

# The Origins of Magnetic Flux Ropes Observed in Near-Earth Space

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A subset of interplanetary coronal mass ejections (ICMEs) observed in near-Earth space or at 1 AU from the Sun are characterized by smoothly rotating magnetic field over large angles. They may be regarded as magnetic flux ropes at least in the first approximation. They may cause strong geomagnetic storms if they contain sustained southward magnetic field. Such organized structures observed in situ may be thought to come from eruptions that contain clearly identifiable flux ropes in the solar corona. But this link between the ICME and the eruption in the corona is often hard to establish. First, the CME responsible for the ICME may not be unambiguously isolated. Second, even if the CME is found, its low coronal signatures of the eruption may be elusive, and we do not know what magnetic structures in the corona may be involved in the CME. These two aspects give major challenges in space weather prediction. We have studied these problem events for some time, and report recent progress in our understanding of how common they are in different phases of solar cycle, whether they can distinguish themselves from normal CMEs, and where they may possibly come from, on the basis of limited observations.

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