X-ray cycles and magnetic activity of solar-like stars
XMM-Newton meets eROSITA

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Abstract: Since the beginning of its operation XMM-Newton carries out a monitoring program to study X-ray cycles, including the nearby stellar systems α Centauri and 61 Cygni. In all studied target stars the X-ray emission varies overall smoothly on timescales of years, indicating that coronal cycles are common in weakly active solar-type stars. The derived global X-ray properties and cyclic phenomena are in line with those observed from the Sun. As an outlook and complementing ongoing pointed observation, future perspectives of stellar X-ray studies with the eROSITA all-sky survey are presented.

The eROSITA all-sky survey (eRASS)
- eROSITA/SRG (DIRBE) – launch end 2017, L2 halo orbit
- 7 co-aligned X-ray telescopes + CCDs, FOV 1.03 ster
- HEW 0.15 dex, effect area 2000000 cm^2 (on-axis/survey)
- 4 yr all-sky survey, 0.3 – 10 keV energy range
- lim. F_0 ≤ 10^{-14} erg cm^{-2} s^{-1} (point sources)

eROSITA and Stars
- ~ 0.7 million X-ray stars (bolometric model, Glatsev et al. 1996)
- order of magnitude sensitivity increase to RASS
- stellar sample well classified by Gaia
- most suited to study SPB, moving groups, active stars...

Survey the solar neighborhood
- virtually complete census of young stellar populations up to 100 pc
- X-ray survey of "rare objects" like young BDs, VLM, ApBp and HAeBe stars
- RECONS 10 pc sample: > 300 stars (4-20-44-248, A-F-G-K-M)
- HEW 15/28
- 4 yr all-sky survey, 0.3 – 10.0 keV energy range
- most suited to study SFRs, moving groups, active stars...
- stellar sample well classified by Gaia
- order of magnitude sensitivity increase to RASS
- stellar systems are old (6 Gyr) and all components rotate slowly (P_rot ∼ 30 – 400 yr)
- weakly to moderately active stars, log L_act/L_⊙ ≲ 3
- presence of 6 – 8 MK plasma around activity maxima
- coronal structures with variable filling factors
- similar coronal structures with variable filling factors
- more irregular chromospheric cycle, long-term variable
- coronal cycle indistinction-similar

Coronal activity cycles in nearby G and K dwarfs
X-ray observations of the binaries 61 Cyg A/B and α Cen A/B show significant long-term variability in all component stars, full activity cycles are covered in 61 Cyg A and α Cen B. The observed X-ray cycles differ in amplitude and period, yet spectral changes of the coronal X-ray emission over the cycles are solar-like in all studied targets.

Global stellar-coronal properties
- stellar systems are old (6 - 1 Gyr) and all components rotate slowly (P_rot ∼ 30 – 400 yr)
- weakly to moderately active stars, log L_act/L_⊙ ≲ 3
- coronal dominated by cool plasma at T_e ∼ 0.1 – 2.5 MK
- presence of 6 – 8 MK plasma around activity maxima

Charateristics of cyclic coronae
- phenomena independent of spectral type or activity level
- strong changes of emission measure over X-ray cycle
- variability is "solar-like" in all studied cases
- variability more dominant in respectively hotter plasma
- similar coronal structures with variable filling factors
- coronal cycle properties are energy band dependent

Corresponding publications: Robrade et al. (2005), Hempelmann et al. (2006), Robrade et al. (2012).