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Michigan Institute for Plasma Science and Engineering

Dr. Phillip Bonofiglo

Princeton Plasma Physics Laboratory (PPPL)

Magnetic Confinement Fusion: The Path to the Spherical Tokamak and NSTX-U

Wednesday
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3:10 pm
Room 1003 EECS

Nuclear fusion research has been ongoing since the 1950's. Following the development of atomic weapons, scientists have been searching for methods to achieve controlled and sustained nuclear fusion for clean and abundant energy production. Magnetic fields quickly became a viable option for confining the high-temperature, high-density plasmas needed. Many magnetic confinement schemes were developed (magnetic mirrors, stellarator, tokamak, spherical tokamak). Each design has had various degrees of success, and each has its own drawbacks. With the invention of the stellarator in 1953, Princeton Plasma Physics Laboratory (PPPL) has been a pioneer in fusion research. Researchers have produced computational and experimental contributions to fusion research, culminating in the 2026 construction and operation of the National Spherical Tokamak Experiment – Upgrade (NSTX-U). This talk will introduce nuclear fusion, discuss why we need a confinement scheme, introduce the basic principles of magnetic confinement fusion (MCF), and provide an overview of the popular confinement schemes. The talk will focus on tokamaks and the potential advantages of the spherical tokamak, examine upcoming experiments on NSTX-U, projected to be the world's most powerful spherical tokamak, and conclude with open questions in MCF.

About the Speaker: Dr. Phillip Bonofiglo is a Staff Research Physicist at the Princeton Plasma Physics Laboratory (PPPL). He received his B.S. in physics from the University of Michigan – Ann Arbor where he was introduced to plasma physics research through high energy density physics experiments. Phil then received his Ph.D. from the University of Wisconsin – Madison where his career in magnetic confinement fusion began. After obtaining his Ph.D., Phil joined PPPL as a postdoc where he specialized in the confinement and transport of energetic particles, often combining numerical simulations and experimental measurements. His research career has since spanned almost every magnetic confinement fusion concept including reversed-field configurations, stellarators, tokamaks, and spherical tokamaks. He participated in the recent DT-campaign on the Joint European Torus (JET), examining DT-alpha confinement, and has upcoming experiments on the Mega Ampere Spherical Tokamak – Upgrade (MAST-U) and National Spherical Tokamak Experiment – Upgrade (NSTX-U) devices.