Samuel Ruthven Ward

Center for Computational Astrophysics, Flatiron Institute,
162 Fifth Avenue, New York, 10010

Email: sward@flatironinstitute.org
Web: samuelrward.github.io

Research Interests

I study the role of Active Galactic Nuclei (AGN) in galaxy evolution and how quasar winds couple to the interstellar medium to produce multiphase outflows. I analyse cosmological simulations and develop my own idealised galaxy simulations to quantify this effect and extract observational predictions.

Education

2020-2024 | **Doctor of Natural Science *(Dr.rer.nat., magna cum laude)*** — *Ludwig Maximilian University of Munich*
Thesis title: *The Impact of AGN Outflows on Multiphase Gas: Linking Observations and Simulations.*
Supervisors: Chris Harrison (Newcastle), Tiago Costa (MPA/Newcastle) & Vincenzo Mainieri (ESO).
Hosted by the European Southern Observatory and Newcastle University.

2016-2020 | **Master of Physics *(MPhys,* 1st Class Hons.*)* in Physics and Astronomy** — *Durham University*
Integrated bachelor's and master's degree.
Thesis title: *Simulating AGN Detection in Radio-Quiet Active Galaxies.*
Supervisors: Leah Morabito & David Alexander.

Research Positions

2024- | **Flatiron Research Fellow (FRF)** — *Center for Computational Astrophysics*

2023-2024 | **Postgraduate Researcher (PGR)** — *Newcastle University*

2020-2023 | **PhD Student** — *European Southern Observatory*
Funded by the ORIGINS Excellence Cluster

2019 | **Summer Research Programme** — *European Southern Observatory*

Computational Experience

- Principal Investigator of computational project *AGN in Clumpy DisCs (ACDC):*
  - Using AREPO moving-mesh hydrodynamic code (Springel'10) combined with BOLA wind model (Costa+20) to simulate interactions between AGN outflows and clumpy ISM structure.
  - Exploring the observational implications of the results, including forward-modelling the resulting X-ray emission into mock *Chandra* observations and working with a team in Montreal to investigate the resulting BAL spectra.
  - Follow-up studies using the simulations include research into outflowing cloud densities (Almeida et al., 2026) and the impact on dust (Haidar, in prep.)
  - CPU time granted: 6 MCPU-h on C2PAP (PI), 300 kCPU-h on SuperMUC (co-PI), 20 MCPU-h on CSD3 and Cosma8, Dirac 16th Call (co-I).
- Analysis of cosmological simulations (IllustrisTNG, EAGLE and SIMBA) and comparison to observations.
  - Invited to join collaborations in Leiden and Bologna to provide computational expertise.
- Along with my student, Emily Kerrison (U.Sydney), wrote a radiative transfer code for mock 21cm HI absorption from radio jets - *Simulating Absorption of Neutral Gas for Radio Astronomy (SANGRiA)*
- Member of the Learning the Universe collaboration; Synth. Obs. and Black Hole working groups.

Observational Experience

- Observing run in Chile: October-November 2022
  - 112 hours observing at APEX as a Support Astronomer.
  - 16 hours shadowing an astronomer on VLT-CRIRES+.
- Involvement with observational groups:
  - Member of the Quasar Feedback Survey, including co-authorship on four papers, and co-I on VLT, ALMA and NOEMA observing proposals.
  - Co-I on two accepted JWST-MIRI proposals as part of the SUPER survey.
  - Member of the LUDO collaboration, a proposed LOFAR2.0 large program.

Selected Talks & Visits

2026	Seminar: DeCAF seminar at the Universidad Autónoma de Madrid (UAM)	*Madrid, Spain*
2025	Seminar: Arizona State University Galaxy Group	*Online*
	Seminar: Durham-Newcastle Accretion Alliance	*Newcastle, UK*
	Contributed Talk: *Galaxy Origins in the JWST Era*	*Toledo, Spain*
	Flash Talk: *Highly Accreting SMBHs across Cosmic Time (ESO Santiago)*	*Online*
	Poster: *Galactic Ecosystems under the Microscope*	*Garching, Germany*
	Poster: *The Role of Feedback in Galaxy Formation*	*Potsdam, Germany*
	Seminar: STScI Galaxy Journal Club	*Baltimore, USA*
2024	Seminar: Online AGN Talk Series at the Instituto de Astrofísica de Canarias	*Online*
	Flash Talk: *Extreme Star Formation* (CCA-CFC workshop)	*Austin, USA*
	Contributed Talk: *Some like it Hot* (MIAPbP workshop)	*Garching, Germany*
	Contributed Talk: *DEX XX: Galaxy Evolution Across Cosmic Time*	*Durham, UK*
2023	Contributed Talk: *New Simulations for New Problems in Galaxy Formation*	*Paris, France*
	Seminar: Kavli Institute for Cosmology, Galaxies Discussion Group	*Cambridge, UK*
	Invited Talk: *The Importance of Jet-Induced Feedback on Galaxy Scales*	*Leiden, Netherlands*
	Seminar: University of Sydney, Astro3D node meeting	*Sydney, Australia*
	Contributed Talk: *New Views on Feedback & the Baryon Cycle in Galaxies*	*Melbourne, Australia*
2022	Seminar: ESO Santiago	*Santiago, Chile*
	Contributed Talk: *What Drives the Growth of Black Holes?*	*Reykjavik, Iceland*
	Contributed Talk: *Epoch of Galaxy Quenching*	*Cambridge, UK*
	Contributed Talk: National Astronomy Meeting (NAM)	*Warwick, UK*
2021	Contributed Talk: *Young Astronomers on Galactic Nuclei (YAGN)*	*Copenhagen, Denmark*
	Contributed Talk: European Astronomical Society Annual Meeting (EAS): *Massive Galaxies: The Build-up of Monsters Through Cosmic History*	*Online*

Scientific & Community Roles

Ongoing	**Journal Reviewer:** Nature Astronomy, Astrophysical Journal
2026	**SOC chair:** *AGN and Energy Flows* workshop (CCA, February 2026) – responsible for planning and organisation of a c.50-person workshop aligned with the CCA baryon cycle strategic focus
	SOC member: *AGN feedback across all Scales and Time* (ESO Garching, July 2026)
2025	**Faculty Selection Committee:** Member of the fellows' review board for new faculty hires.
2022-2023	**ESO Student Representative:** Chaired a committee of five student representatives, holding responsibility for communication with the Office for Science. Successfully advocated for issues such as supporting student cost-of-living and organised mental health awareness events.
2022	**OPC Scientific Assistant:** ESO Observing Programmes Committee, Cycle P.110.
	Selection Committee: ESO Summer Research Programme.
2021-2022	**Science Talks Organiser:** Organised the weekly Informal Discussion and AGN Coffee.

Supervision & Teaching

2025-2026	**Pre-doc Supervision:** Co-supervising a PhD student (Emily Kerrison, U.Sydney) for a pre-doc placement at the CCA (5 months in-person, remote supervision ongoing).
2025	**Guest Lecture:** Gave an undergraduate lecture at Borough of Manhattan Community College (CUNY).
2024	**Guest Lecture:** Gave an online lecture at Meru University of Science and Technology, Kenya, as part of a series introducing astrophysical research.
2023	**Middle School Internship:** Supervised a school student for a week-long internship. Designed a project that led from calculating the trajectories of foam darts to simulating planetary orbits.

Public Engagement

2025-2026	**Choreographer Partnering:** Selected to partner choreographer Jiemin Yang as part of the Open Interval program between SF's Science, Society & Culture and Gibney Dance Company.
2025	**Think Space Lecture:** Delivered an online public lecture at the Royal Observatory Greenwich.
2024	**Museum Installation:** Directed and produced a 45-minute video installation featuring interviews with astronomers for the Space Investigators North East exhibition at the Great North Museum: Hancock.
2023	**INSIGHTS Public Lecture:** Won a public vote to deliver an outreach lecture presenting my research.
	Pint of Science Munich: Speaker at public lecture event, with a talk entitled: *An Extragalactic Murder Mystery: Do Black Holes Kill Galaxies?*
2022	**STFC charity event:** Delivered an online outreach talk and virtual tour of ESO.

Publication List

Link to: ADS library and ORCHID ID

First Author

- **Ward, S. R.**; Kerrison, E. F.; Tonnesen, S. (in prep.), *Simulating Absorption of Neutral Gas for Radio Astronomy (SANGRiA)*

- **Ward, S. R.** et al (2026), *Mixing between AGN winds and ISM clouds produces luminous Bremsstrahlung emission,* MNRAS, 545, staf2065

- **Ward, S. R.** et al (2024), *AGN-driven outflows in clumpy media: multiphase structure and scaling relations,* MNRAS, 533, 1733

- **Ward, S. R.** et al. (2022), *Cosmological simulations predict that AGN preferentially live in gas-rich, star-forming galaxies despite effective feedback,* MNRAS, 514, 2936

Supervising Author

- Kerrison, E. F.; **Ward, S. R.**; Tonnesen, S.; Moss, V. A.; Sadler, E. M. (sub. ApJ), *Forward Modelling the ASKAP-FLASH 21cm Absorption Survey with SANGRiA: Geometry Alone Cannot Explain High HI Detection Fractions Towards Compact Radio Sources*

Contributing Author

- Almeida, I.; Costa, T.; Harrison, C. H.; **Ward, S. R.** (2026), *Tracing AGN Feedback Power with Cool/Warm Outflow Densities: Predictions and Observational Implications,* MNRAS, stag231

- Kakkad, D. et al. [incl. **Ward, S. R.**] (2025), *JWST MIRI/MRS observations of hot molecular gas in an AGN host galaxy at Cosmic Noon,* MNRAS, 541, 3524

- Bertola, E. et al. [incl. **Ward, S. R.**] (2024), *KASHz+SUPER: Evidence of cold molecular gas depletion in AGN hosts at cosmic noon,* A&A, 691, A178

- Frias Castillo, M. et al. [incl. **Ward, S. R.**] (2024), *At the end of cosmic noon: Short gas depletion times in unobscured quasars at $z \sim 1$,* A&A, 683, A211

- Molyneux, S. et al. [incl. **Ward, S. R.**] (2024), *The Quasar Feedback Survey: characterising CO excitation in quasar host galaxies,* MNRAS, 527, 4420

- Girdhar, A. et al. [incl. **Ward, S. R.**] (2024), *Quasar feedback survey: molecular gas affected by central outflows and by 10-kpc radio lobes reveal dual feedback effects in 'radio quiet' quasars,* MNRAS, 527, 9322

- Harrison, C. M.; Girdhar, A.; **Ward, S. R.** (2023), *Establishing the impact of luminous AGN with multi-wavelength observations and simulations,* IAU Symposium 378 Conference Proceedings

- Girdhar, A. et al. [incl. **Ward, S. R.**] (2022), *Quasar feedback survey: multiphase outflows, turbulence, and evidence for feedback caused by low power radio jets inclined into the galaxy disc,* MNRAS, 512, 1608

- Jarvis, M. E. et al. [incl. **Ward, S. R.**] (2021), *The quasar feedback survey: discovering hidden Radio-AGN and their connection to the host galaxy ionized gas,* MNRAS, *503, 1780*