BOSTON UNIVERSITY

Boston University College of Arts & Sciences
Center for Space Physics

2021—2022 SPACE PHYSICS SEMINAR SERIES

The Roar Between Two Lions: How Giant Planet Aurorae and Ionospheres are Wrung and Wrought by Their Atmospheres and Magnetospheres

Our understanding of the aurorae and ionospheres of Giant Planets has changed radically in the past few years. With Jupiter and Saturn, recent and ongoing missions have dramatically changed our understanding of the aurorae of these planets. Unlike Earth, where the entire upper atmosphere is dominated by the Sun's influence, for these planets we know the currents that drive auroral emission are controlled by a complex interplay between the momentum transferred from the atmosphere, volcanic material from active moons orbiting the planets and the chaotic interactions of the Solar Wind. Most notably, at Saturn, this complexity appears to change the radio period of the planet. Given that the radio pulse is usually used to measure the internal rotation rate of a planet, that this period varies with time at Saturn has remained as a two decade mystery. In work that will be published in two weeks, we have shown that these aurora are generated by weather within the planet's atmosphere - the atmospheric equivalent of a light bulb lit up by moving the wire past electrons. At Jupiter, our ongoing analysis of the ionosphere and atmosphere has just revealed a complex interplay at the top of the atmosphere, suggesting the aurora there may be different from past predictions. At Uranus, past observations have struggled to reveal any auroral structures - in recently submitted observations, we resolve a bright arc of emission that bends with the strange magnetic field of the planet.

Away from the auroral regions, past expectations were that the ionosphere and upper atmosphere were largely quiescent, a prediction we now understand was based on the low resolution of observations. Instead, our recent observations have revealed a vast array of complexity. At Jupiter we see evidence of acoustic waves from the raging Great Red Spot being dumped into the overlying layers, vortex flows and shock waves from the variable aurora washing across the entire planet. Behind this, recent magnetic field measurements by Juno seem to align almost perfectly with the strange dimming seen in our measurements of the long-term emission from this region, suggesting the magnetic echoes from the planet are changing the ionosphere. At Saturn, the perfect alignment of the magnetic and rotational poles removes much of this complexity, but instead we see radical changes in the ionosphere caused by infalling material from Saturn's vast rings. The extent of these darkenings suggest the rings themselves may be dying - and will largely disappear in only a few hundred million years.

All these observations highlight the complexity caused by two vast and powerful systems, the underlying atmosphere and overlying twisting currents from the surrounding magnetosphere, as they fight for ascendancy within the thin layer that they can interact: these planets' ionospheres. We'll look at the current science trying to unpick these complex interactions, and look forward to the upcoming JWST observations, along with possible future missions, that may reveal these in stark new detail.

Thursday, February 3rd

4:00-5:00 p.m.

See website for Zoom details

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