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Electron dynamics in magnetic flux rope at Saturn's magnetotail

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Flux rope, which is often known as plasmoid when the guide field is small, is an important process that can transfer magnetic flux and plasmas between interplanetary medium and the magnetosphere of terrestrial and planetary magnetosphere. At Earth, the duration of observed flux ropes in the magnetotail is $\sim$ 2 minutes [Ieda et al., 1998], which is associated with the energization of electrons and enhancement of electron density. At giant planets (i.e. Saturn and Jupiter), the fast rotation of the magnetosphere is an additional important (might be dominant) driver in generating flux ropes. The observed flux ropes have an averaged duration of $\sim$ 8 minutes [Jackman et al., 2011]. The information the plasma properties in the flux at giant planets are pivotal for understanding the energy coupling process at these planets, which however, is poorly investigated. The Cassini spacecraft has detected an amount of flux rope events in the Saturn's magnetosphere. In this work, the electron properties are compared between the flux ropes detected at different distances to Saturn's center and different local times. Unlike small flux ropes on Earth, there is no obvious heating or cooling processes inside the flux rope on Saturn, while the electron density is anti-correlated with the distance to Saturn's center and the local time from the dusk to the dawn.