

Honours Project Presentations

Thursday April 6, 10am, HH3017

Title: Isospectral Plane Domains

Author: Noah MacAulay

Abstract: If two drums make the same sound, do they have the same shape? This question, in an idealized form, attracted the attention of mathematicians. It turned out that the answer to the question is no: there are some drums that sound the same but have different shapes. We call these special drum shapes isospectral non-congruent domains. This thesis revisits the constructions of such pair of isospectral non-congruent plane domains, and the proof that they are isospectral. It also surveys a more general technique for producing isospectral manifolds (Sunada's method), and use it to construct isospectral surfaces.

Title: Yetter-Drinfel'd Modules and the Radford Projection Theorem

Author: Bryan W. Kettle

Abstract: In the theory of groups, the semidirect product is an approach to decompose a group into a product of two smaller groups, where they are both subgroups with one being normal. We examine a Hopf algebra analogue of the semidirect product, which we call the *Radford biproduct*. For a bialgebra H , if B is an algebra in the category ${}^H\mathcal{M}$ whilst being a coalgebra in the category ${}^H\mathcal{M}$, we prove that by endowing $B \otimes H$ with the smash product algebra structure and the smash coproduct coalgebra structure, then $B \otimes H$ is a bialgebra if and only if B is a Yetter-Drinfel'd bialgebra over H . In this case, we call $B \otimes H$ the Radford biproduct of B and H . If we suppose that H is a Hopf algebra and that A is a bialgebra, both over the same field, and if we further assume to have a system $H \xleftrightarrow{i} A$ of bialgebra homomorphisms satisfying $\pi \circ i = \text{id}_H$, then we can construct a projection $\Pi: A \rightarrow A$ in such a way that $\Pi(A) \otimes H$ is the Radford biproduct of $\Pi(A)$ and H , which is isomorphic as bialgebras to A .