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The Role of Magnetic Reconnection in the Formation and Evolution of Eruptive Magnetic Flux Ropes

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Magnetic flux rope (MFR) is generally considered the core structure of coronal mass ejections (CMEs). However, how an MFR forms and develops into a CME has been elusive. Through a series of observational studies, we found that a coherent magnetic flux rope may originate from a 'seed' MFR that is formed through magnetic reconnection in a current layer underneath a sheared magnetic arcade, as a result of the convalescence of plasmoids formed in the current layer. During the eruption, while magnetic reconnections continually convert overlying, untwisted magnetic flux into twisted flux to help further build up the pre-existent MFR, they also restructure the MFR through reconnections between the MFR and the ambient field. The restructuring may go as far as to completely replace the original MFR's flux, which is manifested by drastic footpoint migration, highlighting the 3D nature of magnetic reconnection; and alternatively may dissolve the MFR, while simultaneously exciting a shock wave, revealing an imploding process intrinsic to magnetic reconnection.

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