

# Giulio Caviglia

---

- Research Interests** Commutative algebra and its interactions with combinatorics, computational algebra and algebraic geometry. Recent work involves Koszul Algebras, Castelnuovo-Mumford regularity, properties of initial ideals, Gröbner bases, syzygies, Hilbert functions and Hilbert schemes.
- Education** UNIVERSITY OF KANSAS, Lawrence, KS, 2000-2004.  
Ph.D. in Mathematics, August 2004.  
Dissertation: *Koszul algebras, Castelnuovo-Mumford regularity and generic initial ideals*.  
Advisor: Craig Huneke.
- UNIVERSITY OF GENOA, Genoa, Italy, 1995-2000.  
Laurea *Summa cum Laude* in Mathematics, April 2000.  
Thesis: *On a class of Gorenstein algebras that are Koszul* (in Italian).  
Undergraduate advisors: Giuseppe Valla and Aldo Conca.
- Appointments** PURDUE UNIVERSITY, WEST LAFAYETTE, IN, 2014 - Present.  
Associate Professor.
- PURDUE UNIVERSITY, WEST LAFAYETTE, IN, 2007 - 2014.  
Assistant Professor.
- UNIVERSITY OF CALIFORNIA, BERKELEY, CA, 2005-07.  
*Charles B. Morrey, Jr.* Assistant Professor.
- MATHEMATICAL SCIENCES RESEARCH INSTITUTE (MSRI), Berkeley, CA, 2004-2005.  
Postdoctoral Fellow.
- Membership** MATHEMATICAL SCIENCES RESEARCH INSTITUTE (MSRI), Berkeley, general membership for the Commutative Algebra program, Fall 2012.
- Awards** NSA (MSP Standard Grant) 2015. *Problems on free resolutions and Hilbert functions*.  
Simons Collaboration Grants for Mathematicians (2011-2016). *Syzygies and Hilbert functions*  
Purdue PRF Summer Grant (2010).  
US Junior Oberwolfach Fellow (April 14- April 25 2009) (sponsored by NSF).  
Purdue PRF research grant 2009/2010 Melissa Lindsey (Ph.D Purdue 2011).  
Graduate Dissertation Fellowship, University of Kansas, 2003-2004  
U.G. Mitchell Graduate Scholarship, Mathematics, University of Kansas, 2001, 2002, 2003, 2004.  
The John Bunce Memorial Award, Department of Mathematics, University of Kansas, fall 2003.  
Fellowship from the *Istituto Nazionale di Alta Matematica*, “Francesco Severi” Rome, 2000-2003.
- Publications** *Componentwise regularity (I)* (with M. Varbaro), Journal of Pure and Applied Algebra, Vol. 219, Issue 1, January 2015, 175-182. DOI: 10.1016/j.jpaa.2014.04.017.  
*Poset Embedding of Hilbert functions and Betti numbers* (with M. Kummini), Journal of Algebra, Vol. 410 (2014) 244-257.

*A note on a conjecture by Kalai* (with A. Constantinescu and M. Varbaro), Israel J. Math., (July 2014), 5 pages. DOI: 10.1007/s11856-014-1115-y.

*Betti tables of  $p$ -Borel-fixed ideals* (with M. Kummini), J. Algebraic Combin. (2014) Vol. 39 (3), 711-718.

*Sharp Upper Bounds of the Betti numbers for a given Hilbert polynomial* (with S. Murai), Algebra and Number Theory, Vol. 7 (2013), No. 5, 1019-1064.

*Generic circuits sets and general initial ideals with respect to weights* (with E. Sbarra), J. of Commutative Algebra (2013), Vol. 5, No. 1, 49-62.

*Koszul property of projections of the Veronese cubic surface* (with A. Conca), Advances. in Math. (2013), **234**, 404-413.

*Poset embeddings of Hilbert functions* (with M. Kummini), Mathematische Zeitschrift (2013), **274**, Issue 3-4, 805-819.

*The pinched Veronese is Koszul*, J. Algebraic Combin. (2009), no. 4, 539-548.

*Some ideals with large projective dimension* (with M. Kummini), Proc. Amer. Math. Soc. **136** (2008), no. 2, 505-509.

*Some cases of the Eisenbud-Green-Harris conjecture* (with D. Maclagan), Math. Res. Lett. **15** (2008), no. 3, 427-433.

*Bounds on the Castelnuovo-Mumford regularity of tensor products*, Proc. Amer. Math. Soc. **135** (2007), 1949-1957.

*A Theorem of Eakin and Sathaye and Green's Hyperplane Restriction Theorem*, Commutative algebra, 1-5, Lect. Notes Pure Appl. Math. **244**, Chapman & Hall/CRC, Boca Raton, FL, (2006).

*Characteristic-free bounds for the Castelnuovo-Mumford regularity* (with E. Sbarra), Compositio Math. **141** (2005), 1365-1373.

**(In Press)**

*On Hilbert functions of general intersection of ideals* (with S. Murai), arXiv:1303.6030 [math.AC], accepted in Nagoya Math. Journal, 10 pages.

*Distractions of Shakin rings* (with E. Sbarra), arXiv:1308.4659 [math.AC], accepted in Journal of Algebra.

**(Submitted)**

*A general hyperplane restriction theorem and applications to reductions of ideals.*

*An upper bound for the multiplicity of almost complete intersections.*

*Zero-Generic initial ideals* (with E. Sbarra), arXiv:1303.5373 [math.AC].

*The Lex-Plus-Power inequality for local cohomology modules* (with E. Sbarra), arXiv:1208.2187 [math.AC].

**Works in Progress**

*Some cases of the Lex-Plus-Power conjecture*, in preparation.

*Uniform bounds for projective dimension and Castelnuovo Mumford regularity*, in preparation.

*A class of Gorenstein algebras that are Koszul*, in preparation.

*Length Embeddings and upper bounds for total Betti numbers* (with M. Lindsey), in preparation.

*Betti numbers of  $p$ -Lex ideals.* (with M. Kummini) in preparation.

*Extremal Betti numbers and sparse filter regular sequences*, in preparation.

**Invited Lectures at Advanced International Schools**

Series of 5 lectures on *Generic initial ideals* at the *School on Local Rings and Local Study of Algebraic Varieties* International Centre for Theoretical Physics, Trieste (Italy), May 24 - May 28, 2010.

Series of 3 lectures on *Free resolutions and generic initial ideals* at the Workshop in Combinatorial Algebra and mini course in Commutative Algebra. Halifax, Nova Scotia, Canada, June 2013.

**Summer Schools** Atlantic Association for Research in the Mathematical Sciences (AARMS) Summer School at Dalhousie University, Canada. *Gröbner bases*. Series of lectures, July 21- August 15, 2014.

**Selected Invited Talks** *International conference on commutative Algebra and its interaction to Combinatorics and Geometry*, December 16-20, 2013, Institute of Mathematics Hanoi, Vietnam.

*AMS special session "Combinatorial Commutative Algebra"* on October 5-6, 2013 University of Louisville, Louisville, KY.

*Representation Theory, Homological Algebra, and Free Resolutions*, MSRI, Berkeley, February 11-17 2013.

*MSRI Colloquium*, Berkeley, Oct 18, 2012.

*Commutative Algebra Seminar* U.C. Berkeley, October 9, 2012.

*Joint seminar: Algebra and Linguistics* University of Genoa (Italy), July 9, 2012.

*Algebra seminar*, University of Pisa, (Italy), June 19, 2012.

*Conference on Commutative Algebra and related topics*, University Genoa (Italy), June 08-09 2012.

*Mathematisches Institut colloquium, Universität Basel*, Basel (Switzerland), May 31, 2012.

*AMS Sectional Meeting*, Univ. of Kansas, March 30 - April 1, 2012.

*CMS Winter Meeting*, Toronto, Ontario (Canada), December 9-12, 2011.

*Route 81 conference*, Cornell, September 24, 2011.

*Midwest Commutative Algebra and Geometry Conference*, Purdue, May 22 -26, 2011.

*Commutative Algebra and its Interaction with Algebraic Geometry*, CIRM (Centre International de Rencontres Mathématiques), Luminy (France), November 2010.

*Workshop on Local Rings and Local Study of Algebraic Varieties* Trieste ICTP (Italy), June 4 - June 11, 2010.

*National Meeting of Modern Algebra*, Rome (Italy), May 24-28, 2010.

*Workshop on Kommutative Algebra* at Mathematisches Forschungsinstitut Oberwolfach (Germany), April 2009.

*A Macaulay 2 Conference*, Cornell University, March 16-19, 2008.

*Commutative algebra and its interaction with algebraic geometry*, CIRM, Luminy (France), October 2008

*Hilbert functions and syzygies in commutative algebra and combinatorics, a conference in honor of Juergen Herzog on the occasion of his 65th birthday*, Cortona (Italy), September 2007.

*Workshop on Syzygies and Hilbert Functions* at the Banff International Research Station (Canada), October 2006.

*Commutative Algebra and its Interaction with Algebraic Geometry*, CIRM (Centre International de Rencontres Mathématiques), Luminy (France), May 2006.

Special Session on *Combinatorial Algebraic Geometry*, at the 2006 Spring Central Sectional Meeting of the AMS, University of Notre Dame, April 2006.

Special Session on *Syzygies in Commutative Algebra and Geometry* at the 2006 Joint Mathematics Meetings, San Antonio, January 2006.

*Midwest Algebra, Geometry and their Interactions Conference* (MAGIC05), University of Notre

Dame, October 2005.

Workshop on *Kommutative Algebra* at Mathematisches Forschungsinstitut Oberwolfach (Germany), April 2005.

*Workshop on Resolutions* (part of the Route 81 Conference on Commutative Algebra and Algebraic Geometry), Cornell University, October 2004.

School on *Commutative Algebra and Interactions with Algebraic Geometry and Combinatorics*, Trieste, (Italy), June 2004.

*Giornate di Geometria Algebrica ed argomenti correlati VII* (Conference for young Italian algebraic geometers), Rimini, (Italy), May 2004.

Lisbon Conference on *Commutative Algebra*, Lisbon, (Portugal), June 2003.

*Algèbre commutative et ses interactions avec la géométrie algébrique*, CIRM (Centre International de Rencontres Mathématiques) Luminy (France), June 2003.

## Seminars at Purdue

*Commutative Algebra Seminar*. Bound for the multiplicity of almost complete intersections, 9/30/2013.

*Commutative Algebra Seminar*. A counterexample to a conjecture of K. Pardue, 9/23/2013.

*Commutative Algebra Seminar*. On a conjecture by Kalai, 9/3/2013.

*Bridge to Research Seminar*. Counting faces of simplicial complexes, 2/25/2013.

*Commutative Algebra Seminar*. Some Cases of the Lex-Plus-Powers conjecture, 4/4/2012.

*Commutative Algebra Seminar*. Koszul property of projections of the Veronese cubic surface, 9/28/2011.

*Commutative Algebra Seminar*. Upper bounds for Hilbert functions of local cohomology modules, 12/8/2010.

*Student Commutative Algebra Seminar*. Uniform bounds for projective dimension and regularity (An informal discussion on one of the research topics of this summer MRC in Snowbird), 5/3/2010.

*Commutative Algebra Seminar*. Weak term orders and the corresponding buchberger algorithm, 2/24/2010.

*Bridge to Research Seminar*. Hilbert functions and graded free resolutions, 10/26/2009.

*Commutative Algebra Seminar*. Poset embeddings of Hilbert functions, 4/15/2009.

*Commutative Algebra Seminar*. A sharp upper bound for the multiplicity of almost complete intersections, 2/27/2009.

*Commutative Algebra Seminar*. The Eakin-Sathaye theorem for joint reductions, 1/30/2009.

*Commutative Algebra Seminar*. On the Lex Plus Powers conjecture (II), 1/23/2009.

*Commutative Algebra Seminar*. The Mermin-Murai proof of the Lex Plus Powers conjecture in the monomial case, 1/16/2009

*Commutative Algebra Seminar*. Inequalities for dimensions of tor modules, 9/5/2008.

*Commutative Algebra Seminar*. Computing extremal Betti numbers, 8/29/2008.

## Postdocs

Manoj Kummini, 2008-2011.

## Ph.D. students

Melissa Lindsey, 2008-2011.

Ph.D. Thesis (Purdue 2011): *Betti numbers, Hilbert series and the strong Lefschetz property*.

Gabriel Sosa, since 2011.

Christina Jamroz, since 2013.

Alessio Sammartano, since 2013.

**Undergraduate  
students** Ellen Wongso, 2013.

- Committees**      Ph.D. Advisory Committee Co-Chair for *Melissa Lindsey* and *Vivek Mukundan*.  
Ph.D. Advisory Committee Chair for *Gabriel Sosa*.  
Ph.D. Advisory Committee Member for *Christine Berkesch*, *Paolo Mantero*, *Young Su Kim*, *Amanda Kinzel*, *Lan Nguyen*, *Jacob Boswell*, *Jonathan Montano* and *Rodrigo de Andrade*.  
Master Advisory Committee Member for *Shreekant Gayaka*, *Paolo Mantero*, *Joseph Frederick*, *Heintz Kamber*, *Jonathan Montano* and *Jeffrey Craig*.
- Other Professional Activities**      Referee for *Journal of Algebra*, *Proceeding of the AMS*, *Communications in Algebra*, *Compositio Mathematica*, *Journal of Commutative Algebra*, *Proceedings of the Abel Symposium*, *Mathematical Research Letters*, *Journal of Algebraic Combinatorics*, *Electronic Journal of Combinatorics*, *International Mathematics Research Notices* .  
Member of the *Unione Matematica Italiana*.
- Teaching at Purdue**      **Undegradute courses:**  
MA26500 *Linear Algebra*: Spring 2008 (2 sects.), Fall 2008 (2 sects.), Spring 2009, Spring 2010.  
MA30100 *An Introduction To Proof Through Real Analysis*: Fall 2010, Spring 2011, Spring 2012, Spring 2013, Fall 2013.  
MA37500 *Introduction To Discrete Mathematics*: Spring 2011, Spring 2013, Fall 2013.  
**Graduate courses:**  
MA69000 *Topics In Algebra: Gröbner Bases*: Fall 2009.  
MA69000 *Topics In Algebra: Polytopes, Rings, and K-Theory*: Part (1) Fall 2011, Part (2) Spring 2012.  
MA57500 *Graph Theory*: Fall 2009, Fall 2010, Fall 2011, Spring 2014.