Simultaneous tracking of reconnected flux tubes: Cluster and conjugate SuperDARN observations on 1 April 2004

Qing-He Zhang[1,2], H. Hu[1], R. Liu[1], M. W. Dunlop[3], M. Lester[4]

[1] Polar Research Institute of China, 451 Jinqiao Rd，Shanghai 200136, China.
(zhangqinghe@pric.gov.cn, hhq@pric.gov.cn, ryliu@pric.gov.cn)
[2]School of Science, Xidian University, Xi'an 710071, China.
[3] Rutherford-Appleton Laboratory, Chilton, Didcot, OX11 0QX, UK.
(m.dunlop@rl.ac.uk)
[4] RSPPG, Dept. Physics, University of Leicester, Leicester LE1 7RH, UK.
(mle@ion.le.ac.uk)

While the Cluster spacecraft were located near the high-latitude magnetopause, between 11:30-13:00 UT on 1 April 2004, a series of medium to large scale (40 nT, 0.6-1.2 Re) FTEs were observed. During this pass, simultaneous and conjugated SuperDARN measurements are available that show a global flow pattern which is consistent with the expected (mapped) north-west motion of (predominantly sub-solar) reconnected, magnetic flux at the magnetopause. We focus on analysing the local response of three FTEs, tracking their magnetopause motion via the four-spacecraft measurements together with their corresponding ground mapped motions. For two of these FTEs, where the tracking is strongly coordinated with the ionospheric flow at each footprint of the implied flux tubes in the northern hemisphere, conditions corresponded to stable, increasing (>100 °) clock angle, while the third event, where the correspondence is less strong, coincided with low (<100 °) clock angle. Flux tube motion, both measured and modeled from the inferred X-line, matches the clear velocity enhancements in ionospheric convections with northward and westward flow at each location in the northern hemisphere, measured simultaneously by SuperDARN, and also roughly matches the observed, purely south-eastward ionospheric flow in the southern hemisphere at the time of these events. The time periods of these velocity enhancements infer that the evolution time of the FTEs is about 4 - 6 minutes from its origin on magnetopause to its addition to the polar cap. However, the ionospheric response time in the southern hemisphere might be 2 minutes longer for the 12:31 UT FTE (and 6 minutes longer for the 12:51 UT FTE) than the response time in the northern hemisphere.