Route 81 Conference 2018
Syracuse University

8:00 am	*Light breakfast*	12:30 – 2:00	*Lunch*
9:00 – 9:30	**Nathan Grieve**	2:00 – 2:30	**Charles Paquette**
9:40 – 10:10	**John Wiltshire-Gordon**	2:40 – 3:10	**Kuei-Nuan Lin**
10:10 - 10:40	*Coffee break*	3:10 - 3:40	*Coffee break*
10:40 – 11:10	**Eric Ottman**	3:40 – 4:10	**Rachel Diethorn**
11:20 – 11:50	**Courtney Gibbons**	4:20 – 4:50	**Daniel Smolkin**
12:00 – 12:30	**Alessio Sammartano**		

Dinner at Phoebe's Restaurant 6:30 pm

Rachel Diethorn, Syracuse University
Self-Dual Complete Resolutions
Abstract: In this talk, I will give motivation for the study of self-dual complete resolutions and discuss some preliminary work I have done on the topic. In particular, I will give a class of modules over a local ring which have self-dual complete resolutions and briefly discuss the construction.

Courtney Gibbons, Hamilton College
Boij-Soederberg Decompositions of Complete Intersections
In this talk we introduce a recursive decomposition algorithm for the Betti diagram of a complete intersection using the diagram of a complete intersection defined by a subset of the original generators. This alternative algorithm is the main tool that we use to investigate stability and compatibility of the Boij-Soederberg decompositions of related diagrams; indeed, when the biggest generating degree is sufficiently large, the alternative algorithm produces the Boij-Soederberg decomposition.

Nathan Grieve, Michigan State University
On rational points, positivity and arithmetic of linear series
The recent literature has revealed significant connections between, on the one hand, diophantine and arithmetic aspects of linear series on projective varieties, and, on the other hand, measures of growth and positivity of line bundles. In this talk, I will motivate and report on these developments. One theme is that complexity of rational points should be measured on rational curves. Further, I will explain how these theorems can be interpreted using Chow forms and Okounkov bodies.

Kuei-Nuan Lin Penn State Greater Allegheny
Multi-Rees Algebras and Toric Dynamical Systems
In this talk, I would explain what is a toric dynamical system associated to a chemical reaction network. In the study of chemical reaction networks, the toric methods introduced by Gatermann were formalized by Craciun, Dickenstein, Shiu and Sturmfels in the paper, Toric Dynamical Systems in 2009. We then recall the muti-Rees algebra associated to a direct sum of ideals. Finally, we explore the relation between multi-Rees algebras and ideals that arise in the study of toric dynamical systems from the theory of chemical reaction networks. This is joint work with David Cox and Gabriel Sosa.

Eric Ottman, Syracuse University
Homology over a complete intersection via the generic hypersurface
We study homological properties and constructions for modules over a complete intersection ring $Q/(f_1, \dots, f_c)$ by way of the related generic hypersurface ring $Q[T_1, \dots, T_c]/(f_1T_1 + \cdots + f_cT_c)$. The advantage of this approach is that over a hypersurface free resolutions are eventually 2-periodic, given by matrix factorizations, and are thus relatively easy to understand. In particular, we will discuss the

relationship between Tor groups over these rings, inspired by recent work of Bergh and Jorgensen, and building on cohomological results of Burke and Walker in 2012.

Charles Paquette, RMC Canada

A quiver construction of some subalgebras of asymptotic Hecke algebras

Lusztig defines an asymptotic Hecke algebra J from a Coxeter system (W, S). This is an algebra that is defined using the Kazhdan-Lusztig (KL) basis of the corresponding Hecke algebra of (W, S). Even though these KL bases are generally hard to understand, there is a two-sided cell C of W that gives rise to a nice subalgebra J_C of J having rich combinatorics and whose algebraic description does not use KL bases. We will see that J_C has a presentation using a quiver with relations, and this allows one to study the representation theory of J_C (and of J) from another perspective. Using quiver representations, we will see that the classification of simple modules, which falls into three categories (finite type, bounded type and unbounded type), can be characterized completely using the shape of the weighted graph G of (W, S). This is joint work with I. Dimitrov, D. Wehlau and T. Xu.

Alessio Sammartano, Notre Dame

Maximal syzygies in Hilbert schemes of complete intersections

Let $d_1, \ldots, d_c$ be positive integers and consider the monomial complete intersection $Y = \mathrm{Proj}(k[x_1, \ldots, x_{n+1}]/(x^{d_1}, \ldots, x^{d_c})) \subseteq \mathbb{P}^n$. For each Hilbert polynomial $p(z)$ we construct a distinguished point in the Hilbert scheme $\mathrm{Hilb}^{p(z)}(Y)$, which we call the expansive point. This point achieves the largest possible syzygies among all subschemes Z in $\mathrm{Hilb}^{p(z)}(Y)$. Assuming the validity of the Lex-plus-powers conjecture, the expansive point provides uniform sharp upper bounds for the syzygies of subschemes Z in $\mathrm{Hilb}^{p(z)}(X)$ for all complete intersections $X = X(d_1, \ldots, d_c) \subseteq \mathbb{P}^n$. In some cases, the expansive point achieves extremal Betti numbers for the infinite free resolutions associated to a subscheme in $\mathrm{Hilb}^{p(z)}(Y)$. Our approach is new even in the special case $Y = \mathbb{P}^n$ where it provides new results and simpler proofs of known theorems. This is a joint work with Giulio Caviglia.

Daniel Smolkin, University of Utah

Symbolic powers via test ideals

An important problem in commutative algebra is studying the relationship between symbolic and ordinary ideals. One striking result in this direction was found by Ein-Lazarsfeld-Smith, who showed that for regular rings in characteristic 0, the dn-th symbolic power of any ideal is contained in the n-th ordinary power of that ideal, where d is the dimension of the ring. Their method proved to be quite powerful, and was adapted to the positive characteristic setting by Hara and the mixed characteristic setting by Ma and Schwede. However, all of this work was done in the regular setting. This is because the above method relies on the so-called subadditivity property of test ideals, which only holds for regular rings.

In this talk, we will discuss an approach to extending Ein-Lazarsfeld-Smith's result to the non-regular setting by using a new subadditivity formula for test ideals. Recent joint work with Carvajal-Rojas, Page, and Tucker shows that this approach works for a large class of rings, including all Segre products of polynomial rings. Time permitting, we will discuss how applying this approach to any toric variety reduces to solving a certain combinatorial problem.

John Wiltshire-Gordon Wisconsin, Madison

Computing the tail of an FI-module

FI-modules, and representation stability techniques generally, are enabling new algebraic computations in several mathematical domains. This talk focuses on an analogy between FI-modules and modules for the polynomial ring $k[t]$, and is organized by running examples in each context. Along the way, we explain how to write a presentation matrix for an FI-module, and how to use a presentation matrix to compute a Hilbert series. Time and technology permitting, this talk includes computer demonstrations using Sage and Macaulay2.