Magnetic Source Region Characteristics Influencing the Coronal Velocity of Solar Eruptions

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The velocity of coronal mass ejections (CMEs) is one of the primary parameters determining their potential geoeffectiveness. A great majority of very fast CMEs receive their main acceleration already in the corona. We study the magnetic source region structure for a complete sample of 15 very fast CMEs (v > 1500 km/s) during 2000--2006, originating within 30 deg from central meridian. We find a correlation between CME speed and the decay index profile of the coronal field estimated by a PFSS extrapolation. The correlation is considerably weaker for a comparison sample in which slower CMEs are included. We also study how the decay index profile is related to the structure of the photospheric field distribution. This is complemented by a parametric simulation study of flux-rope eruptions using the analytic Titov-Demoulin active-region model for simple bipolar and quadrupolar source regions. The simulations provide simple relationships between the photospheric field distribution and the coronal decay index profile. Very fast, moderate-velocity, and even confined eruptions are found and the conditions for their occurrence quantified.
We acknowledge support by NSF and NASA's LWS program.

