if valid)	invalid (because MOS-1 has been stopped)	invalid (because MOS-2 has been stopped)	invalid (because PN has been closed in CRP_SYS_5025)	in limit (if valid)	in limit (if valid)	invalid (because PN has been closed in CRP_SYS_5025)	INACTIVE	CRP_SYS_5025: restart/rejoin timeline for MOS 1 & 2 and EPIC- PN
invalid (RGS not in Spect.)	invalid (RGS not in Spect.)	invalid (because MOS-1 has been stopped)	invalid (because MOS-2 has been stopped)	invalid (because also PN was closed in CRP_SYS_5025)	invalid (RGS not in Spect.)	invalid (RGS not in Spect.)	invalid (because also PN was closed in CRP_SYS_5025)	INACTIVE	CRP_SYS_5025: restart MOS 1 & 2 and EPIC-PN at the next Observation
in limit (if valid)	in limit (if valid)	any	any	invalid (because PN was stopped)	in limit (if valid)	in limit (if valid)	invalid (because PN was stopped)	INACTIVE	CRP_SYS_5023: restart PN
invalid (RGS not in Spect.)	invalid (RGS not in Spect.)	any	any	invalid (because PN was stopped, but PN **was in LW / FF/ext FF** when it was stopped)	invalid (RGS not in Spect.)	invalid (RGS not in Spect.)	invalid (but PN **was in LW / FF/ext FF** when it was stopped)	INACTIVE	CRP_SYS_5023: restart PN every 0.5 h (go to OBS) and test status of radiation (extended also to next Observation, if necessary)
invalid (RGS not in Spect.)	invalid (RGS not in Spect.)	any	any	invalid (because PN was stopped, but PN **was not in LW / FF/ext FF** when it was stopped)	invalid (RGS not in Spect.)	invalid (RGS not in Spect.)	invalid (and PN **was not in LW / FF/ext FF** when it was stopped)	INACTIVE	CRP_SYS_5023: restart PN + MOS at the next Observation
invalid (RGS not in Spect.)	invalid (RGS not in Spect.)	invalid (because MOS-1 has been stopped)	invalid (because MOS-2 has been stopped)	invalid (because also PN was closed in CRP_SYS_5025)	invalid (RGS not in Spect.)	invalid (RGS not in Spect.)	invalid (because also PN was closed in CRP_SYS_5025)	went from ACTIVE to INACTIVE	CRP_ERM_0021: rejoin timeline for MOS 1 & 2, PN, RGS's

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