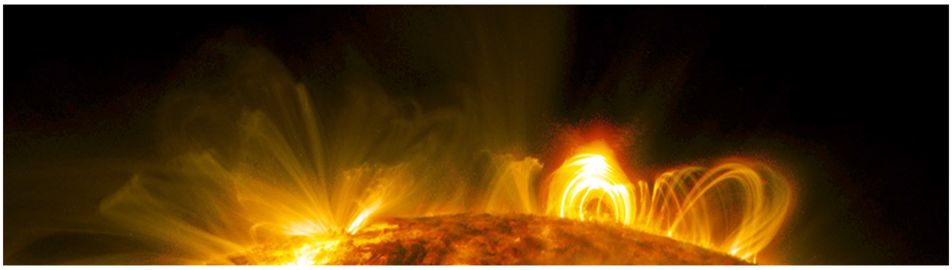

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X-ray Auroral Flares and Solar Flares from Jupiter

Monday, 15 November 2021 09:45 (30 minutes)

In 1979, while the Voyager spacecraft were undertaking their paradigm-shifting explorations of the Jovian system, the Earth-orbiting Einstein X-ray observatory was also taking the first X-ray images of the planet (Metzger et al. 1983). Through the 1990s, ROSAT further evolved our understanding of planetary X-rays, differentiating Jupiter's X-ray aurorae from the scattered solar photons dominating the equator (Waite et al. 1995; Gladstone et al. 1998). The year of 1999 ushered in the modern era of X-ray astronomy with the launch of the highly complementary Chandra and XMM-Newton X-ray observatories. These cutting-edge astrophysics platforms uncovered a treasure trove of high energy astrophysical emissions from Jupiter. In particular, at the poles, they revealed a variety of vibrant aurorae: impulsive auroral X-ray flares which can occur with a regular periodic beat every few 10s of minutes (Gladstone et al. 2002); flickering dim ion aurora along the boundary of the swirl region varying on timescales of minutes (Dunn & Yao et al. in review); electron bremsstrahlung aurora from along the main emission (Branduardi-Raymont et al. 2004; 2008) and hints of a transient electron aurora coincident with magnetospheric injection events (Wibisono et al. 2021). Observations of these diverse and spectacular emissions has sparked ground-breaking theoretical work to deduce the magnetospheric processes responsible, suggesting, for example, the presence of now-observed Megavolt potential drops at Jupiter's pole (e.g. Cravens et al. 2003; Clark et al. 2020).

At Jupiter's equator the scattered solar emissions reflect the spectrum and time signatures of solar flares, with XMM-Newton and Chandra offering high energy resolution from 0.2-12 keV, providing insights into solar spectral signatures that potentially cannot be observed by solar observatories.

In this talk, we will showcase the structures and observations discussed above and show how comparisons between remote X-ray observations and in-situ measurements (particularly by Juno) are revealing the processes that lead Jupiter to produce its X-rays (Yao & Dunn et al. 2021). We'll explore how changing solar and solar wind conditions change the planet's X-ray emissions (Dunn et al. 2016; 2020a,b) and how the X-rays connect with UV and radio emissions, magnetic field vibrations and plasma pulsations, to unify Jupiter's pulsed emissions and their source processes. Finally, we'll touch on other exciting X-ray science in the Jovian system: direct imaging of the radiation belts by Suzaku (e.g. Numazawa et al. 2019), Jupiter's magnetar-like X-ray spectra observed by NuSTAR (Mori et al. in review) and the elemental fingerprint fluorescence glow from plasma impacts with surfaces of the moons (e.g. Nulsen et al. 2020).

Primary author: DUNN, William (University College London, UK)

Presenter: DUNN, William (University College London, UK)

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