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X-rays from Saturn: A study with *XMM-Newton* and *Chandra*

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Abstract

We present a systematic and uniform spectral analysis of all the X-ray observations of Saturn made to date with the *XMM-Newton* and *Chandra* observatories. The spectrum of the X-ray emission is well fitted by an optically thin coronal model with an average temperature of 0.5 keV. The addition of a fluorescent oxygen emission line at $\sim$0.53 keV improves the fits significantly. In accordance with earlier reports, we interpret the coronal component as emission from the planetary disk, produced by the scattering of solar X-rays in Saturn's upper atmosphere, and the line as originating from the Saturnian rings. The strength of the disk X-ray emission is seen to decrease over the period 2002 – 2005, following the decay of solar activity towards the current minimum in the solar cycle. By comparing the relative fluxes of the disk X-ray emission and the oxygen line, we suggest that the line strength does not vary over the years in the same fashion as the disk flux. We consider possible alternatives for the origin of the emission line. We also discuss the apparent lack of X-ray aurorae on Saturn; by comparing the planet's parameters relevant to aurora production with those of Jupiter and Earth we conclude that Saturnian X-ray aurorae are likely to have gone undetected because they are below the sensitivity threshold of current Earth-bound observatories.