Electrodynamic properties of two types of substorm-related field line resonance: Polar satellite observations

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The coupling of fast mode waves to shear Alfvén waves is one generation mechanism of field line resonance (FLR). Observations from the Polar satellite are used to characterize electrodynamic properties of FLR in the nightside plasma sheet, which were initiated at substorm onset. We report two types (Type I and II) of FLR, defined on the basis of the L dependence of the frequency of the toroidal magnetic field oscillations. Type I showed no frequency change across L shells. For type II the frequency decreased with increasing L values. In the case of Type I, we present direct (in situ) evidence of the mode coupling of a fast mode wave to FLR. Poynting flux calculations show the flow of energy during the coupling process. Type II, on the other hand, was a toroidal resonance excited by a broadband frequency source along the field lines but away from the observation point. We will compare properties of these two types of FLR. Importantly, the global magnetospheric context was very similar during both types. Ground magnetometer data showed the presence of monochromatic Pi2s over a wide range of L values during both types. However, whereas Type I was conjugate to the Pi2-recording ground stations, Type II was conjugate to higher L value ground stations. Thus the two types presented here are manifestations of two different drivers, resulting from similar initial substorm disturbances. We conclude that the drivers of the FLR can be a monochromatic cavity-type oscillation (Type I) and a broadband frequency source (Type II) for which we will give observational evidence.