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Development of Ballooning Instability by Flux Rope Merging in the Solar Atmosphere

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A numerical simulation study of the solar coronal plasma reveals that a ballooning instability can develop in the course of flux rope merging. When magnetic field lines from different flux ropes reconnect, a new field line connecting farther footpoints is generated. Since the field line length abruptly increases, the field line expands outward. If the plasma beta is low, this expansion takes place more or less evenly over the whole field line. If, on the other hand, the plasma beta is high enough somewhere in this field line, the outward expansion is not even, but is localized as in a bulging balloon. This ballooning section of the magnetic field penetrates out of the overlying field, and eventually the originally underlying field and the overlying field come to interchange their apex positions. This process may explain how a field structure that has been confined by an overlying field can occasionally show a localized eruptive behavior.