Ashley R. Bemis

Postdoctoral Fellow, Waterloo Centre for Astrophysics
University of Waterloo
abemis@waterloo.ca

Education:

PhD, McMaster University, Hamilton ON, Canada
Thesis: Dense Gas and Star Formation in Nearby Galaxies
Advisor: Dr. Christine Wilson
2020

MSc, Bonn University & Max Planck Institute for Radio Astronomy, Bonn, Germany
Thesis: Methanol as a Probe of Physical Conditions in Star Forming Regions
Advisors: Karl Menten, Friedrich Wyrowski
2013

BSc, *magna cum laude*, University of Massachusetts, Amherst, Amherst, MA, USA
Thesis: The Role of Convergent Gas Streams in Producing Star Formation
Advisors: Mark Heyer, Gopal Narayanan
2011

Employment:

Postdoctoral Fellow, Waterloo Centre for Astrophysics
March 2024 - present
University of Waterloo, Waterloo, ON, Canada

Postdoctoral Research Associate & Support Scientist, ALMA Local Expertise Group (Allegro)
November 2020 - December 2023
Leiden Observatory, Leiden University, Leiden, The Netherlands

Scientific Data Analyst, North American ALMA Science Center
January - August 2015
National Radio Astronomy Observatory, Charlottesville, VA, USA

Teaching:

McMaster University:

- Guest Lecturer, *Physics 2MN3: Media Numeracy*, 2019
- Teaching Assistant, *Physics 2MN3: Media Numeracy*, 2019
- Teaching Assistant, *ArtSci 2D06: Physics*, 2015 – 2019
- Teaching Assistant, *Astron 2B03: Big Questions*, 2015 – 2018
- Teaching Assistant, *Physics 1A03: Introductory Physics*, 2017 – 2018
- Teaching Assistant, *Physics 1AA3: Introduction to Modern Physics*, 2016

Guided Discoveries:

- Science Instructor, *AstroCamp*, Idyllwild, CA, USA, 2014

University of Massachusetts, Amherst:

- Teaching Assistant (incl. lecturing), *Astron 103: Observational Astronomy*, 2010
- Tutor, *Astronomy Help Desk*, 2009

Research Supervision:

- Simon Blasby (Bachelors), *Star Formation Rate in the Stripped Tail of Jellyfish Galaxy NGC 4858*, Phys 437b Research Project, University of Waterloo, 2025
- Simon Blasby (Bachelors), *Dynamics of Molecular Gas in the Stripped Galaxy NGC 4858*, Phys 437a Research Project, University of Waterloo, 2024
- Rashmi Gottumukkala (LEAPS Student), *The Radio Continuum - Star Formation Relation in COSMOS-XS*, Leiden/ESA Astrophysics Program, 2022
- Daria Trotsenko (LEAPS Student), *Molecular Gas and Star Formation in the Jellyfish Galaxy, IC3949*, Leiden/ESA Astrophysics Program, 2022
- Jia Wei Teh (LEAPS Student), *Beyond the Face Value of HCN Emission in the Nearest Major Merger*, Leiden/ESA Astrophysics Program, 2021
- Benjamin Silk and Rens Kievit (Bachelors), *Milky Way Clouds as Templates for Clouds in External Galaxies*, Leiden University, 2021

Outreach and Service:

Waterloo Centre for Astrophysics:

- AstroBubble planetarium presenter, ongoing
- Public lecture, Kitchener Public Library, 2024
- Phys 10: WCA Postdoc Panel, 2025
- Phys 10 Seminar Presenter, 2025

Leiden Observatory, Leiden, the Netherlands:

- Scientific Organizing Committee, Meeting of the ALMA Young Astronomers, 2023
- Organiser & Session Chair, Sixth Leiden ALMA Science Day Day, December 2022
- Co-chair, Leiden/ESA Astrophysics Program for Summer Students, Summer 2022
- Organiser, Leiden/ESA Astrophysics Program for Summer Students, 2021-2022
- Organiser, Fifth Leiden ALMA Science Day Day, November 2021
- Member, Leiden Observatory EDI Committee, 2021-2023
- Public lecture at Old Leiden Observatory, 2021
- Attendee and Session Chair, *Clash of the Titans: the Enigmatic Role of Mergers in Galaxy Evolution*, Lorentz Workshop, March 2021
- Speaker at Astronomy on Tap Leiden

McMaster University:

- Session Chair AAS 236
- Visiting speaker liaison for Promoting Inclusivity in Physics & Astronomy (PIPA), 2018-2020
- Member of McMaster Sidewalk Astronomy, 2015-2020
- Presenter at William J. McCallion Planetarium, 2015-2020
- Member of Promoting Inclusivity in Physics & Astronomy (PIPA), 2015-2020
- Volunteer at Girls in Science Day, McMaster University, 2015-2019

University of Massachusetts, Amherst:

- President of the Five College Astronomy Club, 2010-2011
- Member of the Five College Astronomy Club, 2008-2011
- Presenter at Orchard Hill Observatory, 2009-2011

Scholarships & Recognitions:

- ALMA Fellowship, 2020 (declined)
- Ontario Trillium Scholarship (Doctoral), $160,000 over 4yr, 2015-2019
- Best Poster, The Laws of Star Formation Conference, Cambridge, UK, 2018
- Bonn International Graduate School Scholarship, €1,200, 2011-2012
- Commencement Speaker, College of Natural Sciences, University of Massachusetts, Amherst, Astronomy Dept., 2011
- William F. Field Alumni Scholarship, University of Massachusetts, Amherst, $750, 2010
- Incentive Award, University of Massachusetts, Amherst, $20,000 over 4yr, 2007-2011
- Member of Commonwealth College, University of Massachusetts, Amherst Honors College, 2007-2011

Seminars & Invited Talks (Science):

- Queen's University, Kingston, ON, Canada, *Testing Star Formation Models in Nearby Galaxies: A Focus on Dense Gas*, February 2025
- Star Formation Workshop, McMaster University, Hamilton, ON, Canada *Testing Star Formation Models in Nearby Galaxies: A Focus on Dense Gas*, August 2024
- Waterloo Centre for Astrophysics, University of Waterloo, Waterloo, ON, Canada *Testing Star Formation Models in Nearby Galaxies*, March 2024
- Lund Galaxy Lunch Talk (Virtual), Lund University, *Does the HCN/CO ratio trace the star-forming fraction of gas? I. A comparison with analytical models of star formation*, March 2023
- AAS 236 (Virtual), *Connecting Observations of Molecular Line Ratios to Theories of Star Formation*, June 2020
- East Asian Observatory, Hilo, HI, USA, *Investigating Dense Gas and Star Formation at Different Scales: from Milky Way Molecular Clouds to the GMCs of the Antennae Galaxies (NGC 4038/39)*, July 2017

Seminars (Technical):

- ASTRON, Groningen, the Netherlands, *ALMA Science and Support in the Netherlands*, May 2023
- Allegro ALMA Proposal Preparation Day, Cycle 10, Leiden Observatory, Leiden, the Netherlands, March 2023
  - *The ALMA Observing Tool*
  - *ALMA's new capabilities: Band 1*
- Leiden ALMA Data Reduction Training Day, Leiden Observatory, Leiden, the Netherlands, tclean *Imaging Tutorial*, December 2022
- ALMA I-TRAIN[1] #17 (Virtual), *Introduction to* tclean, November 2022 (YouTube recording)
- Allegro ALMA Proposal Preparation Workshop, Cycle 9, Leiden Observatory, Leiden, the Netherlands, *The ALMA Observing Tool*, March 2022
- Allegro ALMA Proposal Preparation Workshop (Virtual), Cycle 8, *Introduction to Imaging ALMA Data*, March 2021 (YouTube Recording)

[1] Interactive Training in Reduction and Analysis of INterferometric data

Accepted Observing Programs:

- Roberts I.D., **Bemis A.R.**, Davis T., Hudson M.H., Ignesti A., McGee S.L., Parker L.C., van Weeren R.J., Zabel N., *The Coma Legacy Integral Field Survey (CLIFS): High-mass galaxy sample*, William Herschel Telescope, WEAVE semester 2024A2/B1, 25 hr (dark time)
- Ledger B., **Bemis A.R.**, Klimi O., Saito T., Wilson C.D. *Combining new and archival ALMA observations for dense gas and star formation studies in U/LIRGs*, ALMA Cycle 11, 2024.1.00317.S
- Wilson C.D., **Bemis A.R.**, Brunetti N., He H., Leroy A., Rosolowsky E., Schinnerer E., Sun J., *How do clouds regulate star formation? A detailed view of the Antennae merger*
  - ALMA Cycle 9, 2022.1.00077.S
  - ALMA Cycle 8, 2021.1.00439.S
- Roberts I.D., **Bemis A.R.**, Brown T., Ellison S., McGee A., Parker L., Spekkens K., Wilson C.D., Zabel N.,van Weeren R., *Resolving Molecular Gas and Star Formation in Coma Cluster Jellyfish*, ALMA Cycle 8 2021, 2021.1.00669.S
- Finn M., **Bemis A.R.**, Brogan C., Costa A., Indebetouw R., Johnson K., Wilson C.D. *Dense Gas Tracers in Nascent SSCs in the Antennae*, ALMA Cycle 7, 2019.1.01186.S
- Wilson C.D., Aalto S, Aladro R., **Bemis A.R.**, Harada N., Iono D., Michiyama T., Saito T., Sakamoto K., *Probing CN excitation and abundance in dense gas in luminous infrared galaxies*
  - ALMA Cycle 7, 2019.1.00018.S
  - ALMA Cycle 6, 2018.1.00493.S
- Wilson C.D., **Bemis A.R.**, Bigiel F., Brunetti N., Groves B., Herrera C., Kruijssen D., Leroy A., Rosolowsky E., Saito T., Schinnerer E., Schruba A., Sliwa K., *Adjusting the Reception of The Antennae: A Clear Look at GMCs in a Major Merger*, ALMA Cycle 6, 2018.1.00272.S
- **PI: Bemis A. R.**, Wilson C. D., *Investigating Dense Gas and Star Formation in the Antennae*, The Submillimeter Array, 2018B-S022
- **PI: Bemis A. R.**, Wilson C. D., *Constraining the Relationship Between HCN(4-3) Luminosity and Dense Gas Mass by Mapping Clumps and Cores in Galactic GMCs*, James Clerk Maxwell Telescope, 2018A (M18AP063)
- **PI: Bemis A. R.**, Wilson C. D., Rosolowsky E., Kirk H., RxA3m, *Multi-Line Analysis of Dense Gas in Cygnus X*, James Clerk Maxwell Telescope, 2018A (M18AP061)
- Johnson K., **Bemis A.R.**, Brogan C., Harris W., Kamenetzky J., Leroy A., Wilson C., *Understanding the Formation of Globular Clusters*
  - ALMA Cycle 5, 2017.1.01001.S
  - ALMA Cycle 4, 2016.1.00924.S
  - ALMA Cycle 3, 2015.1.00977.S
- **PI: Bemis A. R.**, Wilson C. D., *Multi-Line Analysis of Dense Gas in Aquila.*, James Clerk Maxwell Telescope, 2017B (M17BP036)
- **PI: Bemis A. R.**, Wilson C. D., Rosolowsky E., Kirk H., Gao Y., Jiang X.-J., *Constraining the Relationship Between HCN(4-3) Luminosity and Dense Gas Mass by Mapping Clumps and Cores in the Aquila Rift and Cygnus X Regions*, James Clerk Maxwell Telescope, 2017A (M17AP070)
- Wilson C.D., **Bemis A.R.**, Brogan C., Harris W., Johnson K. *Probing the earliest phases of massive star cluster formation in the Antennae system*, ALMA Cycle 4, 2016.1.00041.S
- **PI: Bemis A. R.**, Wilson C. D., Rosolowsky E., Nguyen-Luong Q., Gao Y., Jiang X.-J., *Constraining the Relationship Between HCN(4-3) Luminosity and Dense Gas Mass by Mapping Cores in the Aquila Rift*, James Clerk Maxwell Telescope, 2016B (M16BP010)

Refereed Publications:

[18] **Bemis**, Wilson, Sharda, Roberts, and He. "Does the HCN/CO ratio trace the star-forming fraction of gas?: II. Variations in CO and HCN emissivity". A&A 692 (Dec. 2024), A146.

[17] He, Wilson, Sun, Teng, Rosolowsky, and **Bemis**. "Unraveling the Mystery of the Low CO-to-H_2 Conversion Factor in Starburst Galaxies: RADEX Modeling of the Antennae". ApJ 971.2 (Aug. 2024), 176.

[16] Brunetti, Wilson, He, Sun, Leroy, Rosolowsky, **Bemis**, Bigiel, Groves, Saito, et al. "Cloud-scale molecular gas properties of the ANTENNAE merger: a comparative study with PHANGS-ALMA galaxies and NGC 3256". MNRAS 530.1 (May 2024), 597.

[15] Krahm, Finn, Indebetouw, Johnson, Kamenetzky, and **Bemis**. "Physical Properties of Molecular Clouds in the Overlap Region of the Merging Antennae Galaxies". ApJ 964.2 (Apr. 2024), 166.

[14] Raouf, Viti, García-Burillo, Richings, Schaye, **Bemis**, Nobels, Guainazzi, Huang, Schaller, et al. "Hydrodynamic simulations of the disc of gas around supermassive black holes (HDGAS) - I. Molecular gas dynamics". MNRAS 524.1 (Sept. 2023), 786.

[13] Yang, Gong, Menten, Urquhart, Henkel, Wyrowski, Csengeri, Ellingsen, **Bemis**, and Jang. "ATLASGAL: 3 mm class I methanol masers in high-mass star formation regions". A&A 675 (July 2023), A112.

[12] Wilson, **Bemis**, Ledger, and Klimi. "A nearly constant CN/HCN line ratio in nearby galaxies: CN as a new tracer of dense gas". MNRAS 521.1 (May 2023), 717.

[11] **Bemis** and Wilson. "Does the HCN/CO Ratio Trace the Star-forming Fraction of Gas? I. A Comparison with Analytical Models of Star Formation". ApJ 945.1 (Mar. 2023), 42.

[10] Roberts, Lang, Trotsenko, **Bemis**, Ellison, Lin, Pan, Ignesti, Leslie, and van Weeren. "LoTSS Jellyfish Galaxies. IV. Enhanced Star Formation on the Leading Half of Cluster Galaxies and Gas Compression in IC3949". ApJ 941.1 (Dec. 2022), 77.

[9] Scicluna, Kemper, McDonald, Srinivasan, Trejo, Wallström, Wouterloot, Cami, Greaves, He, et al. "The Nearby Evolved Stars Survey II: Constructing a volume-limited sample and first results from the James Clerk Maxwell Telescope". MNRAS 512.1 (May 2022), 1091.

[8] He, Wilson, Brunetti, Finn, **Bemis**, and Johnson. "Embedded Young Massive Star Clusters in the Antennae Merger". ApJ 928.1 (Mar. 2022), 57.

[7] Ledger, Wilson, Michiyama, Iono, Aalto, Saito, **Bemis**, and Aladro. "Observed CN and HCN intensity ratios exhibit subtle variations in extreme galaxy environments". MNRAS 504.4 (July 2021), 5863.

[6] Eden, Moore, Currie, Rigby, Rosolowsky, Su, Kim, Parsons, Morata, Chen, et al. "CHIMPS2: survey description and ^{12}CO emission in the Galactic Centre". MNRAS 498.4 (Nov. 2020), 5936.

[5] Wilson, Elmegreen, **Bemis**, and Brunetti. "The Kennicutt-Schmidt Law and Gas Scale Height in Luminous and Ultraluminous Infrared Galaxies". ApJ 882.1 (Sept. 2019), 5.

[4] Finn, Johnson, Brogan, Wilson, Indebetouw, Harris, Kamenetzky, and **Bemis**. "New Insights into the Physical Conditions and Internal Structure of a Candidate Proto-globular Cluster". ApJ 874.2 (Apr. 2019), 120.

[3] **Bemis** and Wilson. "Kiloparsec-Scale Variations in the Star Formation Efficiency of Dense Gas: The Antennae Galaxies (NGC 4038/39)". AJ 157.3 (Mar. 2019), 131.

[2] Tan, Gao, Zhang, Greve, Jiang, Wilson, Yang, **Bemis**, Chung, Matsushita, et al. "The MALATANG Survey: The L_{GAS}-L_{IR} Correlation on Sub-kiloparsec Scale in Six Nearby Star-forming Galaxies as Traced by HCN J = 4 → 3 and HCO^+ J = 4 → 3". ApJ 860.2 (June 2018), 165.

[1] Narayanan, Snell, and **Bemis**. "Molecular outflows identified in the FCRAO CO survey of the Taurus Molecular Cloud". MNRAS 425.4 (Oct. 2012), 2641.

Contributed Talks:

7. Bemis A.R., Wilson C.D., Brunetti N., Sun J., *Testing Star Formation Models in the Nearest Major Merger*, ALMA EU ARC Network All Hands Meeting, Kreuth, Germany, 2022
6. Bemis A.R., Wilson C.D., Brunetti N., Sun J., *Testing Star Formation Models in the Nearest Major Merger*, Nederlandse Onderzoekschool Voor Astronomie (NOVA) Network I Meeting (online), 2021
5. Bemis A.R., Wilson C.D., *Connecting Observations of Molecular Line Ratios to Theories of Star Formation*, AAS 235, Honolulu, HI, USA, 2020
4. Bemis, A.R., Wilson, C.D., Schirm, M. *Star Formation and Dense Gas in Extreme Environments with ALMA*. Views on the Interstellar Medium in Galaxies in the ALMA Era, Bologna, Italy, 2019
3. Bemis, A.R., Wilson, C.D., Schirm, M. *Investigating Dense Gas and Star Formation in the Antennae Galaxies (NGC 4038/39) using ALMA.* Star Formation in Different Environments: From Local Clouds to Distant Galaxies, ICISE, Quy Nhon, Vietnam, 2017
2. Bemis, A.R., Wilson, C.D., Schirm, M. *Investigating Dense Gas and Star Formation in the Antennae Galaxies (NGC 4038/39) using ALMA.* Canadian Astronomical Society Annual General Meeting, Winnipeg, MB, Canada, 2016
1. Bemis, A.R., Wilson, C.D., Schirm, M. *Investigating Dense Gas and Star Formation in the Antennae Galaxies (NGC 4038/39) using ALMA.* Great Lakes Cosmology Workshop, Hamilton, ON, Canada, 2016

Contributed Posters:

7. Bemis A.R., Wilson C.D., *A Multi-line Analysis of Dense Gas Tracers Across the Antennae.* ALMABO 2024: Views on the Multi-phase Interstellar Medium in Galaxies, 2024
6. Bemis A.R., Wilson C.D., *A Multi-line Analysis of Dense Gas Tracers Across the Antennae.* CASCA AGM, 2024
5. Bemis A.R., Wilson C.D., Brunetti N., Sun J., *Testing Star Formation Models in the Nearest Major Merger.* From Stars to Galaxies II, Gothenburg, Sweden, 2022
4. Bemis, A.R., Wilson, C.D., Schirm, M. *Star Formation and Dense Gas in Extreme Environments with ALMA.* The Laws of Star Formation Conference, Cambdridge, UK, 2018
3. Bemis, A.R., Wilson, C.D., Schirm, M. *Investigating Dense Gas and Star Formation in the Antennae Galaxies (NGC 4038/39) using ALMA.* Molecular Gas in Galaxies Workshop, Charlottesville, VA, 2016
2. Bemis, A.R., Wilson, C.D., Schirm, M. *Investigating Dense Gas and Star Formation in the Antennae Galaxies (NGC 4038/39) using ALMA.* Half a Decade of ALMA Conference, Palm Springs, CA, 2016
1. Bemis, A.R., Leroy, A., Friesen, R. *The Effect of Environment on Star Formation in Giant Molecular Clouds in NGC 2403* 217th Meeting of the American Astronomical Society, Seattle, WA, 2011

Observing Experience:

- JCMT: Mapping the Dense Molecular Gas in the Strongest Star-forming Galaxies (MALATANG) JCMT Large Program. Winter 2015.
- JCMT: PI Project M17AP070. Summer 2017.
- JCMT, PI Project M17BP036. Fall 2017.
- JCMT: PI Project M18AP061. Spring 2018.