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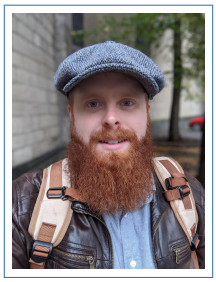

Brandt A.L. Gaches

Astrophysics through Astrochemistry

Research Interests

Astrochemistry; molecular clouds; cosmic rays; computational hydrodynamics; radioactive nuclei and planet habitability

Education

2012-2019 **PhD Astronomy**, *University of Massachusetts*, Amherst, MA.
Advisor Prof. Stella Offner
Title The Impact of Stellar Feedback on Astrochemistry
2008-2012 **B.S. Astronomy & Physics**, *University of Arizona*, Tucson, AZ.
Advisors Prof. Phil Pinto & Prof. Romeel Davé
Title Tensor Smoothed Particle Hydrodynamics

Professional Affiliations

Sept 2022 - Cosmic Origins Fellow, Chalmers University of Technology, Gothenburg, Sweden
Sept 2019 - Sept 2022 Postdoctoral Researcher, Universität zu Köln
2019 - Member, Center for Planetary Systems Habitability, University of Texas at Austin
2017-2019 Visiting Graduate Student, University of Texas at Austin
2012-2019 Graduate Student, University of Massachusetts at Amherst

Professional Organizations

2023- International Astronomical Union
2021- Astronomische Gesellschaft
2021- European Astronomy Society

Publications

Gaches, Grassi, Vogt-Geisse, Bovolenta, Vallance, Heathcote, Padovani, Bovino, Gorai, 2024, A&A, 684, A41, *The Astrochemistry Low-energy Electron Cross-Section (ALeCS) database I. Semi-empirical electron-impact ionization cross-section calculations and ionization rates*

Submitted Hsu, Tan, Holdship, Xu, Viti, Wu, **Gaches**, 2023, MNRAS Submitted, arXiv:2308.11803, *GMC Collisions As Triggers of Star Formation. IX. Chemical Evolution*

Padovani, **Gaches**, *Cosmic Rays: Physics, Chemistry, and Computational Challenges*. Chapter in *Astrochemical Modelling: Practical aspects of microphysics in numerical simulations*, 2023, Elsevier. Editors: Stefano Bovino and Tommaso Grassi, ISBN: 9780323917469

Panessa, Seifried, Walch, **Gaches**, Barnes, Bigiel, Neumann, 2023, MNRAS, 523, 6138, *The evolution of HCO^+ in molecular clouds using a novel chemical post-processing algorithm*

Gaches, Walch, Wünsch, Mackey, MNRAS, 522, 4674, 2023, *Tree-based solvers for adaptive mesh refinement code FLASH – IV: An X-ray radiation scheme to couple discrete and diffuse X-ray emission sources to the thermochemistry of the interstellar medium*

Gaches, Bialy, Bisbas, Padovani, Seifried, Walch, A&A, 2022, 664, A150, *Cosmic-ray-induced H2 line emission: Astrochemical modeling and implications for JWST observations*.

Gaches, Bisbas, Bialy, A&A, 2022, 658, A151, *The impact of cosmic-ray attenuation on the carbon cycle emission in molecular clouds*.

Li, P.S., Cunningham, **Gaches**, Klein, Krumholz, Lee, McKee, Offner, Rosen, Skinner, JOSS, 6(68), 3771, 2021, *ORION2: A magnetohydrodynamics code for star formation*.

Gaches, Walch, Lazarian, ApJL, 2021, 917, L39, *CRAFT (Cosmic Ray Acceleration From Turbulence) in Molecular Clouds*

Yun, Lee, J., Evans, Offner, Heyer, Cho, **Gaches**, Yang, Chen, Choi, Y., Lee, Y., Baek, Choi, M., Kim, Kang, Lee, S., Tetematsu, ApJ Accepted, 2021, *TIMES II: Investigating the Relation Between Turbulence and Star-forming Environments in Molecular Clouds*

Yun, Lee, J. , Choi, Evans, Offner, Heyer, **Gaches**, Lee, Y-H., Baek, Choi, Kang, Lee, S. , Tatematsu, Yang, Chen, Lee, Y., Jung, Lee, C., Cho, 2021, ApJ, 256, 16 , *TIMES I: a Systematic Observation in Multiple Molecular Lines Toward the Orion A and Ophiuchus Clouds*

Fitz Axen, Offner, **Gaches**, Fryer, Hungerford, Silsbee, 2021, ApJ, 915, 43, *Transport of Protostellar Cosmic Rays in Turbulent Dense Cores*

Gaches, Walch, Offner & Münker, 2020, ApJ, 898, 79, *Aluminum-26 Enrichment in the Surface of Protostellar Disks Due to Protostellar Cosmic Ray*, **Featured in Sky & Telescope Magazine.**

Gaches, Offner & Bisbas, 2019, ApJ, 883, 190, *The Astrochemical Impact of Cosmic Rays in Protoclusters II: CI-to-H_2 and CO-to-H_2 Conversion Factors*

Offner, **Gaches**, Holdship, 2019, ApJ, 883, 121, *Impact of Cosmic-Ray Feedback on Accretion and Chemistry in Circumstellar Disks*

Gaches, Offner & Bisbas, 2019, ApJ, 878, 105, *The Astrochemical Impact of Cosmic Rays in Protoclusters I: Molecular Cloud Chemistry*

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

Gaches, & Offner, 2018, ApJ, 854, 156, *A Model for the CO-H2 Conversion Factor of Molecular Clouds with Embedded Star Clusters*

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

Organization of Conferences

Splinter *"Bridging Theory and Observations of the Interstellar Medium"* at the Annual Meeting of the Astronomische Gesellschaft 2023. Co-Convener. Sept 15, 2023.

Conference *"The Olympian Symposium: Star formation in the era of JWST"*. SOC Member. Katerini, Greece, May 29 - June 2, 2023.

Splinter *"Impact of Cosmic Rays on the Physics and Chemistry of Dense Molecular Gas"* at the Annual Meeting of the Astronomische Gesellschaft 2021. Principle Convener. Virtual, Sept 13, 2021.

Awards

Mary Dailey Irvine Travel Grant - 2014, 2017, 2018

Award Winning Poster - UMass HPC Day, November 14, 2014

AAS International Travel Grant - 2015, 2018

Massachusetts Space Grant Fellowship, Summer 2015

Massachusetts Space Grant Fellowship, Summer 2013

Weaver Award for Undergraduate Research

Glenn Purviance Scholarship in Physics

Slipher Scholarship

Telescope Proposals

CoI Far-Infrared Spectroscopy Space Telescope (FIRSST) NASA APEX 2023 call, proposed FIR telescope. SO3 (cores) theory/models co-lead.

CoI JWST. Accepted for 13 hours, later cancelled. *Does star formation require molecular gas?*, ID 3162. PI: Simon Glover

CoI JWST. Allocated 62 hours. *The JWST Whirlpool Galaxy Treasury*, ID 3435. PI: Karin Sandstrom

CoI ALMA. *The First Ever Low Metallicity PDR Benchmark: Revealing the CO-Dark H2*. PI: Karin Sandstrom

CoI JWST. Allocated 16 hours. *The First Ever Low Metallicity PDR Benchmark*, ID 2521. PI: Karin Sandstrom

CoI TRAO-KSP. Allocated 1451 Hours. *mapping Turbulent properties In star-forming MolEcular clouds down to the Sonic scale (TIMES)*. PI: Jeong-Eun Lee

Co-PI IRAM 30m. Allocated 11 hours. *Probing Complex Chemistry under High Energy Irradiation in Cygnus X-3's "Little Friend"*. PIs: Lia Corrales & Brandt Gaches

Computing allocations

NAISS The HADES Simulations. Allocated 100k CPU-hr/mo on the Dardel HPC machine. Proposal SNIC 2022/5-654. Ended Sept 2023

Recent Research Presentations

Talk The Olympian Symposium: Star Formation in the Era of JWST, June 1, 2023.

Invited NASA's Universe of Learning: Science Briefing, December 1, 2022, virtual

Invited Cosmic Rays 2: The Salt of Star Formation, Florence, Italy, November 10, 2022

Poster From Stars to Galaxies II, Gothenburg, Sweden, June 20 - 24, 2022

Talk Midwest Magnetic Field Workshop 2022, Virtual, May 26, 2022

Talk Early Phases of Star Formation, Ringberg Castle, Germany, April 27, 2022

Invited Kapteyn Institute Lunch Seminar, Virtual, April 6, 2022

Invited Center for Astrochemical Studies Seminar, Virtual, September 27, 2021

Talk Astrochemical Frontiers 2021, Virtual, July 5, 2021

Talk Midwest Magnetic Field Workshop 2021, Madison, WI, Virtual, June 14, 2021

Invited Webinar SSDC, Agenzia Spaziale Italiana, Virtual, June 10, 2021

Talk	ISM 2021, Virtual (Beirut), May, 2021
Invited Talk	ANU Astrocoffee, Canberra, Australia, November, 2020
Talk	ESO Conference: Threats from the surroundings. Virtual, November 2020
Talk	Astrochemistry Discussions, May 6, 2020.
Invited Talk	Seminar at the Center for Astrochemical Studies, Max-Planck-Institut für extraterrestrirsche Physik, Garching, Germany, January 2020

Teaching and Mentoring Experience

Students Co-advisor

Master's	*Daria Paul*. Subject: Radioactive nuclei transport in molecular clouds and impact on habitability.
Bachelor's	*Franziska Kern*. Subject: Impact of protostellar x-rays on dense molecular gas.
REU Supervisor	*Shushmi Chowdhury*, Summer 2023, Chalmers Astrophysics & Space Sciences Summer (CASSUM)
REU Mentor	*Jonah Chaban*. Summer 2016, University of Massachusetts Summer REU program mentor

Teaching

2020	Tutorials for graduate level Star Formation Course, University of Cologne
Summer 2016 & 2017	Taught and organized lectures for the University of Massachusetts astronomy summer school for high school students, organized by Prof. Stephen Schneider.
Spring 2013	Lead Teaching Assistant for Team Based Learning lab, run by Prof. Stephen Schneider. Assisted and taught lab classes.
Fall 2012	Teaching Assistant for Gen. Ed astronomy labs at University of Massachusetts - Amherst, run by Dr. Thomas Burbine. Assisted students during labs and graded assignments.

Service

Science Evaluation

Journal referee: *The Astrophysical Journal*, *Astronomy & Astrophysics*, *Galaxies*, *Molecules*, *Universe*.

Grant evaluator and panel member for NASA funding call 2023 (Details confidential)

2020	LOC. SFB2023+ Workshop. Universität zu Köln.
2020	LOC. AstroML Day. Universität zu Köln.
2016 - 2017	Graduate Student Senator
2015	Mary Dailey Irvine Travel Grant Committee - Graduate Student Representative

Outreach

2022	NASA's Universe of Learning: Science Briefing, December 1, 2022
2021	Astronomy on Tap - Köln #8
2020	Astrochemistry Discussions
2017, 2019	Astronomy on Tap - Austin #42, #55
Fall 2011-Spring 2012	Physics Discovery: Physics outreach program through Flandrau Planetarium for K-12 students, run by Dr. Srinivas Manne.
2011-2012	Physics demonstrations at Physics Phun Night and through the Physics Bus at University of Arizona.