

**SPEAKER:**

David Sher, University of Michigan

**TITLE:**

Spectral geometry and the heat equation

**ABSTRACT:**

Spectral geometry is the study of the spectra - that is, the eigenvalues and eigenfunctions - of operators which appear in geometry and physics. The best-known example is the Laplacian on a Riemannian manifold, whose eigenvalues and eigenfunctions correspond to resonance frequencies and modes of vibration. One of the key questions in the field, the so-called "inverse spectral problem", is to determine what geometric information is encoded in the eigenvalues of such an operator. In other words, if you know the resonance frequencies of an object, what can you say about its shape?

In this talk, I will first discuss the basics of spectral geometry and explain its close relationship with the heat equation. I will then briefly explain how this connection can be used to formulate a Cheeger-Muller-type theorem, which links spectral geometry and topology, on certain types of singular manifolds. Finally, I will discuss recent developments that use the heat equation to analyze the inverse spectral problem for the Dirichlet-to-Neumann operator, which has applications to fluid dynamics and medical imaging. I will present some results related to generalization of Meyers result to nonlocal equation. It happens that any weak solution of a nonlocal equation with data in  $L^2$  is automatically better at the integrability AND differentiability scale. This is a completely new phenomenon relying on the nonlocality of the operator. The proof is based on a new stopping time argument and a suitable generalization of Gehring lemma.