Is the evolution of Interplanetary shock evolution self-similar in the inner heliosphere?

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Abstract: In situ observations of interplanetary (IP) coronal mass ejections (ICMEs) and IP shocks are important to study as they the main link between the solar activity and the terrestrial environment. Hundreds of IP shocks have been detected by various space missions at different times and heliocentric distances. Some of these are followed by well-defined signatures from ICMEs while in others the signatures are not detected by the spacecraft. In this study we carry out a statistical analysis on the behavior of the distributions of some parameters of the IP shocks. To accomplish this task, we classify the shocks according to the heliocentric distance at which they were observed by the space missions, namely from 0.29 to 0.99 au (Helios-A/B); near 1 au (Wind, ACE and STEREO-A/B); and from 1.35 to 5.4 au (Ulysses). We also differentiate the IP shocks into two populations, those with a detected a ICME and those without it. In the same way, we also analyze the dependence of the distributions of the properties of the IP shocks with the solar activity cycle. We find that there are no spacecraft biases positioned at 1 au, which is expected as there should be no differences for all shocks detected at the same distances from the Sun. As well as the distributions of shock parameters are isotropic throughout the IP medium, regardless of the heliocentric distances. For the solar cycle, we find no significant variations in the shock parameters. We also investigate the relationship of the heliocentric distance with the shape of the shock front based on the ellipsoidal model.

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