

# Brandt A.L. Gaches

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## *Astrophysics through Astrochemistry*

### Research Interests

Local star formation; molecular cloud dynamics; computational hydrodynamics; astrochemistry; astrostatistics; cosmic rays

### Education

2008-2012 **B.S. Astronomy & Physics**, *University of Arizona*, Tucson, AZ, .

*Awards* Weaver Award for Undergraduate Research  
Glenn Purviance Scholarship in Physics  
Slipher Scholarship

2012- **PhD Astronomy**, *University of Massachusetts*, Amherst, MA.

*Awards* Massachusetts Space Grant Fellowship, Summer 2013  
Mary Dailey Irvine Travel Grant - 2014, 2017, 2018  
Award Winning Poster - UMass HPC Day, November 14, 2014  
Massachusetts Space Grant Fellowship, Summer 2015  
AAS International Travel Grant - 2015, 2018

*Other* Mary Dailey Irvine Travel Grant Committee - Graduate Student Representative - 2015  
Graduate Student Senator - Fall 2016 → Spring 2017

### Research Experience

Fall 2012- Summer 2013 Implemented atomic cross section calculations for use in Discrete Simulation Monte-Carlo methods for rarefied fluids.

Fall 2013- Summer 2015 Research into the statistical correlations between density and velocity structures in molecular cloud simulations traced by different molecules.

Summer 2015- Modified 3D Ray tracing algorithms in ORION2 code to calculate time-dependent UV field from protostellar sources. Created novel adaptive 6-ray approach for calculating extinction from background radiation sources

2016-2017 Astrochemical modeling of the effects of far-ultraviolet (FUV) radiation from protoclusters on natal molecular cloud gas, especially with regard to CO chemistry

2018- Developed novel theoretical model for cosmic rays accelerated at protostellar accretions shocks and their propagation through the protostellar core.

2018- Added cosmic ray attenuation into the 3D-PDR astrochemistry code to model the astrochemical effects of the attenuated cosmic rays, and of cosmic rays leaking from protoclusters. First implementation of cosmic ray attenuation into an astrochemistry code.

Languages Fortran 95, C, C++, Python

### Teaching Experience

Fall 2011-Spring 2012 Physics Discovery: Physics outreach program through Flandrau Planetarium for K-12 students, run through Dr. Srinivas Manne.

Fall 2012 Teaching Assistant for Gen. Ed astronomy labs at University of Massachusetts - Amherst, run by Thomas Burbine. Assisted students during labs and graded assignments.

- Spring 2013 Lead Teaching Assistant for Team Based Learning lab, run by Stephen Schneider. Assisted and taught lab classes.
- Summer 2016 Taught lectures for the University of Massachusetts astronomy summer school for high school students, organized by Dr. Stephen Schneider.
- & 2017

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## Publications

**Gaches** & Offner, Rosolowsky, & Bisbas 2015, ApJ, 799, 235, *Astrochemical Correlations in Molecular Clouds*

**Gaches**, & Offner, 2018, ApJ, 854, 156, *A Model for the CO-H<sub>2</sub> Conversion Factor of Molecular Clouds with Embedded Star Clusters*

**Gaches** & Offner, 2018, ApJ, 861, 87, *Exploration of Cosmic-ray Acceleration in Protostellar Accretion Shocks and a Model for Ionization Rates in Embedded Protoclusters*

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## Research Presentations

- Poster AAS Summer 2012 - Anchorage, AK. *Tensor Smoothed Particle Hydrodynamics.*
- Oral - AAS Summer 2014 - Boston, MA. *Astrochemical Correlations in Molecular Clouds.*
- Contributed
- Poster NRAO Filaments Conference 2014 - Charlottesville, VA. *Astrochemical Correlations in Molecular Clouds.*
- Poster UMass HPC Day 2014 - Dartmouth, MA. *Astrochemical Correlations in Molecular Clouds.*
- Oral - Invited UMass, Amherst HPC Seminar - April 15, 2015
- Poster From Clouds to Protoplanetary Disks: The Astrochemical Link - Berlin, Germany, October 2015
- Poster From Stars to Massive Stars - Gainesville, Florida, USA, April 2016
- Attendee Krome School 2016 - Florence, Italy
- Poster European Week of Astronomy and Space Science 2017 - Prague, Czech Republic, June 2017
- Oral - The Olympian Symposium - Spring, 2018
- Contributed