KEYNOTE LECTURE

Professor Roland Roeder
Associate Professor
Department of Mathematical Sciences
Indiana University—Purdue University Indianapolis

The Ising Model for magnets and the mysterious Lee-Yang zeros

The Ising Model was developed by Lenz and Ising in the 1920s to describe magnetic materials. It is the most fundamental model of such materials, but there are still many open questions about it that continue to challenge present day physicists and mathematicians. In suitable variables, the Ising model can be described by a single polynomial $Z(z,t)$ of two variables z and t that is called the "partition function". Lee and Yang proved in 1952 that if $t \in [0, 1]$, then the zeros of the partition function lie on the unit circle $|z| = 1$. Most of the physical properties of the magnet are determined by the location of these "Lee-Yang zeros". In this talk, I will explain the Ising model, the Lee-Yang Theorem, and describe several interesting results and open questions about the locations of the Lee-Yang zeros. One of the beauties of the subject is how many different types of mathematics can be used to approach a fundamental problem from physics.

IUPUI