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Low-altitude magnetic reconnection events as possible drivers of Jupiter's polar auroras

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Charged particles impacting Jupiter's atmosphere represent a major energy input, generating the most powerful auroral emissions in the Solar System. Most auroral features have now been explained as the result of impacting particles accelerated by quasi-static electric fields and/or wave-particle interactions in the surrounding space environment. However, the reason for Jupiter's bright and dynamic polar regions remains a long-standing mystery. Recent spacecraft observations above these regions of "swirl" auroras have shown that high-energy electrons are regularly beamed away from the planet, which is inconsistent with traditional auroral drivers. The unknown downward-electron-acceleration mechanism operating close to Jupiter represents a gap in our fundamental understanding of planetary auroras. Here we propose a possible explanation for both the swirl auroras and the upward electron beams. We show that the perturbations of Jupiter's strong magnetic field above the swirl regions that are driven by dynamics of the distant space environment can cause magnetic reconnection events at altitudes as low as ~ 0.2 Jupiter radii, rapidly releasing energy and potentially producing both the required downward and observed upward beams of electrons. Such an auroral driver has never before been postulated, resembling physics at work in the solar corona.