FORMATION AND PROPAGATION OF CORONAL SHOCKS

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Observational signatures of large-scale coronal MHD shocks are reviewed, including the relationship between shocks, coronal mass ejections (CMEs), and flares. Special attention is paid to empirical aspects which reveal the physical background of the shock formation, such as timing of the shock appearance relative to the energy release in the associated flare and the CME acceleration phase, shock formation distance, shock amplitude, kinematics of the shock front, etc. Observational characteristics are explained by considering basic theoretical principles that govern the formation and nonlinear evolution of large-amplitude MHD waves. Specifically, the 3-D expanding-piston mechanism is employed to describe the process of the shock formation. The process is illustrated by applying a simple analytical model to the situation where the piston accelerates over a limited time interval, until achieving maximum velocity. Following the nonlinear evolution of the large-amplitude wavefront that is created by such a source-region expansion, the time/distance at which the shock is formed can be calculated. Further evolution depends on the nature of the driver: In the case of CMEs, the shock is permanently driven, whereas in the case of the flare-associated pressure pulse it becomes a freely propagating blast. Finally, the effects of decreasing ambient-plasma density and changing Alfven speed are considered, including also results of various numerical simulations.

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