



## **On the relationships between low-latitude Pi2 pulsations, auroral brightenings, and fast flows in the plasma sheet**

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Since the timing relationships between nightside Pi2 pulsations, auroral brightenings, and fast flows in the plasma sheet differ among previous studies, it is still not well certain about what is exactly their occurrence sequence that is essential for determination of their cause and effect. In this study, their relationships are examined with 11 events of fast flows perpendicular to the ambient magnetic field observed by Geotail at  $-14.8 \text{ Re} < X_{\text{gsm}} < -30.0 \text{ Re}$  and by comparing to low-latitude Pi2s sensed by the SMALL array and Polar UVI images respectively. The main results are summarized as follows. 1) These selected fast flows do not have a clear preference of preceding or following the onsets of auroral brightening and ground Pi2. 2) Auroral brightenings occur with a likelihood of three in seven for the earthward fast flow events and three in four for the tailward ones. 3) The occurrence number of the earthward fast flows preceding ground Pi2 onsets is higher than that of the ones following ground Pi2 onsets by five to one. For the tailward fast flows, the occurrence number is the same for both. 4) For at the same onset time sector, the delay time of ground Pi2 to the fast flow is from -11 (ahead) to +11 (lag) min. Moreover, the delay time of auroral bulge to the fast flow is from -1 to +22 min. Consequently, these show that the selected fast flows in the plasma sheet do not directly result in auroral brightenings and low-latitude Pi2s. Instead, we suggest that they could result from the same impulsive sources initiated in the near Earth region and in the distant Earth region in the plasma sheet.