Front-side Type II Radio Bursts without Shocks near Earth

N. Gopalswamy¹, P. Mäkelä², H. Xie², S. Yashiro², S. Akiyama²
¹NASA Goddard Space Flight Center, Greenbelt, USA; ²The Catholic University of America, Washington DC, USA

Type II radio bursts are due to shocks driven by coronal mass ejections (CMEs), so the shocks are expected to arrive at Earth in 2-3 days if the source is on the front-side of the Sun. However, a significant fraction of front-side CMEs producing type II bursts did not result in shocks at 1 AU. On can think of several possibilities for the lack of shocks: (1) CMEs originating at large central meridian distances may be driving a shock, but the shock may not be extended sufficiently to reach to the Sun-Earth line. (2) CME cannibalism results in the merger of shocks so that one observes a single shock at Earth even though there are two type II bursts near the Sun. (3) CME-driven shocks may become weak and dissipate before reaching 1 AU. We examined a set of 30 type II bursts observed by the Wind/WAVES experiment that had the solar sources very close to the disk center (within a CMD of 15 degrees), but did not have shock at Earth. We find that the near-Sun speeds of the associated CMEs average to ~600 km/s, only slightly higher than the average speed of CMEs associated with radio-quiet shocks. However, the fraction of halo CMEs is only ~28%, compared to 40% for radio-quiet shocks and 72% for all radio-loud shocks. We conclude that the disk-center radio loud CMEs with no shocks at 1 AU are generally of lower energy and they drive shocks only close to the Sun.