

## Seminar & Events Bulletin: Student Algebraic Geometry

01-01-2013 to 06-30-2013

Monday, January 14, 2013

3:00pm-4:00pm **Student Algebraic Geometry** -- Zhixian Zhu (UM) *An Invitation to Fujita's Conjectures 1* -- 4088 East Hall

Monday, January 28, 2013

3:00pm-4:00pm **Student Algebraic Geometry** -- Linquan Ma (UM) *Fujita's conjecture in characteristic  $p$*  -- 4088 East Hall

Monday, February 04, 2013

3:00pm-4:00pm **Student Algebraic Geometry** -- Xin Zhou (UM) *Asymptotic Schur decomposition of Veronese Syzygies* -- 4088 East Hall

Monday, February 11, 2013

3:00pm-4:00pm **Student Algebraic Geometry** -- Nic Ford (UM) *Positroid varieties and Schubert calculus* -- 4088 East Hall

Monday, February 18, 2013

3:00pm-4:00pm **Student Algebraic Geometry** -- Felipe Perez (UM) *The Briancon-Skoda Theorem* -- 4088 East Hall

Monday, February 25, 2013

3:00pm-4:00pm **Student Algebraic Geometry** -- David Stapleton (UM) *Introduction to Toric Variety Invariants from Algebraic Topology* -- 4088 East Hall

Monday, March 18, 2013

3:00pm-4:00pm **Student Algebraic Geometry** -- Brooke Ullery (UM) *Introduction to Boij-Soderberg Theory* -- 4088 East Hall

Monday, March 25, 2013

3:00pm-4:00pm **Student Algebraic Geometry** -- David Stapleton (UM) *Toric Blow-ups* -- 4088 East Hall

Monday, April 01, 2013

3:00pm-4:00pm **Student Algebraic Geometry** -- Robert Auffarth (Pontificia Universidad Catlica de Chile) *Elliptic curves in abelian varieties* -- 4088 East Hall

Monday, April 08, 2013

3:00pm-4:00pm **Student Algebraic Geometry** -- Robert Silversmith (UM) *Excess Intersections* -- 4088 East Hall

Monday, April 15, 2013

3:00pm-4:00pm **Student Algebraic Geometry** -- Zhixian Zhu (UM) *Zariski decomposition* -- 4088 East Hall

Monday, April 22, 2013

3:00pm-4:00pm **Student Algebraic Geometry** -- Xiaolei Zhao (UM) *Dual cone of pseudo-effective divisor cone* -- 4088 East Hall

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**Abstracts**

**Student Algebraic Geometry**

**Monday, January 14, 2013, 3:00pm-4:00pm**

**4088 East Hall**

**Zhixian Zhu (UM)**

*An Invitation to Fujita's Conjectures 1*

Let  $X$  be a smooth projective variety and  $A$  an ample line bundle on  $X$ . Fujita conjectured how large  $m$  we must choose to have the adjoint linear series  $|K_X + mA|$  globally generated or very ample. In this talk, we will do the baby case of Fujita's Conjectures for curves by using Riemann-Roch and mention some results for higher dimensional varieties. For instance, Fujita's Conjectures in positive characteristic or for toric varieties will be covered later in our student seminar.

**Student Algebraic Geometry**

**Monday, January 28, 2013, 3:00pm-4:00pm**

**4088 East Hall**

**Linquan Ma (UM)**

*Fujita's conjecture in characteristic  $p$*

We will discuss a result by K.E.Smith on Fujita's freeness conjecture in positive characteristic. If  $X$  is a smooth projective variety of dimension  $d$  over an algebraically closed field of characteristic  $p$  and  $L$  is an ample globally generated line bundle on  $X$ , then  $K_X + mL$  is globally generated when  $m \geq d+1$ . The original proof uses tight closure, I will present D.Keeler's simplified proof of this result and some generalizations (for example Fujita's very ampleness conjecture in this setting).

**Student Algebraic Geometry**

**Monday, February 04, 2013, 3:00pm-4:00pm**

**4088 East Hall**

**Xin Zhou (UM)**

*Asymptotic Schur decomposition of Veronese Syzygies*

A very gentle introduction to the problem Mihai and I try to solve in this joint paper.

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### **Student Algebraic Geometry**

**Monday, February 11, 2013, 3:00pm-4:00pm**

**4088 East Hall**

**Nic Ford (UM)**

*Positroid varieties and Schubert calculus*

Take a bunch of vectors in a vector space, and impose some linear conditions on them --- for example, say that vectors 1, 3, 5, and 6 need to span a subspace of dimension 2, and that vectors 2 and 4 have to be parallel. When the conditions are all on left- or right-justified collections of vectors, the study of these arrangements is called Schubert calculus. In general, imposing these linear conditions specifies some subvariety of the Grassmannian, and computing its cohomology class will help us solve enumerative problems of this type. This talk will be about some of the progress that's been made in this direction, and some half-baked ideas for extending it further.

### **Student Algebraic Geometry**

**Monday, February 18, 2013, 3:00pm-4:00pm**

**4088 East Hall**

**Felipe Perez (UM)**

*The Briancon-Skoda Theorem*

The Briancon-Skoda Theorem gives bounds on how large the integral closure of powers of an ideal can be. In this talk we give a proof of this theorem that involves multiplier ideals.

### **Student Algebraic Geometry**

**Monday, February 25, 2013, 3:00pm-4:00pm**

**4088 East Hall**

**David Stapleton (UM)**

*Introduction to Toric Variety Invariants from Algebraic Topology*

The explicit, hands-on, combinatorial nature of a toric variety makes it possible to access some of its topological invariants. In this talk we will introduce toric varieties and compute their fundamental groups and euler characteristics from the information in their fans. For example, we will exhibit a complex algebraic variety which has torsion fundamental group.

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**Monday, March 18, 2013, 3:00pm-4:00pm**  
**4088 East Hall**  
**Brooke Ullery (UM)**

*Introduction to Boij-Soderberg Theory*

Every graded module has a corresponding Betti table: an invariant describing the structure of its minimal free resolution. We can think of these tables as lying in an infinite-dimensional rational vector space. A natural question that arises is which elements of this vector space are realized as Betti tables of modules? Boij-Soderberg Theory attempts to answer this question (among others).

**Student Algebraic Geometry**  
**Monday, March 25, 2013, 3:00pm-4:00pm**  
**4088 East Hall**  
**David Stapleton (UM)**

*Toric Blow-ups*

We will discuss the combinatorial data associated to blowing up a toric invariant subvariety of a toric variety.

**Student Algebraic Geometry**  
**Monday, April 01, 2013, 3:00pm-4:00pm**  
**4088 East Hall**  
**Robert Auffarth (Pontificia Universidad Catlica de Chile)**

*Elliptic curves in abelian varieties*

It is well known that the Jacobian of a curve is a principally polarized abelian variety, and the divisor that defines its polarization is irreducible. However, there are examples of Jacobians that are isomorphic as varieties to the product of elliptic curves, and so these must contain a divisor that is as "reducible as possible". We will discuss these examples, and find a nice criterion, using intersection theory, for an abelian variety to contain an elliptic curve.

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**Student Algebraic Geometry**  
**Monday, April 08, 2013, 3:00pm-4:00pm**  
**4088 East Hall**  
**Robert Silversmith (UM)**  
*Excess Intersections*

I'll start off with a reminder of how the intersection product works on the Chow ring of a (smooth, projective) variety. Computing intersections of subvarieties with this product usually requires verifying some sort of transversality property. In real life, though, subvarieties aren't always transverse. I'll discuss what we can still conclude. For example, the excess intersection formula expresses the intersection of two subvarieties in terms of both their Chow classes and other terms involving their normal bundles.

**Student Algebraic Geometry**  
**Monday, April 15, 2013, 3:00pm-4:00pm**  
**4088 East Hall**  
**Zhixian Zhu (UM)**  
*Zariski decomposition*

Zariski decomposition is a useful tool for the study of divisors on surface. In this talk, we will briefly explain several generalizations of Zariski decomposition on higher dimensional varieties.

**Student Algebraic Geometry**  
**Monday, April 22, 2013, 3:00pm-4:00pm**  
**4088 East Hall**  
**Xiaolei Zhao (UM)**  
*Dual cone of pseudo-effective divisor cone*

We will introduce a result of Boucksom-Demailly-Peternell-Paun describing the dual cone of pseudo-effective divisor cone. As a corollary, a numerical criteria of uniruled varieties will be proved. Then we will prove the BDPP result using an orthogonal property of Fujita approximation.