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Reconnection acceleration in Saturn's dayside magnetodisc: a multicase study with Cassini

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Magnetic reconnection is a fundamental physical process that converts energy and accelerates charged particles in cosmic, laboratory, and space plasma environments. Recently, rotationally driven magnetic reconnection was firstly discovered in Saturn's dayside magnetosphere (Guo et al. 2018, doi:10.1038/s41550-018-0461-9). This newly confirmed process could potentially drive bursty phenomena at Saturn, i.e. pulsating energetic particles and auroral emissions. Using Cassini's measurements of magnetic fields and charged particles, we investigate particle acceleration features during three magnetic reconnection events observed in Saturn's dayside magnetodisc. The results suggest that the rotationally driven reconnection process plays a key role in producing energetic electrons (up to 100 keV) and ions (several hundreds of keV). In particular, we find that energetic oxygen ions are locally accelerated at all three reconnection sites. Isolated, multiple reconnection sites were recorded in succession during an interval lasting for much less than one Saturn rotation period. Moreover, a secondary magnetic island is reported for the first time at the dayside, collectively suggesting that the reconnection process is not steady and could be 'drizzle-like'. This study demonstrates the fundamental importance of internally driven magnetic reconnection in accelerating particles in Saturn's dayside magnetosphere, and likewise in the rapidly rotating Jovian magnetosphere and beyond.