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Ion Heating in the Solar Corona and Solar Wind

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The solar corona is the hot, ionized outer atmosphere of the Sun that expands into interplanetary space as a supersonic solar wind. This tenuous medium is a unique laboratory for the study of magnetohydrodynamics (MHD) and plasma physics with ranges of parameters that are inaccessible on Earth. The last decade has seen significant progress toward identifying and characterizing the processes that heat the corona and accelerate the solar wind, but the basic physics is still unclear. Some key clues about the mechanisms responsible for energizing the plasma have come from UV spectroscopy of the extended corona (i.e., using a combination of an occulting coronagraph and a spectrometer). There is evidence for preferential acceleration of heavy ions in the fast solar wind, ion temperatures exceeding 100 million K, and marked departures from Maxwellian velocity distributions. These collisionless departures from thermal equilibrium point to specific types of kinetic processes. This presentation reviews the measurements (both telescopic and from 'in situ' probes) that constrain theoretical explanations and provides a current survey of the landscape of proposed ideas for ion energization. Many of the suggested processes are related to the dissipation of MHD waves (e.g., ion cyclotron waves), and many involve multiple steps of energy conversion between waves, turbulence, current sheets, and other nonlinear plasma features. A discussion of future measurements that could help to test, refine, and possibly winnow down the list of competing models will also be presented.