Relation between formation of preliminary and main SI impulses during a sharp compression of the magnetosphere by solar wind

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By using geomagnetic global network data of high- and low-latitude stations and observations of the magnetic field in the Earth's magnetosphere the characteristics of preliminary (Pi) and main (Pm) sudden geomagnetic impulses during the sharp increase of solar wind dynamic pressure are studied.
The following results have been obtained:
1. The duration of the negative Pi impulse increases from ~1 to 7 min with increasing latitude from ~40 to ~75-80є. It is related to the propagation of the positive Pm impulse in the anti-sunward direction with a velocity decreasing from ~450 to 10 km/s with increasing latitude;
2. The Pi impulse is of the negative sign at latitudes Φ/=60-70° of the dayside magnetosphere and does not change the sign relative to the noon at lower latitudes.
3. The current system of SI during first ~3-5 min is characterized by simultaneous intensification of western and eastern electrojets with maximum intensity in postnoon and prenoon sectors, respectively, at Φ/~70-75° with the primary spreading to lower latitudes. The eastern current is registered in both sectors of MLT in next minutes.
The results obtained in contrast to the SI Araki physical model [1994] indicate that there are the following substantial influences:
a) besides of the intensification of the zone 1 field-aligned currents (FACs) intensity, the growth of cusp-cleft FACs (zone 0 or 3), Hall currents, streaming between these FAC layers and also stream currents, closed in the dayside magnetosphere by FACs;
b) the propagation effect of a pressure wave in the inhomogeneous magnetospheric waveguide in the anti-sunward direction.
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