BOSTON UNIVERSITY

SPACE PHYSICS SEMINAR

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Superheating the solar wind and solar corona

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725 Commonwealth Ave.
Refreshments at 3:30pm in CAS 500
Talk begins at 4:00pm in CAS 502

Abstract:
Observations of the solar wind are a uniquely powerful tool for testing theories of coronal heating because we can directly observe particles and their interactions with electromagnetic structures and fluctuations. However, there are challenges. A mechanism that works well in the solar wind may not be applicable to regions in the corona where the plasma beta is much smaller; a non-thermal aspect of the solar wind could reflect an ongoing process or be a relic signature of events deep in the corona. The purpose of this presentation is to demonstrate how large solar wind datasets may be used to determine how heating mechanisms depend on ambient plasma conditions, such as plasma beta, and to illustrate a new technique for unfolding the overall heating history of solar wind from the corona into interplanetary space. We focus on the question of the relative heating of ionized hydrogen and helium in the solar wind as a function of plasma beta, differential ion flow, and plasma beta. We demonstrate that the preferential heating of helium is regulated by both differential flow and plasma beta, and compare our observations with several theories of ion heating. In particular, we propose an extension of the resonance condition for parallel-propagating ion cyclotron waves for finite temperatures, and show that the resulting predictions for the beta-dependence of relative ion heating compare favorably with our observations. Finally, we show how the dependence of ion properties on the Coulomb collisional age of the plasma can be inverted to estimate the relative strength of this heating mechanism as a function of distance from the Sun. Our predictions for the inner heliosphere will be tested directly by the upcoming Solar Probe Plus and Solar Orbiter missions.