Spring 2016

- **January 26**
  Organizational Meeting

- **February 2**
  Ben Brewster (Joint work with Dandrielle Lewis) (Binghamton University)
  Maximal Subgroups of a Subgroup of a Direct Product

  Abstract: It is known how to describe each subgroup of a direct product of two groups. This classification is often called Goursat's Theorem. Dandrielle Lewis worked out a criterion that determines when one such subgroup is contained in another. Using this criterion, Dandrielle computed the subgroup lattice of $Q_8\times Q_8$. For a non-supersolvable group, the orders of the subgroups do not determine when one subgroup is a maximal subgroup of another. This talk supplies a criterion for maximality.

- **February 9**
  Eran Crockett (Binghamton University)
  Free spectra: A brief survey

  Abstract: The free spectrum of a locally finite variety measures how quickly the cardinalities of the free algebras in that variety grow. It turns out that the asymptotic growth of a variety's free spectrum is closely related to the structure of the algebras in the variety. I will survey some of the results on this topic.

- **February 18 (Thursday; joint with Geometry/Topology Seminar)**
  Artem Dudko (SUNY Stony Brook)
  On representations of weakly branch groups.

  Abstract: The class of weakly branch groups acting on rooted trees plays important role in group theory and dynamics and contains many examples of groups with unusual properties. I'll present results on representations associated to actions of weakly branch groups on boundaries of rooted trees and corollaries related to invariant random subgroups, centralizers of group actions, spectra of Schreier graphs etc. The talk is based on a joint work with R. Grigorchuk.

- **February 23**
  Rachel Skipper (Binghamton University)
  The congruence subgroup problem for branch groups and the Hanoi tower group

  Abstract: Branch groups derive their importance from the interesting properties that groups in this class can exhibit (amenable but not elementary amenable, finitely generated infinite torsion, etc.) and from their connections to other fields such as combinatorics and computer science. The focus of this talk will be the congruence subgroup problem for branch groups, which is related to the famous question of the same name for special linear groups which was solved in the 1960's. In this talk, I will discuss what is known about this problem for branch groups with a special focus at the end on a group of particular interest, the Hanoi tower group which models the game the Tower of Hanoi.

- **March 1**

Name (University)
Title of Talk

Abstract: Abstract for Talk

- **March 8**
  Alex Feingold (Binghamton University)
  Hyperbolic Weyl Groups as Vahlen Groups

  Abstract: The Weyl group of the rank 3 hyperbolic Kac-Moody Lie algebra, F, studied by Feingold-Frenkel in 1983, was shown to be isomorphic to PGL(2,Z). In 2009 Feingold-Kleinschmidt-Nicolai extended that work to understand the Weyl groups of more hyperbolic KM algebras with ranks 4, 6 and 10 by using PSL(2,O) where O is a ring of integers in one of the four division algebras. In this joint work with Daniel Vallieres we show how those and other hyperbolic Weyl groups can be described as Vahlen groups, that is, groups of 2×2 matrices with entries in a Clifford algebra. This new point of view applies to the more general class of Lorentzian KM algebras. We hope it will be especially helpful in the case of the hyperbolic KM algebra E_{10}, and will show interesting connections with number theory in all cases.

- **March 15**
  Dikran Karagueuzian (Binghamton University)
  False Analogs of the Buchsbaum-Eisenbud-Horrocks Conjecture

  Abstract: I will discuss various attempts to prove the Buchsbaum-Eisenbud-Horrocks Conjecture, including my own, many of which turned out not to work because the version of the conjecture studied turned out to be false.

- **March 22**
  Andrew Kelley (Binghamton University)
  The maximal subgroup growth of some metabelian groups

  Abstract: There is a significant amount of work (by Mann, Shalev, and others) on characterizing what it means for a group to have polynomial maximal subgroup growth (PMSG), just as there had been (work by Mann, Segal, Lubotzky etc.) for classifying when a group has polynomial subgroup growth (PSG). A natural next question is to find a method for calculating the actual degree of growth of a PSG group. No general formula has been found, in contrast with the situation for polynomial word growth. However, there has been partial progress; for example, in 1999, Shalev gave a formula for calculating the degree of subgroup growth for certain metabelian groups. This talk will present work inspired by Shalev's paper, showing how to count maximal subgroups (by their index) of certain metabelian groups, namely (f.g. abelian) by cyclic groups.

- **March 29**
  No Meeting (Spring Vacation)
  Title of Talk

  Abstract: Abstract for Talk

- **April 5**

Joe Cyr (Binghamton University)
A Brief Introduction to Tame Congruence Theory

Abstract: Developed in the early 80's, tame congruence theory is a deep structure theory of finite algebras and the varieties generated by them. Since its beginning it has proven to be a rich field with a wide spread of uses. In this talk I will introduce the basic notions of the theory as well as some of its applications.

- **April 12**
  Matt Evans (Binghamton University)
  A Duality for Distributive Meet-Semilattices

  Abstract: In the early 1970's, Priestley showed that the category of bounded distributive lattices is dually equivalent to so-called Priestley spaces; this duality extended Stone's duality for Boolean algebras. After reviewing the basics of Priestley's duality, I will present results of Bezhanishvili and Jansana (2011) that extend Priestley's work to a dual equivalence for distributive meet-semilattices and a class of topological spaces called generalized Priestley spaces

- **April 19**
  Luise C. Kappe (Binghamton University)
  On the nonabelian tensor product of cyclic groups of p-power order

  Abstract: The non-abelian tensor product of a pair of groups was introduced by R. Brown and J.-L. Loday. It arises in the applications in homotopy theory of a generalized Van Kampen theorem. Let G and H be groups which act on each other via automorphisms and which act on themselves via conjugation. The actions are said to be compatible if $^{^g}$$^h g' =\ ^g(^h(^{g^{-1}}g'))$ and $^{^h}$$^g h' =\ ^h(^g(^{h^{-1}}h'))$ for all $g,g'\in G$ and $h,h' \in H$. The nonabelian tensor product $G\otimes H$ is defined provided G and H act compatibly. In such a case $G\otimes H$ is the group generated by the symbols $g\otimes h$ with relations $gg' \otimes h = (^gg'\otimes\ ^gh)(g\otimes h)$ and $g\otimes hh' = (g\otimes h)(^hg\otimes\ ^hh')$ for $g,g' \in G$ and $h,h' \in H$. If $G = H$, we call $G\otimes G$ the tensor square of G. Here the action is conjugation which is always compatible. Good progress has been made in determining the nonabelian tensor square for large classes of groups. However in the case of nonabelian tensor products the enigma of compatible actions has prevented such progress. Only in a few cases the nonabelian tensor product of two groups with nontrivial compatible actions has been determined. One such case is the nonabelian tensor product of two infinite cyclic groups, where the mutual actions are inversion. In 1989 Gilbert and Higgins showed that the nonabelian tensor product was isomorphic to the free abelian group of rank 2, contradicting an earlier conjecture that the nonabelian tensor product of two cyclic groups is cyclic. We were able to show that the minimal number of generators of a nonabelian tensor product of two cyclic groups does not exceed two. Furthermore, we established a necessary and sufficient condition that a pair of actions on two cyclic groups is a compatible pair. With its help we classified all compatible actions in the case of cyclic p-groups. The resulting nonabelian tensor products turn out to be cyclic p-groups with the exception of some 2-groups with certain actions of order 2. This is joint work with M.P. Visscher and M.S. Mohamad.

- **April 26**
  An Huang (Harvard University)
  Riemann-Hilbert problem for period integrals

Abstract: Period integrals of an algebraic variety are transcendental objects that describe, among other things, deformations of the variety. They were originally studied by Euler, Gauss and Riemann, who inspired modern Hodge theory through the theory of periods. Period integrals also play a central role in mirror symmetry in recent years. In this talk, we will discuss a number of problems on period integrals that are crucial to understanding mirror symmetry for Calabi-Yau manifolds. We will see how the theory of D-modules have led us to solutions and deep insights into some of these problems.

- **May 3**
  John Brown (Binghamton University)
  Beukers-Heckman Criteria for finiteness of a hypergeometric group.

  Abstract: In their 1989 paper "Monodromy for the hypergeometric function" Beukers and Heckman classified the hypergeomtric series which have finite monodromy group. We will discuss some facts about hypergeometric series and their associated differential equations and monodromy group, as well as some of the main ideas involved in the classification.

- **May 10**
  Diego Penta (Binghamton University)
  Decomposition of the rank 3 hyperbolic Kac-Moody algebra $\mathcal F$ with respect to a rank 2 hyperbolic subalgebra Fib

  Abstract: In 1983 Feingold-Frenkel studied the structure of a rank 3 hyperbolic Kac-Moody algebra $\mathcal F$ containing the affine KM algebra $A_1^{(1)}$. In 2004 Feingold-Nicolai showed that $\mathcal F$ contains all rank 2 hyperbolic KM algebras with symmetric Cartan matrices, $A = \begin{bmatrix} 2&-a\\-a&2\end{bmatrix}$, $a\geq 3$. The case when $a = 3$ is called Fib because of its connection with the Fibonacci numbers (Feingold 1980). Some important structural results about $\mathcal F$ come from the decomposition with respect to its affine subalgebra $A_1^{(1)}$. Here we study the decomposition of $\mathcal F$ with respect to its subalgebra Fib. This talk is the dissertation defense of Diego Penta.