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Interactive comment on "Multisatellite observations of the magnetosphere response to changes in the solar wind and interplanetary magnetic field" *by* Galina Korotova et al.

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Dear Dr. Foster,

Thank you very much for your comments. Here is our response.

lines 255-258: Two techniques for calculating the normal vector of the shock (n) are described. How well do these two techniques agree with each other?

The Finnish data base gives the coordinates of the normal vector to shocks as calculated from the magnetic field data and velocities using the mixed mode method of Abraham-Shrauner and Yun [1976]. When there is data gap in the velocity compo-

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Discussion paper

nents, the normal is calculated using magnetic field coplanarity [Colburn and Sonett, 1966]. Abraham-Shrauner [1972] suggested the "mixed mode method as an alternative to other methods when the accuracy of the magnetic field used in the calculations is uncertain. She noted that, for example, if the magnetic field is exactly normal or tangential to the shock front, magnetic coplanarity fails to give an expression for the shock normal. Our list of interplanetary shocks contains events for which the determination of the values of the magnetic field ahead and behind the shock was not complicated (no strong oscillations), so we always use magnetic field coplanarity to calculate the shock orientations. We found that the sense of our shock orientations (spiral or orthospiral) agrees well with the shock parameters in the Finnish database. For the fast mode propagation velocities, it would be good to describe the theoretical parametric dependence of the fast mode velocity (e.g. its dependence on radial dis- tance). How well do the observed pulse velocities agree with theory for the Feb 2014 event (e.g. lines 310-312) and others?

The exact value of the fast mode wave speed in the magnetosphere depends on the direction of its propagation. For propagation perpendicular to B, the phase velocity VF is (VA2+CS2), where VA is Alfven velocity and CS is the sound velocity. To calculate VA we used the Carpenter and Anderson density profile obtained from a least squares linear fit to 25 ISEE dayside saturated plasmasphere profiles [J. Geophys. Res., 97, A2, 1097-1109, 1992]. Figure 1a shows their reference density profile given by ne =10(-0.3145L+3.9043) for L increments of 0.5. Figure 1b and Figure 1c show the values of the magnetic field obtained from a CCMC run for the Tsyganenko geomagnetic field model for the solar wind conditions on February 27, 2014 and the corresponding Alfven velocity, respectively. Then we set the plasmapause at L = 6 and took the density ne as 4 cm-3 beyond this distance to obtain the corresponding Alfven velocity presented in Figure 1d. The values for the Alfven velocity at the locations of Van Allen Probes A (L=5.1) and B (L=5.5) are about 284 km/s whereas at the GOES location it is 1240 km/s. Because the temperature is very low, the fast mode velocity is the same as the Alfven velocity in the plasmasphere [Takahashi et al., J. Geophys. Res. 115, 2010] and is only ~100 km/s greater in the outer magnetosphere. These model values for the fast mode velocities are in good agreement with the values obtained in our paper.

In the Introduction (lines 89-100), the resonant acceleration of trapped particles is discussed briefly. This paper presents observations and calculations of the propagation speed of the shock-induced pulse, the strength and variation of Ey, and the associated plasma drift velocities Vx and Vy. A useful addition to the paper would be to present some detail on how those parameters have important effects on plasma acceleration in interactions involving the initial fast-mode pulse or with subsequent ULF oscillations. For example, the studies of Wygant et al [1994] using CRRES data, Foster et al. [2015] using Van Allen Probes data, and others have shown that within the magnetosphere, the tailward propagation of the strong shock-induced electric field impulse can result in the extremely fast acceleration of high energy, ultra-relativistic electrons deep within Earth's Van Allen radiation belts. The strong electric field associated with the shock-induced fast mode pulse is of about 1-min duration and accelerates radiation belt electrons for the length of time they are exposed to it.

We added new Figures 7, 10, 11, 12, made some calculations, rewrote the section of statistical study and the conclusions to improve our paper. Thank you again for your help. Regards, Galina Korotova.

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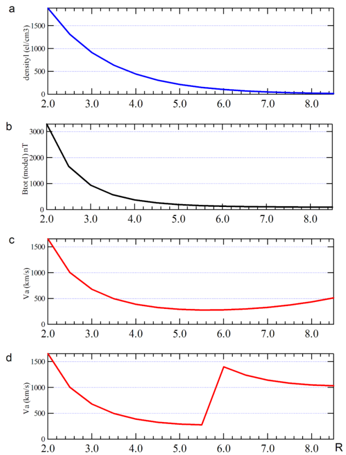

Fig. 1. Figure 1. Radial profiles: (a) reference density profile given by ne =10(-0.3145L+3.9043) for L increments of 0.5, (b) values of the magnetic field obtained from a CCMC run for the Tsyganenko geomagn