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XMM-Newton Observations of X-ray Emission from Jupiter

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XMM-Newton, the state-of-the-art observatory launched by ESA in 1999, provides us with an unparalleled combination of high sensitivity and excellent energy resolution; as such, it is a powerful diagnostic tool in the study of cosmic X-ray sources, from distant active galaxies to planets in our own solar system; a tool which has opened new perspectives on the Universe.

Jupiter, the biggest planet in the solar system, was observed by XMM-Newton in April and November 2003 for 110 and 250 ks (or 3 and 7 planet rotations) respectively.

X-ray CCD images of Jupiter show prominent emission from the auroral spots and, albeit at a lower intensity, from the equatorial regions; while the spectra of the auroral X-rays can be modeled with a superposition of unresolved emission lines, including most prominently those of highly ionised oxygen, Jupiter's equatorial emission has a spectrum consistent with that of solar X-rays scattered in the planet's upper atmosphere. More remarkably, a large solar X-ray flare, which took place on the Sun's Jupiter-facing side in November 2003, has been found to be associated with a corresponding feature in the Jovian equatorial X-ray lightcurve. This suggests that the non-auroral X-ray emission from Jupiter is directly controlled by the Sun.

On-board XMM-Newton, in addition to the X-ray CCD cameras, is a high resolution X-ray spectrometer capable of separating the line components in Jupiter's X-rays and of identifying the ion species responsible; while the auroral X-rays are mostly due to oxygen ion transitions, a strong contribution by iron ions is identified in the equatorial emission, in addition to an oxygen component. These spectral results support the hypothesis that Jupiter's auroral emissions originate from the capture and acceleration of solar wind ions in the planet's magnetosphere, followed by X-ray production by charge exchange.