PHYSICS COLLOQUIUM:

Waves of Topological Origin in the Fluid Earth System and Beyond

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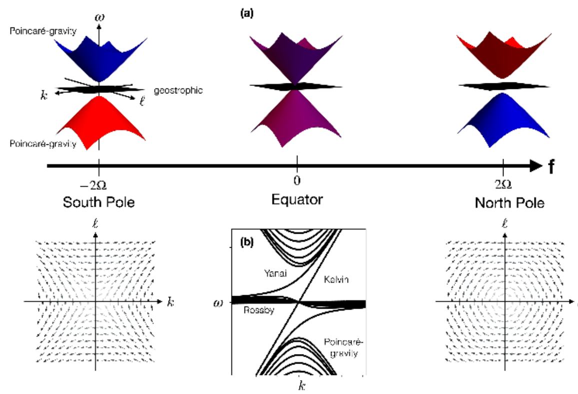
About The Speaker:

Brad Marston is a professor of physics at Brown University. A graduate of Caltech, he received his Ph.D. from Princeton University in 1989 and did postdoctoral work at Cornell University as an IBM Fellow. He has been a visiting professor at MIT, a visiting associate at Caltech, a visiting professor at ENS-Lyon, and a General Member of the Kavli Institute for Theoretical Physics (KITP) at UC Santa Barbara. Marston is an Alfred P. Sloan Fellow and a recipient of a National Young Investigator Award. In 2008 he was designated a NSF American Competitiveness and Innovation Fellow, and in 2010 an American Physical Society (APS) Outstanding Referee. Marston is a fellow and lifetime member of the American Physical Society (APS). He has chaired the Advisory Board of the KITP, and was a Councilor for the APS Division of Condensed Matter Physics (DCMP). He is the 2026 president of the APS.



Date:
3/06/2026

Time:
10:30 AM – 11:50 AM

Location:
GRAN 135

Abstract:

Symmetries and topology are central to our understanding of physical systems. Topology, for instance, explains the precise quantization of the Hall effect and the protection of surface states in topological insulators against scattering from disorder or bumps. However discrete symmetries and topology have not, until recently, contributed much to our understanding of the fluid dynamics of oceans and atmospheres. In this talk I show that, as a consequence of the rotation of the Earth that breaks time reversal symmetry, equatorial Kelvin and Yanai waves emerge as topologically protected edge modes. The non-trivial topology of the bulk Poincaré waves is revealed through their winding number in frequency - wavevector space. Bulk-interface correspondence then guarantees the existence of the two equatorial waves. I discuss our recent direct detection of the winding number in observations of Earth's stratosphere. Thus, the oceans d atmosphere of Earth naturally share basic physics with topological insulators. As equatorially trapped Kelvin waves in the Pacific Ocean are an important component of El Niño Southern Oscillation, the largest climate oscillation on time scales of a few years, topology plays a surprising role in Earth's climate system. We also predict that waves of topological origin will arise in magnetized plasmas. I will describe experiments that we are conducting at UCLA's Basic Plasma Science Facility (BaPSF). The waves may also arise in the solar system and beyond.

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