

## Stefania Barsanti



### Title

An observed link between spin-filament alignment flips and bulge formation

### Abstract

The observational study of the interplay between galaxy angular momentum and structure in the cosmic web is challenging due to the weakness of the signal. We study the alignments of galaxy spin axes with respect to cosmic web filaments as a function of different properties for galaxies and for their bulge and disk components. We exploit the SAMI Galaxy Survey to identify 3D spin axes from spatially-resolved kinematics and to decompose galaxies into their kinematic bulge and disk components. We use the GAMA spectroscopic survey to reconstruct the surrounding cosmic filaments. We find a strong correlation between the galaxy spin-filament alignment and the mass of the bulge: galaxies with lower bulge masses tend to have their spins parallel to the closest filament, while high-bulge mass galaxies show a perpendicular orientation. This observed link between the flip in the spin-filament alignment and the growth of the bulge can be explained by mergers. Bulges tend to have perpendicular alignments, indicating mergers as their main formation channel; in contrast, pseudo-bulges tend to have a parallel alignment, consistent with secular accretion. Disks show different alignments according to their kinematic features and bulge mass, suggesting varying formation pathways. We conclude that bulge mass is the primary parameter tracing the processes that cause the galaxy spin-filament alignment to flip from parallel to perpendicular.

# CURRICULUM VITAE – Stefania Barsanti

## PERSONAL INFORMATION

Current position: **ASTRO3D postdoctoral fellow at the Australian National University (April 2021-)**

📍 Work address: Research School of Astronomy and Astrophysics, Cotter Road, Weston Creek, ACT 2611, Australia

✉ E-mail: [stefania.barsanti@anu.edu.au](mailto:stefania.barsanti@anu.edu.au), [stefania.jess@gmail.com](mailto:stefania.jess@gmail.com)

## RESEARCH INTERESTS

- galaxy formation and evolution
- stellar populations and galaxy angular momentum
- cosmic web reconstruction
- bulge/disk decomposition
- galaxy groups and clusters, environmental effects
- optical photometric/spectroscopic data, spatially resolved spectroscopic surveys

## EDUCATION

### 2021 - DOCTOR OF PHILOSOPHY DEGREE

Subject: **Extragalactic astrophysics**

University: **Macquarie University, Australia**

Thesis: **Disentangling the stellar population properties of bulges and disks in cluster galaxies**

Thesis submission date: **10/12/2020**

PhD award date: **24/06/2021**

Research field: **evolution of S0 galaxies, bulge/disk decomposition, stellar populations, galaxy clusters, SAMI survey**

Supervisors: **Matthew Owers, Richard McDermid**

### 2017 - MASTER OF RESEARCH DEGREE

Subject: **Physics and Astronomy**

University: **Macquarie University, Australia**

Graduation date: **21/07/2017**

Final mark: **83.40/100**

Thesis: **Investigating the impact of group environment on galaxy properties**

Research field: **galaxy evolution, star formation, galaxy groups, GAMA survey**

Supervisors: **Matthew Owers, Sarah Brough**

### 2015 - MASTER OF RESEARCH DEGREE

Subject: **Astrophysics and Cosmology**

University: **University of Trieste, Italy**

Graduation Date: **23/11/2015**

Final mark: **110 cum laude/ 110**

Title: **Characterizing galaxy clusters through the population of their star forming galaxies**

Research Field: **galaxy evolution, star formation, galaxy clusters, ESA Euclid space mission**

Supervisors: **Marisa Girardi, Andrea Biviano, Stefano Borgani**

## 2013 - BACHELOR DEGREE

Subject: **Physics**

University: **University of Pisa, Italy**

Graduation Date: **26/09/2013**

Final Mark: **109 / 110**

Thesis: **The Muon Paradox: the Rossi-Hall Experiment**

Supervisor: **Claudio Bonati**

## SCIENTIFIC PUBLICATIONS

- **S. Barsanti**, M. S. Owers, R. M. McDermid, K. Bekki, J. J. Bryant, S. M. Croom, S. Oh, A. S. G. Robotham, N. Scott, J. van de Sande. *The colors of bulges and disks in the core and outskirts of galaxy clusters*. The Astrophysical Journal, 911:21 (April 2021)  
<https://iopscience.iop.org/article/10.3847/1538-4357/abe5ac>
- **S. Barsanti**, M. S. Owers, R. M. McDermid, K. Bekki, J. Bland-Hawthorn, S. Brough, J. J. Bryant, L. Cortese, S. M. Croom, C. Foster, J. S. Lawrence, A. R. Lopez-Sanchez, S. Oh, S. N. Richards, A. S. G. Robotham, N. Scott, S. M. Sweet, J. van de Sande. *The SAMI galaxy survey: bulge and disk stellar population properties in cluster galaxies*. The Astrophysical Journal, 906:100 (January 2021)  
<https://iopscience.iop.org/article/10.3847/1538-4357/abc956>
- S. Oh, M. Collnes, **S. Barsanti** et al. *The SAMI galaxy survey: Decomposed stellar kinematics of galaxy bulges and disks*. Monthly Notices of the Royal Astronomical Society, 495:4638-4658 (May 2020)  
<https://academic.oup.com/mnras/article-abstract/495/4/4638/5837093?redirectedFrom=PDF>
- **S. Barsanti**, M. S. Owers, S. Brough, L. J. M. Davies, S. P. Driver, M. L. P. Gunawardhana, B. W. Holwerda, J. Liske, J. Loveday, K. A. Pimblet, A. S. G. Robotham, E. N. Taylor. *Galaxy And Mass Assembly (GAMA): impact of group environment on galaxy star formation*. The Astrophysical Journal, 857:71 (April 2018).  
<https://iopscience.iop.org/article/10.3847/1538-4357/aab61a/pdf>
- **S. Barsanti**, M. Girardi, A. Biviano, S. Borgani, M. Annunziatella and M. Nonino. *Velocity segregation effects in galaxy clusters at  $0.4 \leq z \leq 1.5$* . Astronomy & Astrophysics, 595:A73 (November 2016).  
<https://www.aanda.org/articles/aa/pdf/2016/11/aa29012-16.pdf>

## SKILLS

**Research:** data science (big data, high-performance computing), data analysis (modelling, fitting), data processing (catalogues production), statistics (Bayesian, tests), project/time management (research projects), scientific writing/talks/posters (papers, conferences).

**Problems solving:** dynamical/creative thinking (novel methods/approaches, implementing/debugging codes), team working (collaborations, survey groups, committees).

**Technical skills:**

Programming languages: Python, R - C, IDL , Fortran

Photometric data analysis packages: ProFound (source detection), ProFit (galaxy profile fitting)

Spectroscopic data analysis package: pPXF (full spectral fitting)

Cosmic web extractors: Disperse

Graphic/analysis tools: TopCat, SuperMongo, Gnuplot

Web development: WordPress

Writing editing tool: Latex, Office

Science experiments risk assessment tool: RiskAssess

**Teaching:** science communication (schools, public events), presentation (mini-lectures, lab demonstrations), marking (exams, assignments), online teaching (zoom, recorded videos), leadership (lab supervisor).

**TALKS/POSTER PRESENTATIONS (selection)**

- “The SAMI Galaxy Survey: disentangle bulge and disk properties in cluster galaxies” during the ASTRO 3D Colloquium (Zoom, 8/06/2021), AstroSeminar at University of New South Wales (Zoom, 23/06/2021), AstroSeminar at Macquarie University (Sydney, 1/11/2019), the Seminar at INAF-University of Trieste (Trieste, 15/07/2019), the Tracing Cosmic Evolution with Clusters of Galaxies IV conference (Sesto, 8-12/07/2019), the Life and Death of Star-forming Galaxies conference (Perth, 19/03/2019), the SAMI busy week at University of Sydney (04/02/2019).
- “The impact of group environment on star formation in GAMA” during the ASA conference at Swinburne University (Melbourne, 26/06/2018), the GAMA conference at ICRAR (Perth, 6/11/2017), the AstroSeminar at Macquarie University (Sydney, 13/10/2017), the SAMI busy week at Macquarie University (Sydney, 29/08/2017).
- “The Giants of the Universe: clusters of galaxies” during the Astronomy Open Night at Macquarie University (Sydney, 20/05/2017).
- “Characterizing Galaxy Clusters through the Population of their Star Forming Galaxies” thesis dissertation (Trieste, 23/11/2015).
- “The Muon Paradox: the Rossi-Hall Experiment” thesis dissertation (Pisa, 26/09/2013).

**ASTRONOMICAL EXPERIENCES**

- Wiki and website manager for the Hector Galaxy Survey (July 2021-): <https://hector.survey.org.au/>
- Internship at INAF - National Institute for Astrophysics of Trieste, Italy (2015-data collection).
- Observations at the Astronomical Observatory of Trieste, Basovizza, Italy (2014-general sky objects).
- Observations at the Astronomical Observatory of Padua, Asiago, Italy (2014-nebulae).
- Volunteering at Macquarie University Astronomy Open Night, Sydney (2017, 2018, 2019).

## TEACHING OCCUPATIONS/ LAB EXPERIENCES (face-to-face and online)

- Science laboratory technician at The Pittwater House Schools, Sydney (August 2020 – March 2021).
- Junior Unit Convenor at Macquarie University (Sydney) for PHYS1210 during 2020.
- Physics tutor at Macquarie University for PHYS1210 (with mini-lectures) and at Macquarie University International College for the Physics Bridging Course during 2020.
- Supervisor lab demonstrator at Macquarie University for HLTH3410, PHYS1210/1510 during 2020/2019 and at Macquarie University International College for PHYS1520 during 2021/20.
- Lab demonstrator at Macquarie University for HLTH3410, PHYS1210/1010/1510/1520 and high school visits during 2019/2018/2017.
- Private tutor of five high school students in mathematics and physics during 2015/2016

## HONORS AND AWARDS

- Winner of the 2019 **Macquarie University Postgraduate Research Fund (PGRF)**.
- Winner of the 2017/2020 **International Macquarie University Research Training PhD Program scholarship**.
- Winner of the 2016/2017 **International Macquarie University Research Training Master of Research Program scholarship**.
- Winner of the 2015 **“Licio Giorgieri” award** based on my academic curriculum.

## MEMBERSHIPS

- Member of ASTRO 3D, ARC Centre of Excellence for All Sky Astrophysics in 3 Dimensions
- Member of the MAGPI galaxy survey
- Member of the Hector galaxy survey
- Member of the SAMI (Sydney-AAO Multi-Object Integral-Field Spectrograph) galaxy survey
- Member of the GAMA (Galaxy And Mass Assembly) survey
- Member of ASA - Astronomical Society of Australia
- Member of SIF - Italian Physical Society

## COMMITTEES

- Member of the ASTRO 3D Early Career Researchers committee (Dec 2021-)
- Member of the RSAA Workplace Giving committee and RSAA Recognition and Celebration of Diversity and Inclusion (November 2021-)
- Member of the Australian Telescope Users Committee (ATUC- 2019/20)
- Member of the Local Committee for the 2018 Observational Techniques Workshop at the AAO (Australian Astronomical Observatory).
- Member of the Scientific Committee for the 2018 Harley Wood School