BOSTON UNIVERSITY

Boston University College of Arts & Sciences
Center for Space Physics

2022—2023 SPACE PHYSICS SEMINAR SERIES

Nonlinear Wave Interactions in Space Plasmas

The near-Earth space environment hosts a wide range of plasmas including the ionosphere and the radiation belts. The Maxwell and Boltzmann equations describe the dynamics of a plasma, and for decades linear solutions to them have provided an abundance of information about naturally occurring wave modes. I will show results from the Arecibo observatory where a new linear theory explains how observed Langmuir waves are generated by high energy electrons that are produced by photoionization in the ionosphere. Despite the continued success of linear theory, it is constrained to plasmas where all of the wave modes have small amplitudes and do not couple with each other. In contrast, whistler mode chorus waves in the radiation belts have large enough amplitudes to drive a nonlinear diffusion process that causes energetic electrons to precipitate into the auroral oval. I will show how measurements of precipitating electrons at low-Earth orbit can be combined with quasilinear diffusion to obtain estimates of the wave activity and plasma density in the outer radiation belts. Finally, I will discuss an ongoing effort to describe the nonlinear coupling of two wave modes. In this case, the Langmuir mode in the ionosphere couples to the ion-acoustic mode through the nonlinear term in the Boltzmann equation. This nonlinear mode coupling explains some of the outstanding problems with 150 km echoes and could further be used to model incoherent scatter.

Thursday, October 27th

4:00-5:00 p.m.

CAS 502

William Longley

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