



## **Travelling foreshocks and foreshock phenomena**

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We use the multi-spacecraft capabilities of the THEMIS and Cluster missions in order to show the existence of a new kind of foreshocks which we call traveling foreshocks. These were first proposed by numerical simulations of Omidi et al. (2013) who performed global hybrid simulations of planetary bow-shock, under varying upstream conditions. The authors launched two consecutive rotational discontinuities (RD) of interplanetary magnetic field (IMF). The magnetic field lines between the discontinuities connected to the originally perpendicular simulated bow-shock in a way that the angle between the IMF direction and the local shock normal was less than  $45^\circ$ , so a foreshock developed in the region between RDs. Since the two RDs were convected with the solar wind, this foreshock travelled along the bow-shock surface hence the name traveling foreshocks. We show that such foreshocks exist and that the “usual” foreshock phenomena (compressive ultra-low frequency waves, spontaneous hot flow anomalies) develop in them. We also show how the locations of different foreshock phenomena are ordered in space by using the solar foreshock coordinates.