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In What Magnetic Environment Are Coronal Loop Plasmas Located?

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Coronal loop plasmas are often regarded to be confined within magnetic flux ropes as in the case of laboratory plasmas. However, a plasma pressure profile, which decreases from the center of a flux rope to its periphery, can be ideal MHD interchange unstable if individual flux tubes constituting the flux rope are freely movable. In the solar corona, the strong line-tying condition impedes the interchange of flux tube positions, but ubiquitous magnetic reconnection processes can change plasma distribution in such a way that the system moves to a possible lower energy state. In this paper, we present a 2.5D MHD simulation study of the plasma redistribution in the merging process of many small flux ropes possibly representing loop strands. We have found that the redistributed plasma is more concentrated between flux ropes rather than near the center of flux ropes. When flux ropes initially have different amounts of twists, the plasma tends to accumulate in less twisted regions. As larger and larger flux ropes are formed by successive merging processes, the toroidal field of the flux ropes become stronger and stronger, i.e. field lines are less and less twisted. Our study may explain why the observed coronal loops appear very little twisted and quite well ordered in spite of continuous entangling motions in the photosphere and below.