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Emergence and Eruption of Magnetic Flux Ropes, a Mechanism for Coronal Mass Ejections WARD MANCHESTER, University of Michigan — We present the results of simulations of flux ropes buoyantly emerging from the convection zone into the corona and examine shear flows that spontaneously occur during the emergence process. Shear flows have been prescribed in numerical models of coronal mass ejections and flares for decades as a way of energizing magnetic fields to erupt. While such shear flows have long been observed in the solar atmosphere, until recently, there was no compelling physical explanation for them. We will discuss the discovery that such shear flows are readily explained as a response to the Lorentz force that naturally occurs as bipolar magnetic fields emerge and expand in a gravitationally stratified atmosphere. It will be shown that shearing motions transport axial flux, and magnetic energy from the submerged portion of the field to the expanding portion, strongly coupling the solar interior to the corona. This physical process explains active region shear flows and why the magnetic field is found to be nearly parallel to photospheric polarity inversion lines where prominences form. Finally, shear flows driven by the Lorentz force are shown to produce a loss of equilibrium and eruption in magnetic arcades and flux ropes offering a convincing explanation for CMEs and flares.

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