

JULIA M. SISK-REYNÉS

Institute of Astronomy (IoA), University of Cambridge, UK

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RESEARCH INTERESTS

\diamond Astrophysical searches for Axion-Like Particles (ALPs) using the X-ray spectrum of Active Galactic Nuclei (AGNs). Constraining Supermassive Black Hole (SMBH) spin over mass scales to probe SMBH growth and evolution over cosmic time. Current and future X-ray missions my work involves include: *Chandra*, *Athena*, and the *AXIS*, *LEM* and the *STROBE-X* Probe-Class concepts. I am a member of *STROBE-X*.
 \diamond Themes: Physics Beyond the Standard Model (axions, ALPs and dark matter), gravity and strong radiation (black hole accretion and superradiance), extragalactic astrophysics (galaxy clusters, turbulence and magnetic fields). Techniques: high-energy astrophysics, observations and modelling, Bayesian statistics.

EDUCATION

Ph.D. in Astronomy

Cambridge, UK

University of Cambridge, Institute of Astronomy

Oct 2020 - Expected Jun 2024

Fully funded studentship from the Science and Technology Facilities Council, UKRI.

Thesis topic: Probing light ALPs and SMBHs with current and future X-ray observatories.

Supervisor: Prof. Christopher S. Reynolds. Main collaborator: Dr. James Matthews.

MPhys Physics - Integrated Bachelors and Masters in Physics

Manchester, UK

University of Manchester

Sep 2016 - Jun 2020

Graduated with First Class Honours.

Masters project title: Building analytic models of the thermal Sunyaev-Zel'dovich effect from universal cluster pressure profiles from analytic models and hydrodynamic simulations.

Supervisor: Prof. Scott Kay. Examiners: Profs. Jens Chluba and Clive Dickinson.

AWARDS, PRIZES AND RECOGNITIONS

Fluid Dynamics for Astrophysics Summer School Sponsorship

New York, NY, US

Center for Computational Astrophysics, Flatiron Institute, Simons Foundation

Aug 2023

Two-week course on numerical methods needed to model the range of physical processes encountered in astrophysics.

Paul Murdin Prize

Cambridge, UK

Institute of Astronomy, University of Cambridge

Oct 2022

Best published journal paper by a Ph.D. student for [MNRAS, 510, 1, pp. 1264-1277](#).

Stellify Award

Manchester, UK

University of Manchester

Jun 2020

Honorary award received in recognition of extracurricular contributions made in the areas of Ethical Grand Challenges, Volunteering and Leadership from 2016 to 2020.

RELEVANT RESEARCH EXPERIENCE

Undergraduate Research Internship

Manchester, UK

Particle Physics Department, University of Manchester

Jun - Aug 2019

Project title: Feasibility study on enlarging the energy recoil window for direct dark matter searches at the DarkSide-20k facility.

Supervisors: Prof. Darren Price and Dr. Andrej Szelc.

TECHNICAL SKILLS AND LANGUAGES

Programming & OS	Python (including <code>mpi</code>), <code>tcl</code> , <code>bash</code> , \LaTeX Unix, macOS, Windows
Astrophysics software	PYXSPEC, XSPEC, HEASOFT, DS9
Numerical & axion codes	AREPO (basic), ATHENA++ (basic) ALPRO (code for astrophysical axion searches)
Languages	English (full professional working proficiency) Catalan and Spanish (both native)

SUMMER SCHOOLS AND WORKSHOPS

Summer School - Computational Fluid Dynamics for Astrophysics	<i>Aug 2023</i>
Attendance sponsored by the Simons Foundation.	
Location: Center for Computational Astrophysics, Flatiron Institute, New York, NY, US.	

INVITED SEMINARS AND PRESENTATIONS

Since October 2022, I have been invited to present my research on ALPs and SMBHs on 10 occasions at national and international conferences, workshops and departments.

◇ Invited Seminars	(60 mins each)
AGN Group, NASA Goddard Space Flight Center (NASA GSFC)	Greenbelt, MD, US
High Energy Astrophysics Division, CfA, Harvard & Smithsonian	Cambridge, MA, US
Department of Astronomy, University of Maryland	College Park, MD, US
◇ Solicited Presentations by Future X-ray Observatories	(20-60 mins each)
<i>NewAthena</i> UK Community Science Meeting 2023	Edinburgh, UK
Cosmology Working Group (WG) of the <i>STROBE-X</i> Probe-Class Concept	Virtual
<i>AXIS</i> Probe-Class Concept Monthly Seminar	Virtual
Intergalactic Medium WG of the <i>LEM</i> Probe-Class Concept	Virtual
◇ Solicited Presentations by Current Observatories and Departments	(15-60 mins each)
<i>Chandra</i> /HETG WG, MIT Kavli Institute	Cambridge, MA, US
<i>Fermi</i> Gamma-Ray Telescope WG, NASA GSFC	Greenbelt, MD, US
Tea Talk for KIPAC and SLAC Members, KIPAC, Stanford University	Virtual

CONTRIBUTED CONFERENCE AND WORKSHOP PRESENTATIONS

Since May 2022, I have given contributed talks at 11 national and international conferences and workshops.

New Results in X-ray astronomy Annual Conference	Edinburgh, UK
<i>A Bayesian study of the SMBH spin distribution from X-ray reflection</i> (15 mins)	<i>Sep 2023</i>
National Astronomy Meeting 2023 - Future of UK X-ray Astronomy	Cardiff, UK
<i>Constraining ALPs with current and future X-ray missions</i> (10 mins)	<i>Jul 2023</i>
The X-Ray Universe 2023 - Current and Future Missions	Athens, Greece
<i>Constraining ALPs with NewAthena and other future X-ray missions</i> (15 mins)	<i>Jul 2023</i>
The X-Ray Universe 2023 on AGN - Evolution and high z	Athens, Greece
<i>A Bayesian study of SMBH spins from X-ray reflection</i> (15 mins)	<i>Jun 2023</i>
RAS Specialist Discussion Meeting - Evidence for SMBH binaries	London, UK
<i>SMBH spin constraints with X-ray reflection methods: An overview</i> (15 mins)	<i>Apr 2023</i>

3rd Scientific Meeting of the Athena X-ray Observatory <i>Constraining Physics Beyond the Standard Model with Athena</i> (15 mins)	Barcelona, Spain <i>Nov 2022</i>
9th Mid-Atlantic Radio-Loud AGN Meeting <i>Using AGNs to probe Physics Beyond the Standard Model</i> (10 mins)	Baltimore, MD, US <i>Oct 2022</i>
Recent Progress in Axion Theory and Experiment Workshop <i>Using cluster-hosted galaxies to constrain very-light ALPs</i> (60 mins)	Durham, UK <i>Sep 2022</i>
European Astronomical Society (EAS) Annual Meeting <i>Tightest bounds on light ALPs from a Chandra view of H1821+643</i> (15 mins)	Valencia, Spain <i>Jun 2022</i>
Black Hole Accretion Under the X-ray Microscope <i>Evidence for a moderate spin of the high-mass SMBH H1821+643</i> (15 mins)	Madrid, Spain <i>Jun 2022</i>
New Results in X-ray Astronomy Annual Conference <i>An updated spin constraint for the high-mass SMBH H1821+643</i> (15 mins)	Leicester, UK <i>May 2022</i>

TEACHING AND MENTORING

◇ University of Cambridge, Institute of Astronomy

Mentor to summer research intern **Cambridge, UK**
Institute of Astronomy, University of Cambridge *Jul - Aug 2022*

Assisted a Third-Year Physics undergraduate in using X-ray astronomy software. Project centred on studying relativistic reflection in the *XMM-Newton*+*NuSTAR* spectra of 4C 74.26.

Undergraduate Supervisor **Cambridge, UK**
University of Cambridge *Jan 2021 - Jun 2022*

Led small group tutorial sessions to prepare students for final examinations. Marked worksheets and proposed and marked past paper questions.

First-Year Mathematics, Natural Sciences - 6 students, 4 hours/week, 20 weeks.

Third-Year Astrophysical Fluid Dynamics - 3 students, 3 hours/week, 4 weeks.

◇ Teacher Training

Teach First Insight Programme **London and Southampton, UK**
Oasis Academy Mayfield, Southampton *Jun 2019*

Teaching placement and training program. Offered a full-time teacher training role.

Ogden Trust Teach Physics Internship **Bury, UK**
The Derby High School, Bury *Jun - Jul 2018*

Summer placement at a school where I taught lessons in Physics, Biology, Ethics and Spanish.

EQUALITY, DIVERSITY AND INCLUSION

International Women's Day Lead Organiser **Cambridge, UK**
Institute of Astronomy, University of Cambridge *Oct 2021 - Present*

Management of events: liaise with external speakers and panel members, secure funding, maintain [web-site](#), co-chair panel discussions, issue invitations and write event reports for publication in the International Astronomical Union Women in Astronomy Working Group Newsletter.

Seminar Speaker Series Organiser **Cambridge, UK**
Newnham College, University of Cambridge *Mar - May 2021, Dec 2022 - Nov 2023*

Organise seminars in different disciplines. Led a *Women in STEM* series ([YouTube](#)) a four-lecture series on the *Legacies of Enslavement* (see [College article](#) on a lecture on reparative justice by Prof. Catherine Hall).

Nuclear and Particle Physics Society Lead Member
University of Manchester

Manchester, UK
Sep 2017 - Jun 2020

Organised events to introduce undergraduates to advances in Nuclear and Particle Physics, including monthly talks and visits such as a three-day trip to CERN for fifty people. Secured external funding.

SERVICE AND DEPARTMENTAL RESPONSIBILITIES

◇ **University of Cambridge, Institute of Astronomy**

Cosmology and Astronomy Graduate Student Jamboree, **Main Organiser** *Oct 2022*

Equality, Diversity and Inclusion Committee, **Member** *Oct 2022 - Present*

Open and Graduate Applicant Day, **Graduate Representative** *Jan 2020, Nov 2022*

Computer Users Committee, **Graduate Leader** *Oct 2021 - Apr 2023*

First-Year Ph.D. Student Journal Club, **Co-chair** *Jan - Jun 2021*

Postgraduate Student Forum, **2020 Entry Representative** *Oct 2020 - Present*

◇ **University of Manchester, Department of Physics and Astronomy**

Final-Year Bachelors & Masters, Physics, **Class Representative** *Oct 2019 - Jun 2020*

Peer-Assisted Study Sessions for First-Year Physics, **Co-leader** *Oct 2017 - Jun 2019*

PUBLIC ENGAGEMENT, OUTREACH AND PRESS RELEASES

Press release, Athena Community Office *May 2023*

Physics Beyond the Standard Model with Future X-ray Observatories ([Press release](#)).

Press release, Chandra Press Office *Jun 2022*

Chandra Shows Giant Black Hole Spins Slower Than Its Peers ([Press release](#), [Guest Blog Post](#)).

Invited Public talk by the Lindemann Trust **Cambridge, UK**

Magdalene College, University of Cambridge *Mar 2023, Mar 2024*

Talk title: *Black Holes: Exotic Objects in the Universe* (30 mins) for 160 schoolchildren.

Volunteer, Cambridge Science Festival **Cambridge, UK**

Institute of Astronomy, University of Cambridge *Mar 2021, Mar 2023*

Organising and leading activities on *Women in Astronomy* and *Physics at Home* for children.

Volunteer, Manchester Physics Outreach **Manchester, UK**

University of Manchester *Oct 2017 - Feb 2020*

Participating in events aimed at encouraging girls to take an interest in STEM and at introducing local families to recent scientific advances such as in graphene.

ACADEMIC MEMBERSHIPS AND ORGANISATIONS

◇ **Physics & Astronomy** Institute of Physics, EAS, RAS Fellow

◇ **Mission Development** *STROBE-X* Probe-Class Concept, Cosmology Subgroup

◇ **University of Cambridge** Newnham College, Philosophical Society

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PUBLICATION LIST

SUMMARY OF PUBLICATIONS

Since October 2020, my work comprises: 3 first-author journal papers; 1 co-author journal paper; 1 first-author conference paper; 1 co-author conference paper.

Links to publications: [NASA/ADS](#), [ORCID](#).

Citation statistics: h-index of 2/3 for first-author/all publications.

JOURNAL PUBLICATIONS

◇ 3 first-author journal papers with 56 citations including 1 paper with > 45 citations.

Physics Beyond the Standard Model with Future X-ray Observatories: Projected Constraints on Very-Light Axion-Like Particles with Athena and AXIS. ◇ 2 citations

J. Sisk-Reynés, C. Reynolds, M. Parker, J. Matthews and M. C. D. Marsh.

July 2023, *ApJ*, 951, 1.

Evidence for a moderate spin from X-ray reflection of the high-mass supermassive black hole in the cluster-hosted quasar H1821+643. ◇ 7 citations

J. Sisk-Reynés, C. Reynolds, J. Matthews and R. Smith.

August 2022, *MNRAS*, 514, 2.

New constraints on light axion-like particles using Chandra transmission grating spectroscopy of the powerful cluster-hosted quasar H1821+643. ◇ 47 citations

J. Sisk-Reynés, J. Matthews, C. Reynolds, H. Russell, R. Smith and M. C. D. Marsh.

February 2022, *MNRAS*, 510, 1.

◇ 1 journal publication of which I am co-author with 18 citations.

How Do Magnetic Field Models Affect Astrophysical Limits on Light Axion-like Particles? An X-ray Case Study with NGC 1275. ◇ 18 citations

J. Matthews, C. Reynolds, M. C. D. Marsh, **J. Sisk-Reynés** and P. Rodman.

May 2022, *ApJ*, 930, 1.

Contribution: analysis and interpretation.

SELECTED CONFERENCE PROCEEDINGS

◇ 1 refereed first-author conference paper with 1 citation.

Evidence for Supermassive Black Hole Binaries. To be submitted

M. Bourne, S. Britzen, A. Foord, J. Greene, M. Habouzit, M. Horton, M. Krause, L. Mayer, H. Middleton, R. Nealon, C. Reynolds, D. Sijacki and **J. Sisk-Reynés**.

Invited contribution after presentation at RAS Specialist Discussion Meeting on SMBH binaries on 14 April 2023 in London, UK. To be submitted to RAS A&G magazine in the first part of 2024.

Current and Future constraints on Very-Light Axion-Like Particles from X-ray observations of cluster-hosted AGN. ◇ 1 citation

J. Sisk-Reynés, C. Reynolds and J. Matthews.

April 2023, [arXiv: 2304.08513](#).

To be published in Mem. S. A. It. by December 2023. Submitted after contribution at “The Dark Matter Challenge” session at the EAS 2022 annual meeting on 28 June 2022 in Valencia, Spain.