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3D Dynamics of Magnetic Flux Ropes Across Scales: Solar Eruptions and Sun-Earth Plasma Coupling[1] JAMES CHEN, Plasma Physics Division, Naval Research Laboratory — Central to the understanding of the eruptive phenomena on the Sun and their impact on the terrestrial plasma environment is the dynamics of coronal mass ejections (CMEs)—a 3D magnetic flux rope configuration—and the evolution of their magnetic fields. I will discuss the basic physics of CME eruption and solar flare energy release in the context of the analytic erupting flux rope model of CMEs. In this ideal MHD model, a CME is treated as a 3D flux rope with its two stationary footpoints anchored in the Sun. The model structure is non-axisymmetric and embedded in a model corona/solar wind. The initial flux rope is driven out of equilibrium by "injection" of poloidal flux and propagates under the Lorentz hoop force from the Sun to 1 AU, across a wide range of spatial and temporal scales. Comparisons of the model results and recent STEREO observations show that the solutions that best fit the observed CME position-time data (to within 1-2% of data) also correctly replicate the temporal profiles of associated flare X-ray emissions (GOES data) and the *in situ* magnetic field and plasma data of the CME ejecta at 1 AU where such data are available (e.g., ACE and STEREO/IMPAXCT/PLASTIC data), providing a unified basis of understanding CME dynamics and flare energetics.

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James Chen
Plasma Physics Division, Naval Research Laboratory

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