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Recent X-ray studies of stellar cycles and long-term variability

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Abstract. We discuss recent X-ray studies of stellar cycles and long-term variability.

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X-ray observations of the Sun, most recently with *Yohkoh*-SXT, have clearly shown that the X-ray luminosity of the corona changes by more than an order of magnitude along the solar cycle, albeit the exact value depends on the specific X-ray band of interest. One may thus expect that equally or more luminous X-ray stars show similar X-ray cycles. Detecting similar X-ray cycles on other stars, however, is not easy.

First of all, the idea that X-ray luminosity is due to magnetic activity, in turn tied to dynamo effect which is known to cause cyclic behavior on the Sun, cannot simply be extended to other stars, especially those much more luminous than the Sun, given our incomplete understanding of the highly non-linear dynamo action; some stars, furthermore, are believed to host a turbulent dynamo, different from the solar one, and hardly conducive to cyclic behavior.

Second, detecting any X-ray cycle demands several observational requirements, e.g., having a high enough photon count rate, making relatively short observations (a few thousand seconds) frequently enough (roughly every six months) and over 10 - 20 yr, gaining enough time at highly-on-demand X-ray telescopes (*Chandra*, *XMM-Newton*), being able to disentangle short-term variability from long-term/cyclic one.

Despite all these caveats, Marino *et al.* (2000, 2002, 2003) gave statistical evidence of long term variability in dF7 - dK2 stars in field and in Pleiades. More important, Hempelmann *et al.* (2003) in 61 Cyg A and B, Favata *et al.* (2004) in HD 81809, and Robrade *et al.* (2005) in Alpha Cen A, are accumulating clear evidence for long term X-ray variations, possibly stellar X-ray cycles. Indeed the variability in some cases resemble the solar one (e.g., large luminosity variations and small temperature changes) and long time with additional data points are still needed to prove whether these are cycle.

However, if we want a scenario of stellar X-ray cycles instead of a few case-studies, we need a dedicated project or satellite.

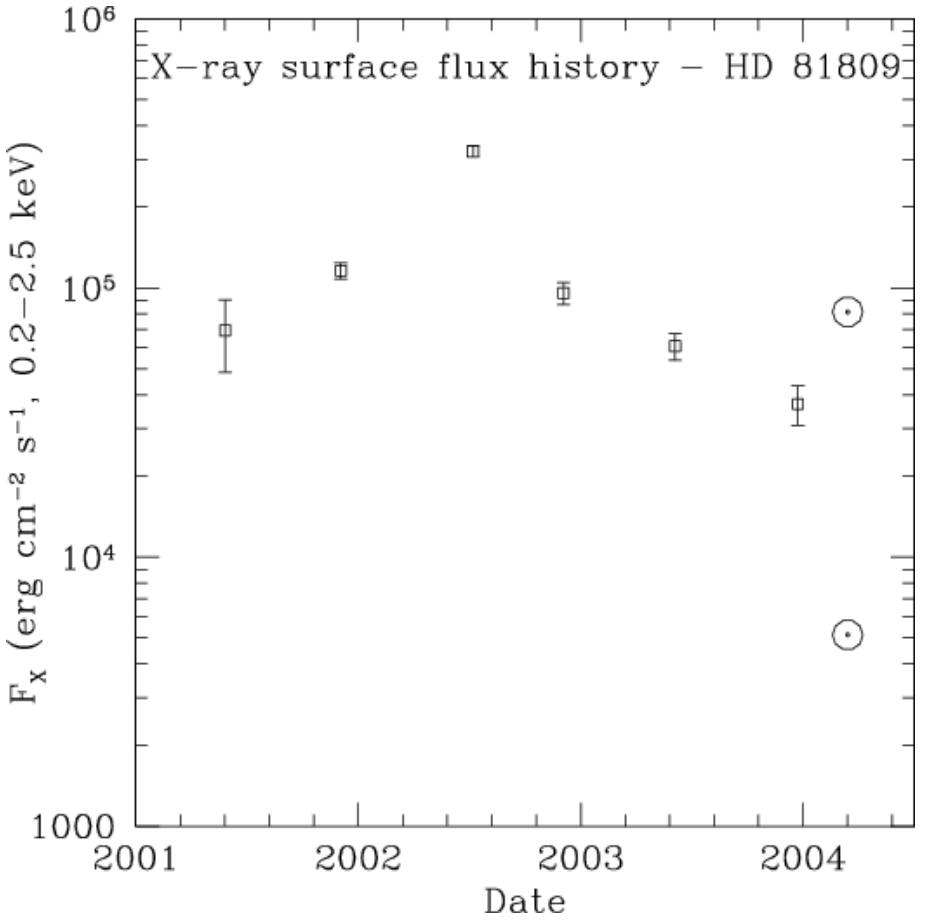

Figure 1. Evolution of the X-ray surface flux (in the 0.2 - 2.5 keV band) of HD 81809 from April 2001 to November 2003. At the right of the plot also the typical X-ray surface flux of the Sun at minimum and maximum of the cycle are plotted (from Favata *et al.* 2004).

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