

Ashley Thomas Barnes



Title

A Balancing Act: Observational determination of the pressures in HII regions across the Galactic Centre and nearby galaxies

Abstract

High-mass stars inject a large amount of energy and momentum - stellar feedback - into the interstellar medium (ISM) during their relatively short lifetimes. The feedback from these stars can influence the ISM both locally ($<1\text{pc}$) and across their entire host galaxy ($\sim 1\text{kpc}$), and occurs through a variety of feedback processes; e.g. protostellar outflows, stellar winds, ionizing radiation. The most important of these feedback mechanisms for the overall energy and momentum budget of ISM occurs at the end of the stars lifetime, when they explode as supernovae. However, the efficiency with which SNe couple with their environment strongly depends on their local gas density distribution. Hence, the early pre-SNe feedback processes from high-mass stars play a crucial role in setting this environment into which SNe later explode, and, therefore, in effect limit the efficiency of SNe feedback. In this talk, I will discuss our recent efforts in a quantitative study of pre-SNe feedback mechanisms within both the centre Milky Way, and a large sample of nearby extragalactic systems. In these analyses, we focus on the balance of various internal and external pressures within young HII regions. The study of the Galactic Centre represents the first such study in a high-pressure environment, which has important implications for high-redshift environments. The study of extragalactic systems is the first to attempt such a study on a statistically significant sample of HII regions (>2000). Together, these make key advancements in our understanding of young stellar feedback as a function of environment.

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EMPLOYMENT

- Postdoctoral position** 2018 – present
Argelander-Institut für Astronomie (AIFA), Universität Bonn
Supervisor: Frank Bigiel
- Postdoctoral position** summer 2018
Center of Astronomy (Zentrum für Astronomie Heidelberg der Universität)
Supervisor: Frank Bigiel

EDUCATION

- Postgraduate student** 2014 – 2018
Liverpool John Moores University & Max Planck Institute for Extraterrestrial Physics
PhD in Astrophysics
Thesis: *A comparison of Star formation within the Galactic Centre and Galactic Disc*
Supervisors: Steven Longmore and Paola Caselli
- Undergraduate student** 2010 – 2014
University of Leeds
First class, bachelor and master degrees in Astrophysics
Thesis: *Complex, coherent kinematics in a highly filamentary infrared dark cloud*
Supervisor: Paola Caselli
- Research placement** summer of 2012 & 2013
University of Leeds
Work undertaken during this period was published (Barnes et al. 2016, MNRAS, 458, 1990)
Subject: *Widespread deuteration across the IRDC G035.39-00.33*
Supervisor: Paola Caselli

RESEARCH INTEREST

The investigation of the star, cluster and molecular cloud formation within a range of environments using (millimetre and sub-millimetre) radio and infrared observations. Quantifying the magnitude and effect of feedback within the young star-forming region across the Milky Way and extragalactic environments.

EXPERIENCE

- Teaching:**
Physics of the interstellar medium (master's level) Bonn, September 2020
- Observational:**
IRAM-30m telescope (single dish) Several observing runs as part of the LEGO project 2018-2020
ARO telescope (single dish) Observing team as part of the SHREC large project 2019-current

IRAM-30m telescope (single dish) NEOMA zero spacing observations 2019
IRAM-30m telescope (single dish) 56 hours of “pool observations” over November 2016
Australia Telescope Compact Array (interferometer) a week of duty astronomer in August, 2016
Australia Telescope Compact Array 20 hours of observations in July & September 2016

Data reduction and analysis: <https://github.com/ashleythomasbarnes>
Common Astronomy Software Applications (CASA) package for ALMA and VLA observations
GILDAS package for IRAM-30m and NOEMA observations
MIRIAD package for ACTA and SMA observations
Programming languages: Python and IDL.

AWARDS

CSIRO Astronomy and Space Science Student Scholarship 2014 – 2018
The role of cloud-scale gas properties on the process of stellar mass assembly
Supervisor: Jill Rathborne

PUBLICATIONS (7 First author; 19 Co-author; 568 Citations total)

Google Scholar: https://scholar.google.com/citations?user=_auV9TgAAAAJ&hl=en

ADS: <https://ui.adsabs.harvard.edu/user/libraries/N8pxdvIIRP-tJwx7Wj4YKA>

First author papers:

1. *Which feedback mechanisms dominate in the high-pressure environment of the central molecular zone?*
[Barnes et al. 2020, MNRAS, 498, 4906B](#)
2. *LEGO - II. A 3 mm molecular line study covering 100 pc of one of the most actively star-forming portions within the Milky Way disc*
[Barnes et al. 2020, MNRAS, 497, 1972B](#)
3. *ALMA-IRDC: Dense gas mass distribution from cloud to core scales*
[Barnes et al. 2020, MNRAS, submitted](#)
4. *Young massive star cluster formation in the Galactic Centre is driven by global gravitational collapse of high-mass molecular clouds*
[Barnes et al. 2019, MNRAS, 486, 283B](#)
5. *Similar complex kinematics within two massive, filamentary infrared dark cloud*
[Barnes et al. 2018, MNRAS, 475, 5268B](#)
6. *Star formation rates and efficiencies in the Galactic Centre*
[Barnes et al. 2017, MNRAS, 469, 2263](#)
7. *Widespread deuteration across the IRDC G035.39-00.33*
[Barnes et al. 2016, MNRAS, 458, 1990](#)

Selected recent co-author papers:

1. *CMZoom: Survey Overview and First Data Release*
[Battersby et al. 2020, ApJS, 249, 35B](#)
2. *SOFIA/FORCAST Galactic Center Legacy Survey: Overview*
[Hankins et al. 2020, ApJ, 894, 55H](#)
3. *Mass inflow rate into the Central Molecular Zone: observational determination and evidence of episodic accretion*
[Sormani & Barnes, 2019, MNRAS, 484, 1213S](#)

CONFERENCES AND WORKSHOPS

Contributed talk

Multi-line Diagnostics of the Interstellar Medium Nice, 2020

Where are the commonly used "dense gas" molecular line tracers really emitting within star-forming regions?

Poster presentation

The Early Phases Of Star formations (EPOS) Ringburg, Germany, 2020

Where are the commonly used "dense gas" molecular line tracers really emitting within star-forming regions?

Contributed talk

New Horizons in Galactic Center Astronomy and Beyond Yokohama, Japan, October 2019

Young massive cluster formation and feedback in the Galactic Centre

Contributed talk

Linking The Milky Way And Nearby Galaxies Helsinki, Finland, June, 2019

Summary of ongoing projects

Contributed talk

SFB 956 annual meeting Eifel, Germany, May 2019

Summary of ongoing projects

Contributed talk

Heidelberg-Harvard meeting Heidelberg, December 2018

Young massive cluster formation in the Galactic Centre

Poster presentation

The 6th MPIA Summer Conference: Galactic Star Formation with Surveys Heidelberg, July 2017

Star formation rates on global and cloud scales within the Galactic Centre

Contributed talk

MPE-CAS group workshop Ringberg, Germany, June 2017

The complex kinematics within an infrared dark cloud

Poster presentation

Multi-scale star formation Morelia, Mexico, April, 2017

Star formation rates on global and cloud scales within the Galactic Centre

Poster presentation

IAUS 322: The Multi-Messenger Astrophysics of the Galactic Centre Cairns, Australia, July 2016

Star formation rates on global and cloud scales within the Galactic Centre

Contributed talk

ASA Annual Scientific Meeting Sydney, June 2016

Star formation rates on global and cloud scales within the Galactic Centre

Contributed talk

The Soul of High-Mass Star Formation Conference Puerto Varas, Chile, March 2015

Complex, coherent kinematics in a highly filamentary infrared dark cloud: The case of G034.43+00.24

Five day workshop

Sixth European Radio Interferometry School (ERIS2015) Munich, October, 2015

OBSERVING PROPOSALS

Successful as PI:

APEX 2019 50 hours

Project code: M9511a_104

Line Emission to assess Galaxy Observations (LEGO) – 1mm follow-up survey

ALMA cycle 6 5 hours/12m array (~50 hours total)

Project code: 2018.1.00850.S

From filaments to cores: Dynamics in infrared dark clouds

ALMA cycle 5 5 hours/12m array (~50 hours total)
(Project code: 2017.1.00687.S
From filaments to cores: Dynamics in infrared dark clouds

VLA 2017A semester 15.0 hours total
Project code: 17A-321
The dynamics of ionised gas within the Galactic Centre

ATCA April 2016 semester 40.3 hours total
Project code: C3091
Tracing the conversion of gas into stars in a Galaxy-wide sample of high-mass protoclusters: a pilot study

NOEMA Winter 2015 semester 19.4 hours total
Project code: W15AN
Deuterium chemistry in the earliest phases of massive star-formation

Successful as co-PI:

ALMA (6), APEX (2), ARO (1 large), GBT (1), JCMT (2), SMA (1), ATCA (1), IRAM-30m (4), NOEMA (1), SOFIA (1 large + 2), VLA (3)

REFERENCES

ON REQUEST.