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Velocity distribution of energetic particles within large-scale twisted and untwisted loops in the corona

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A complete study over the emission mechanisms of solar radio bursts requires a good knowledge of velocity distribution function (VDF) of energetic particles. These particles can be trapped within a large-scale twisted magnetic structure in the corona after their acceleration during solar eruptions, according to latest observational studies on moving type IV solar radio bursts and microwave emission. These studies also point out the potential of using relevant radio data to diagnose important parameters such as magnetic configuration and field strength in the corona. Thus, it is necessary to develop numerical scheme to investigate the transport and VDF evolution of energetic particles within a large-scale twisted magnetic structure.

For this purpose, we develop the guiding-center parallel scheme to simulate particle transport within twisted\untwisted magnetic loops in the corona that are given by NLFFF magnetic field extrapolation for a real solar active region (AR 11283). 5 Millions of particles are injected into the structures and their trajectories are traced. We then examine the particle VDFs within different sections (or boxes) along the loops. This is done for particles with different injection positions, different way of injection, as well as different initial VDFs (Maxwellians or isotropic power-laws). Our results show that for a static simple loop the distribution of particles can be understood from a single particle perspective using adiabatic invariant concept, while the situation may become more complex for particles trapped within twisted structure. Implications of our studies to emission mechanism of radio bursts observed during the pre-flare stage will be presented.

References:

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