

Ricarda Beckmann

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RESEARCH EXPERIENCE & EDUCATION

From 01/11/2024	University of Edinburgh Future Leaders Fellow
04/2024 - Current	University of Edinburgh Elizabeth Gardner research fellow
11/2020 - 04/2024	University of Cambridge, UK Ruth Holt research fellow , Newnham College
11/2017 - 10/2020	Institut d'Astrophysique de Paris, France Postdoctoral Researcher
10/2013 - 10/2017	University of Oxford, UK DPhil in Astrophysics - "From seed to supermassive: simulating the origin, evolution and impact of massive black holes"
10/2008 - 08/2012	Imperial College London, UK MSci in Physics with First Class Honours (grade average: 81.1%)

PUBLICATION SUMMARY

34 accepted refereed publications for a total of 1286 citations, **h-index = 16** (adsabs.harvard.edu)

[Click for the full list of publications](#)

EXCELLENCE OF RESEARCH ACHIEVEMENTS

I am a **computational astrophysicist** who tackles unsolved challenges in our understanding of the co-evolution between galaxies and their supermassive black holes. I have built **strong, independent research expertise in high-resolution simulations of black holes** in the context of their host galaxy, and worked extensively on black hole accretion physics, feedback and dynamics. This work includes **leading major papers and working groups** for the HORIZON and the LYRICS international collaborations. My **five highest-impact research outputs** are:

- 1. Quantifying the coevolution of black holes and galaxies:** In Beckmann2017, I made the first quantitative predictions for how feedback from active black holes reduces the stellar mass of galaxies for a statistical sample of galaxies. With 87 citations, this paper has quickly become a key reference for black hole and galaxy coevolution. I have since collaborated on a further 9 papers using HORIZON, including a recent project I initiated with Dr Smethurst that demonstrates black hole-galaxy coevolution in the absence of galaxy mergers [Beckmann2023, Smethurst2023].
- 2. Intermediate mass black holes in dwarf galaxies:** In 2018 I was invited to lead the working group on black holes for the [newHORIZON](#) simulation, which pushes the study of black hole and galaxy coevolution into the unexplored low-mass regime. I recently submitted the first of a series of three trailblazing papers on intermediate-mass black holes [Beckmann2022d].
- 3. Cosmic rays and magnetic fields in galaxy clusters:** I conducted a series of ground-breaking simulations that demonstrated how the structure of magnetic fields in galaxy clusters determines the ability of cosmic rays to solve the cooling flow problem, offering a new potential solution to the long-standing cooling flow problem [Beckmann2019b, Beckmann2022a, Beckmann2022b].
- 4. Resolving black hole environments in simulations:** I have independently developed the only algorithm able to resolve black hole environments at two orders of magnitude above standard simulations [Beckmann2019a], giving me an unprecedented view on their evolution. This unique technical capability will make the ambitious project proposed for the fellowship feasible.
- 5. Understanding dynamic forces on black holes:** In Beckmann2018 I conducted a state-of-the-art study of the small-scale dynamical forces that changed how black hole dynamical forces are modelled

in large-scale galaxy evolution simulations. Based on this work, I have recently been invited to co-supervise a PhD student at the University of Oxford to extend this work to include magnetic fields.

SCIENTIFIC LEADERSHIP & COLLABORATION

1. **Leading the black hole working group for newHORIZON:** HORIZON is an international collaboration on state-of-the-art numerical galaxy evolution of over 30 researchers across France, the UK, South Korea and the US. After leading a key paper for the HORIZON collaboration, I was invited to lead the working group on black holes for the follow-up project, [newHORIZON](#). I coordinated the creation of a data catalogue for black holes and their host galaxies, and am currently lead-authoring a series of three papers on black hole population statistics, spin evolution and dynamics.
2. **Spearheading black holes for the EDGE dwarf galaxies:** In autumn 2022, I was invited to use my expertise in modelling intermediate-mass black holes to add black holes, and their feedback, to the ambitious ["Engineering Dwarfs at Galaxy formation's Edge"](#) EDGE simulation project, headed by Prof. Justin Read at the University of Surrey. For the EDGE collaboration, I lead an ambitious ongoing research project on simulating the impact of black holes on low-mass dwarf galaxies.
3. **Leading the simulations of the multi-disciplinary LYRICS project:** LYRICS is a multi-disciplinary collaboration of 16 French and British experts in radio observation, ionisation modelling and numerical simulations which studies the evolution of multi-phase gas in galaxy clusters. From 2017 to 2020, I led the simulation side of LYRICS. I designed, executed and analysed a series of simulations, and presented the results in a set of 3 published first-author papers. I also coordinated data exchanges within the collaboration, which resulted in a set of well-cited multidisciplinary papers.

FUNDING AND RESOURCES

Since 2020, my research has been funded through a **competitive independent junior research fellowship** at the University of Cambridge, and was awarded a prestigious **Marie-Slowdowska Curie postdoctoral fellowship** in 2023.

After being awarded both an independent junior research fellowship at the University of Cambridge, and a competitive Marie-Slowdowska Curie postdoctoral fellowship in 2023, I won a prestigious Future Leaders Fellowship in 2024. As a numerical astrophysicist, my work requires access to resources on large-scale scientific supercomputing facilities. Such crucial resources, measured in CPUhours, are obtained through computing time proposals, which, like funding proposals, undergo a competitive national scientific review process.

2024	[Upcoming] Future Leaders fellowship, UKRI, 1.4 million GBP, University of Edinburgh, UK
2023	[Declined] EU HORIZON 2020 Marie-Slowdowska Curie postdoctoral fellowship , 190 100 GBP, Maynooth University, Ireland
2020	[Completed] Junior research fellowship , 158,218 GBP, Cambridge, Newnham College
10/2022	Co-PI on computing time proposal, UK (34 million CPUhours, under review)
07/2021	Funding for a summer student, 1336 GBP, Institute of Astronomy, Cambridge
06/2021	Funding for a summer student, 1702 GBP, Newnham College, Cambridge
03/2021	Co-PI on computing time proposal, France (5.9 million CPUhours)
04/2021	Co-PI on computing time proposal, UK (>30 million CPUhours)
03/2020	Co-PI on computing time proposal, France (9.7 million CPUhours)

RECOGNITION THROUGH INVITED SEMINARS & CONFERENCE TALKS

I am regularly invited to present my research at international conferences, departmental seminars and colloquia. Overall, I have given **a total of 34 talks**. Since 2020, **I have been invited to:**

09/2024	YAGN2024 meeting, Como, Italy
05/2024	Black holes in the first billion years, Kinsale, Ireland
02/2023	Multi-messenger Black hole Physics conference, Sesto, Italy

11/2022	Colloquium, University of St Andrews, UK
10/2022	Seminar, University of Surrey, UK
10/2022	Colloquium, University of Edinburgh, UK
06/2022	AGN feedback and feeding conference, Sesto, Italy
03/2022	Colloquium, University of Bath, UK
02/2022	Colloquium, University of Oxford, UK
01/2021	Seminar, University of Cambridge, UK
12/2020	Colloquium, Maynooth University, Ireland
11/2020	Seminar, University of Cambridge, UK
11/2020	Seminar, Université de Toulouse, France
10/2020	YAGN conference, Copenhagen
05/2020	Seminar, University of Marseille, France

INVITED JOURNAL REVIEW

I am regularly invited as an expert reviewer for prestigious journals, including the Monthly Notices of the Royal Astronomical Society (MNRAS), Astronomy & Astrophysics and Nature Astronomy.

STUDENT SUPERVISION

I have **supervised 10 students, including three PhD students**. With the first PhD, who successfully obtained her PhD in July 2022, I worked on an ambitious project to understand the dynamics of black holes in a clumpy background medium. With the second student, defended his PhD in December 2022, we investigated the impact of strong black hole feedback episodes (so-called super-Eddington feedback) on the long-term mass growth of black holes. Work with the final two students, one on predicting observational signatures of black holes in gravitational waves and electromagnetic radiation, and one on the impact of magnetic fields on dynamical forces on black holes, is ongoing.

Since 2018, I have **designed and supervised annual Master's student projects**. In 2021, I secured external funding for my master's student to continue working with me over the summer, leading to a publication that has recently been accepted for publication [Jennings2022].

2021 - 2024 **PhD co-supervisor**, IAP, France - "Observing early black hole mergers"

2020 - 2023 **Annual master project supervisor**, Cambridge (3 students)

2021 - 2021 Summer student supervisor, Cambridge, UK

2020 - 2022 **PhD co-supervisor**, IAP, France - "Dynamical friction in a turbulent medium"

2019 - now **PhD co-supervisor**, IAP, France - "Super-Eddington accretion across cosmic time"

2018 - 2019 **Annual master project supervisor**, IAP, France (2 students)

TEACHING

I have teaching experience in a range of different contexts. In 2021, I guided the students in problem-solving skills and also addressed exam questions through a series of biweekly small-group tutorials with 3-5 students as part of an "Astrophysical fluid dynamics" course at the University of Cambridge. In the summer of 2021, I was **invited to design and deliver a 2-hour "Modelling active galactic nuclei" module** as part of the Bid4Best summer school. Students feedback highlighted that they appreciated the clarity of my explanations in making a difficult technical subject accessible. In 2022, I was asked to become an undergraduate tutor for a group of 12 students at Newnham College, Cambridge.

06/2022 - 04/2024 **Undergraduate tutor**, Newnham College, Cambridge

06/2021 "Simulating AGN feedback", invited lecture, Bid4Best summer school

01/2021 - 06/2021 Small-group **teaching "Astrophysical fluid dynamics"**, Cambridge

10/2014 - 07/2016 Teaching assistant for Scientific Computing, Oxford, UK

SCIENTIFIC MEETING ORGANISATIONS

- Ongoing Co-organiser of the “Galaxy discussion group” seminar, Cambridge, UK
- 06/2023 Co-organise of the NAM2023 session “Origins of Galaxies: from the Dark Ages to Cosmic Noon”, Cardiff, UK
- 07/2022 **Lead organiser** of the NAM2022 session “Linking simulations to observations to understand galaxy evolution”, Warwick, UK
- 05/2022 **Lead organiser** of the Kavli Focus day “Early Universe”, Cambridge, UK

EQUALITY AND DIVERSITY WORK

I have been working for many years to support and inspire others, and address the systemic problems around the under-representation of different groups in Astronomy. I am a **trained peer supporter**, have served on academic representative and anti-harassment committees, and worked hard to diversify the speakers at conferences and seminar series I organise.

- 2018 - 2020 **Anti-harassment committee, Institut d’Astrophysique de Paris**, France
- 2015 - 2017 Graduate **peer support coordinator** for Balliol College Oxford
- 2015 - 2016 Graduate mentor in Astrophysics, Oxford UK
- 2015 - 2016 **Division graduate representative for Physics**, Oxford, UK
- 2015 - 2016 Graduate living-out officer at Balliol College Oxford
- 2015 Organised a **Conference for Undergraduate Women in Physics**, Oxford, UK
- 2014 - 2015 Graduate student representative for Astrophysics, Oxford, UK

OUTREACH HIGHLIGHTS

I am passionate about sharing my fascination for black holes and their complex lives with the general public and using my expertise as a female astrophysicist to demystify the profession and widen participation. I give on average 5 outreach talks a year. Listed below are some highlights:

- 04/2022 Invited speaker at “New Scientist Instant Expert - Frontiers of Cosmology”, London
- 07/2021 Invited guest appearance on “Multiscale musings” podcast
- 2020 - 2022 5 YouTube outreach talks
- 2013 - 2017 Organised “Stargazing Oxford”

REFERENCES

All three referees have agreed to be contacted

Dr Marta Volonteri	Professor Debora Sijacki	Professor Adrienne Slyz
Directeur de Recherche	Professor	Professor
Institut d’Astrophysique de Paris	Kavli Institute for Cosmology, University of Cambridge	Department of Astrophysics, University of Oxford
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PUBLICATIONS

Papers marked with an asterisk* are led by my students. Papers marked with circumflex^ are joint first-author publications. Please click on titles for an open-access version of the publication.

REFEREED FIRST-AUTHOR PUBLICATIONS (reverse chronological order)

1. Beckmann, R. S., Dubois, Y., Volonteri, M., et al (2023), "[Population statistics of intermediate mass black holes in dwarf galaxies using the NewHorizon simulation](#)", MNRAS, 523, 5610
2. Beckmann, R. S., Smethurst, R. J., Simmons, B. D., et al. (2023) "[Supermassive black holes in merger-free galaxies have higher spins which are preferentially aligned with their host galaxy](#)", arXiv preprint:2211.13614, accepted in MNRAS
3. Beckmann, R. S., Dubois, Y., Pellissier, A., et al. (2022), "[AGN jets do not prevent the suppression of conduction by the heat buoyancy instability in simulated galaxy clusters](#)" A&A, 666, A71
4. Beckmann, R. S., Dubois, Y., Pellissier, A., Olivares, V., et al. (2022), "[Cosmic rays and thermal instability in self-regulating cooling flows of massive galaxy clusters](#)" A&A, 665, A129
5. Beckmann, R. S., Dubois, Y., Guillard, P., et al. (2019), "[Dense gas formation and destruction in a simulated Perseus-like galaxy cluster with spin-driven black hole feedback](#)" A&A, 631, A60
6. Beckmann, R. S., Devriendt, J., & Slyz, A. (2019), "[Zooming in on supermassive black holes: how resolving their gas cloud host renders their accretion episodic](#)" MNRAS, 483, 3488
7. Beckmann, R. S., Slyz, A., & Devriendt, J. (2018), "[Bondi or not Bondi: the impact of resolution on accretion and drag force modelling for supermassive black holes](#)" MNRAS, 478, 995
8. Beckmann, R. S., Devriendt, J., Slyz, A., Peirani, S., et al. (2017), "[Cosmic evolution of stellar quenching by AGN feedback: clues from the Horizon-AGN simulation](#)" MNRAS, 472, 949

REFEREED COLLABORATIVE PUBLICATIONS (reverse chronological order)

1. *Dong Paez, C. A., Volonteri, M., Beckmann R. S., Dubois Y. et al (2023), "[Multi-messenger study of merging massive black holes in the OBELISK simulation: Gravitational waves, electromagnetic counterparts, and their link to galaxy and black-hole populations](#)", A&A, 676, A2
2. *Dong Paez, C. A., Volonteri, M., Beckmann R. S., Dubois Y. et al (2023), "[Black hole mergers as tracers of massive black hole and galaxy populations in the Obelisk simulation: properties and spins](#)", A&A, 673, A120
3. ^Smethurst, R. J., Beckmann, R. S., Simmons, B. D., et al. (2023) "[Evidence for non-merger co-evolution of galaxies and their supermassive black holes](#)", arXiv preprint:2211.13677, accepted for publication in MNRAS
4. *Massonneau, W., Volonteri, M., Dubois, Y., & Beckmann, R. S. (2023), "[How the super-Eddington regime regulates black hole growth in high-redshift galaxies](#)", A&A, 670, A180
5. *Jennings, F., Beckmann, R. S., Sijacki, D., et al (2023) "[Shattering and growth of cold clouds in galaxy clusters: the role of radiative cooling, magnetic fields and thermal conduction](#)", MNRAS, 518, 5215
6. Olivares, V., Salomé, P., Hamer, S. L., Combes, F., et al. (2022), "[Gas condensation in brightest group galaxies unveiled with MUSE. Morphology and kinematics of the ionized gas](#)" A&A, 666, A94
7. *Lescaudron, S., Dubois, Y., Beckmann, R. S., & Volonteri, M. (2022), "[Dynamical friction of a massive black hole in a turbulent gaseous medium](#)" A&A, arXiv:2209.13548, accepted for publication
8. *Massonneau, W., Dubois, Y., Volonteri, M., & Beckmann, R. S. (2022), "[How the super-Eddington regime affects black hole spin evolution](#)", A&A,669, A143

9. Volonteri, M., Pfister, H., Beckmann, R., Dotti, M., et al. (2022), "[Dual AGN in the Horizon-AGN simulation and their link to galaxy and massive black hole mergers, with an excursus on multiple AGN](#)" MNRAS, 514, 640
10. Trebitsch, M., Dubois, Y., Volonteri, M., Pfister, H., et al. (2021), "[The OBELISK simulation: Galaxies contribute more than AGN to H I reionization of protoclusters](#)" A&A, 653, A154
11. Dubois, Y., Beckmann, R., Bournaud, F., Choi, H., et al. (2021), "[Introducing the NEWHORIZON simulation: Galaxy properties with resolved internal dynamics across cosmic time](#)" A&A, 651, A109
12. Polles, F. L., Salomé, P., Guillard, P., Godard, B., et al. (2021), "[Excitation mechanisms in the intracluster filaments surrounding brightest cluster galaxies](#)" A&A, 651, A13
13. Jackson, R. A., Martin, G., Kaviraj, S., Ramsøy, M., et al. (2021), "[The origin of low-surface-brightness galaxies in the dwarf regime](#)" MNRAS, 502, 4262
14. Volonteri, M., Pfister, H., Beckmann, R. S., Dubois, Y., et al. (2020), "[Black hole mergers from dwarf to massive galaxies with the NewHorizon and Horizon-AGN simulations](#)" MNRAS, 498, 2219
15. Chabanier, S., Bournaud, F., Dubois, Y., Palanque-Delabrouille, N., et al. (2020), "[The impact of AGN feedback on the 1D power spectra from the Ly \$\alpha\$ forest using the Horizon-AGN suite of simulations](#)" MNRAS, 495, 1825
16. Soussana, A., Chisari, N. E., Codis, S., Beckmann, R. S., et al. (2020), "[The impact of AGN feedback on galaxy intrinsic alignments in the Horizon simulations](#)" MNRAS, 492, 4268
17. Olivares, V., Salomé, P., Combes, F., Beckmann, R.S., et al. (2019), "[Ubiquitous cold and massive filaments in cool core clusters](#)" A&A, 631, A22
18. Regan, J. A., Downes, T. P., Volonteri, M., Beckmann, R., et al. (2019), "[Super-Eddington accretion and feedback from the first massive seed black holes](#)" MNRAS, 486, 3892
19. Raouf, M., Silk, J., Shabala, S. S., Mamon, G. A., et al. (2019), "[Feedback by supermassive black holes in galaxy evolution: impacts of accretion and outflows on the star formation rate](#)" MNRAS, 486, 1509
20. Hamer, S. L., Fabian, A. C., Russell, H. R., Salomé, P., et al. (2019), "[Discovery of a diffuse optical line emitting halo in the core of the Centaurus cluster of galaxies: line emission outside the protection of the filaments](#)" MNRAS, 483, 4984
21. Chisari, N. E., Richardson, M. L. A., Devriendt, J., et al. (2018), "[The impact of baryons on the matter power spectrum from the Horizon-AGN cosmological hydrodynamical simulation](#)" MNRAS, 480, 3962
22. Chisari, N. E., Koukoufilippas, N., Jindal, A., Peirani, S., et al. (2017), "[Galaxy-halo alignments in the Horizon-AGN cosmological hydrodynamical simulation](#)" MNRAS, 472, 1163