Discontinuity analysis and evolution of magnetic switchbacks

Mojtaba Akhavan-Tafti¹, Justin Kasper¹, Jia Huang¹, and Stuart Bale²
¹Department of Climate and Space Sciences and Engineering, University of Michigan, Ann Arbor, Michigan 48109, USA
²Department of Physics and Space Sciences Laboratory, University of California, Berkeley, California 94720, USA

Magnetic switchbacks are Alfvénic structures characterized as intervals of intermittent reversals in the radial component of magnetic field. Switchbacks comprise of magnetic spikes preceded/succeeded by quiet, pristine solar wind. Determining switchback generation and evolution mechanisms will further our understanding of the global circulation and transportation of Sun’s open magnetic flux. Here, we investigate switchback transition regions using measurements from fields and plasma suites aboard the Parker SolarProbe (PSP). Minimum variance analysis (MVA) is applied on switchback transition region magnetic signatures. Discontinuity analyses are performed on 273 switchback transition regions with robust MVA solutions. Our results indicate that switchbacks are rotational discontinuities (RD) in 214 (or 78%) of the cases. 21% of the switchback transition regions are categorized as “either” discontinuity (ED), defined as small relative changes in both magnitude and the normal component of magnetic field. RD-to-ED event count is found to reduce with increasing distance from the Sun. On average, plasma beta falls by −28% across RD-type switchback transition regions and magnetic shear angle is 60 [deg], therefore making switchback transition regions theoretically favorable to local magnetic reconnection. The evolution of switchbacks away from the Sun may involve increasing mass flux across RD-type switchback transition regions. The evolution mechanism(s) remain to be discovered. Our results indicate negligible magnetic curvature across switchback transition regions which may inhibit local magnetic reconnection.