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Chandra X-Ray Observations of Jupiter's Low-Latitude Disk Emission

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Chandra X-ray Observatory observed X-rays from Jupiter during 24–26 February 2003 for 40 hours (4 Jupiter rotations) using both the Advanced CCD Imaging Spectrometer (ACIS-S) and the imaging array of the High-Resolution Camera (HRC-I). Two ACIS-S exposures, each ∼8.5 hr, were separated by an HRC-I exposure of ∼20 hr. Analysis of Jovian low-latitude "disk" X-ray emissions are presented in this paper and are compared with the high-latitude "auroral" emissions. We report the first Chandra ACIS-S measured 0.3–2 keV X-ray spectrum of Jupiter's low-latitude disk emission. The disk X-ray spectrum is harder than the auroral spectrum. The two ACIS-S spectra of the disk are different at energies above 700 eV showing variability in the Jovian disk emission on the time scale of a day. The temporal variation in Jovian disk X-rays appears consistent with the variation observed in solar X-rays observed by GOES and TIMED/SEE. There is an indication of a non-uniform component in the disk emission, both in rate and in spectrum, but the results are not conclusive due to lower count rate. Unlike the ∼40±20-min quasi-periodic oscillations seen in auroral X-ray emission, the disk emission does not show any systematic pulsations. Comparison of the HRC-I observations suggest that X-rays from Jupiter are about 50% dimmer in February 2003 compared to that in December 2000, which is consistent with a decrease in the solar activity index (F10.7 cm flux) by a similar amount. The Jovian disk spectrum observed with the Chandra-ACIS is spectrally quite similar to that observed with the XMM-Newton two months later during April 28–29,

2003. Though contribution from other processes is not ruled out at present, the X-ray emission from Jupiter's disk is largely generated by solar X-rays resonantly and fluorescently scattered in its upper atmosphere. This property of Jovian disk X-rays makes them a potentially important tool for monitoring solar flare activity on the hemisphere of the Sun that is not visible to space weather satellites and for studying the solar soft X-ray flux variability.