

## A statistical study of severe magnetic fluctuations effective for ion gyration in the near-earth magnetotail observed by THEMIS-E

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We have statistically studied severe magnetic fluctuations which can modify ion gyro-motion to cause kinetic effect in the magnetotail dynamics which can be a cause of current disruption in the inside-out substorm model. We used magnetic field data from 2013 and 2014 obtained by the THEMIS-E satellite with a sampling rate is 4 Hz in the nightside near-Earth plasma sheet at  $|X|= 6 - 12$  Re. A total of 1283 severe fluctuation events were identified that satisfy the criteria  $\text{Sigma}_B/B_{\text{bar}}$  larger than 0.5, where  $\text{Sigma}_B$  and  $B_{\text{bar}}$  are the standard deviation and the average of magnetic field intensity during the time interval of local ion gyro-periods. The occurrence rates of severe fluctuation events are 0.00118%, 0.00899% and 0.0238% at  $|X|= 6-8$  Re, 8-10 Re and 10-12 Re, respectively. Most events last for no more than 15 s. By using the Tsyganenko magnetic field model (T01), we found that almost all the severe fluctuation events occurred at the Zgsm close to the model neutral sheet within 1.0 Re. The superposed epoch analyses indicated that the fluctuation events occurred in association with a sudden decrease in AL index and magnetic field depolarization, suggesting their association with substorms. Sixty-two percent of events were accompanied by ion flow with  $v$  larger than 100 km/s. The superposed epoch analysis also indicated that flow speed increased before the severe magnetic fluctuations, suggesting that the magnetic fluctuations are caused by these ion flows. This contradicts the assumption of the inside-out model which suggests that the fluctuations cause earthward ion flow by reducing the tailward pressure-gradient force. These results indicate that the inside-out substorm onset caused by severe magnetic fluctuations can only be suitable for a relatively small number of substorm cases. These results also indicates that the violation of ion gyro-motion is mainly caused by high-speed ion flow in the near-earth tail. In the presentation, we will also show the result based on modified criteria ( $\text{Sigma}_B / B_{\text{bar}}$  larger than 0.2) for a comparison.