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Relations between substorms and BBFs

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Although a great deal progress have been over the past three decades, the relation between BBFs and substorms, and BBF's roles in the substorm energy transport are still not fully clear. Using the observations of three satellites of Cluster (C1, C3 and C4) during the periods July-Oct 2001 and July-Oct 2002, we study the correlation between BBFs and substorms, the duration of BBFs. Single satellite observations show that the average duration of BBFs selected by the criterion of Angelopoulos et al. is 604s, while multi satellite observations show that the average duration of BBFs is 1105s. Single satellite sometimes misses the BBFs. The missing ratio of single satellite is 22.4% for the criterion of Angelopoulos et al. and 44.9 % for the criterion of Raj et al.. Therefore the single satellite observations can't tell the true number of BBFs. The single satellite observations also show that 22% of substorms are not accompanied by BBFs, while multi satellite observations show that only 4.5% of substorms are not accompanied by BBFs. Thus it seems possible that all substorms are accompa-

nied by BBFs. The occurrence frequency of BBFs in the central plasma sheet is 9.5% for single satellite observations and 19.4% for multi satellite observations. Based on the dimensions of BBF obtained by Nakamura[2004], the average energy transport of BBFs are estimated. The results show that BBFs may contribute more to the transport of magnetic flux, mass and energy than what was estimated by previous studies based on single satellite observations.