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Negative ions at Titan: New results using spacecraft attitude changes

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The ELS (ELectron Spectrometer) part of the Cassini Plasma Spectrometer (CAPS) revealed the existence of negative ions in Titan's ionosphere (Coates et al, 2007, Waite et al, 2007). The instrument is mounted on a rotating platform called the actuator. The negative ions are detected when this actuator points in the direction in which the spacecraft travels (the 'ram direction'). This is because the negative ions have slow thermal speeds compared to the spacecraft speed, whereas electrons have much higher thermal speeds and are detected in any direction as their distribution is isotropic. Hence the negative ions can be identified as narrow spikes in the ELS electron spectrograms. During most Titan flybys, the spacecraft attitude is oriented such that the central anode of the instrument points in the ram direction. However, during Titan encounters when the spacecraft rotates, other anodes can point in the ram direction for short periods of time, or in a direction very close to the ram direction. In the latter case, only higher mass ions are detected. Comparing data from different anodes in and near the ram direction can be used to obtain information related to the ion velocity and temperature, which we discuss.
The study of measurements from all anodes of the instrument also significantly increases the number of negative ion spikes available for analysis. The resulting set of data allows a statistical study of the different mass groups at a range of altitudes and latitudes, and their scale heights. We summarise and discuss the results.

References:

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