Dr. Janardhan P.,
PRL, Ahmedabad
05 May 2017

Dear Dr. Maeda,

Given below is a brief write up of a paper accepted for publication in the journal Geophysical Research Letters on 1 May 2017. The result is a new finding, by a group of researchers at the Physical Research Laboratory, Ahmedabad, India, on the efficacy of geo-effectiveness of the solar wind flows caused by co-rotating interaction regions in the solar wind. The lead author is a Graduate Student at PRL, working towards his PhD.

Paper Accepted in GRL:

- **Solar wind flow angle and geo-effectiveness of corotating interaction regions: First results**

  Diptiranjan Rout, Chakrabarty, D., Janardhan, P., Sekar, R., Vrunda Maniya and Kuldeep Pandey (2017). *Geophysical Research Letters*. DOI: 10.1002/2017GL073038. **[In Press]**

The geo-effectiveness of solar wind flows caused by CIR.

The magnetic field in the heliosphere continuously evolves in response to the solar photospheric field at its base. Together with the rotation of the Sun, this evolution drives space weather through the continually changing conditions of the solar wind and the magnetic field embedded within it. The aim of space weather studies has therefore been to try and predict the geo-effectiveness of solar wind streams interacting with the terrestrial magnetosphere and ionospheric system. In other words, space weather studies try to establish a causal relationship between solar wind events or disturbances taking place outside the terrestrial magnetosphere with events occurring within the terrestrial magnetosphere or the earth's ionosphere.

Solar rotation coupled with the fact that solar wind streams can have different flow velocities will yield interaction regions, in the inner-heliosphere, where the different flow streams will interact. Such interaction regions are commonly referred to as co-rotating interaction regions (CIR) and are identified by rapid fluctuations in the z-component of the interplanetary magnetic field (Bz). A group of researchers from PRL have identified a large number of such CIR's at the L1 Lagrangian point of the sun-earth system which lies along the sun earth line at a distance of 232 earth radii (R_E) from the earth. They have shown that the geo-effectiveness of these CIR are governed by their azimuthal or non-radial flow angle. Interestingly, only those CIR associated solar wind flows that deviate with respect to the radial direction by less than 6^o in the azimuthal plane are seen to be geo-effective and show a causal relationship between Bz, measured at L1 and the equatorial electrojet (EEJ).

These results thus, provide one an easy and quick method of predicting the geo-effectiveness of solar wind outflows by merely examining their degree of deviation from the radial direction.

The schematic (Figure 1) represents the scenario described above. It is easy to see from the schematic that flows exceeding 6^o in the azimuthal plane will not interact with the terrestrial magnetosphere at all and pass by well beyond its flank which lies at a typical distance of 20 R_E, where 1 R_E is the Earth's radius. The L1 Lagrangian point is at a distance of 232 R_E along the sun-earth line

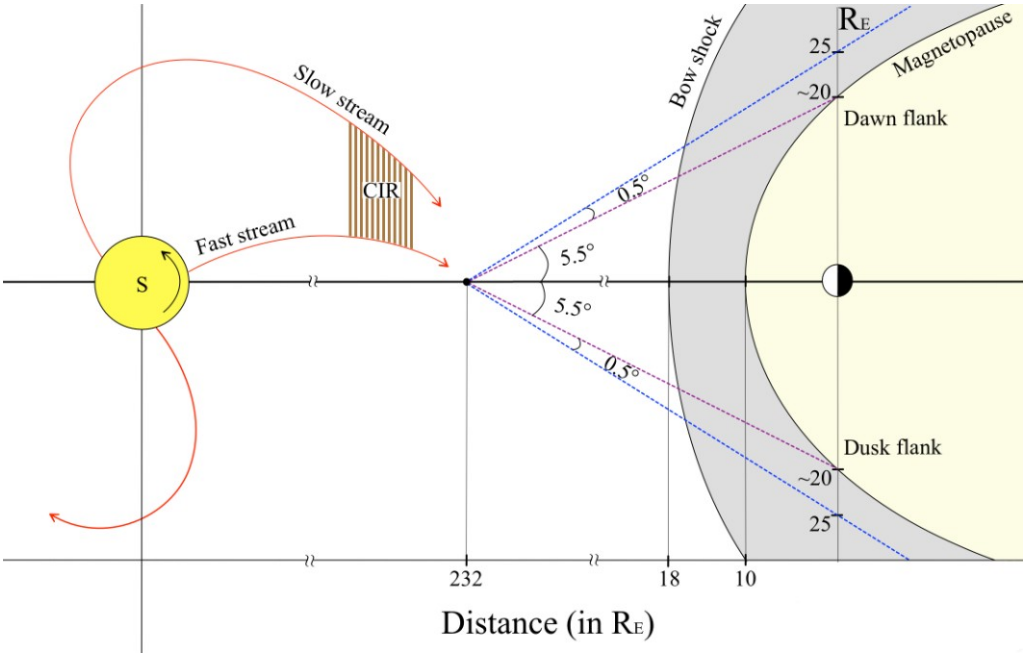

Figure 1: *Schematic (not to the scale; viewed from above the ecliptic plane) depicts the Co-rotating Interaction Region (CIR) caused by different velocity outflows from the Sun which reveals the efficacy of geo-effectiveness of such CIR associated solar wind flows. For azimuthal flow angles below 6 ^{o} ,with respect to the Sun-Earth line, measured at the first Lagrangian point (L1) at 232 R_E, fluctuations in the interplanetary magnetic field (Bz) and the equatorial electrojet (EEJ) are causally connected*.