James Petley

Curriculum Vitae

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Radio astronomer and developer

Employment History

01/07/2024extension of 1 year)

Postdcotoral Researcher, Leiden Observatory, Leiden, Netherlands, Group of Dr. Reinout van Weeren. 01/07/2026 High resolution radio imaging development, particularly of wide-field, computationally intensive projects. Studies of (Possible quasars and their role in galaxy evolution. Assist in the supervision of master's students and support the development of other PhD students within the group.

Qualifications

PhD, Durham University, Durham, UK, Supervisor: Dr Leah Morabito. October 2020–July High resolution imaging and survey studies of quasars with outflows using the International LOFAR Telescope (ILT) 2024

October Physics and Astronomy, MPhys - 1st class with honours, Durham University, Durham, UK, Supervisors: 2016–July Prof. Mark Swinbank & Prof. Ian Smail.

2020 Investigating the Most Luminous Starbursts in the Universe

Research Highlights

- Demonstrated that the absorption properties of BALQSOs are linked to their radio-emission
- Revealed a key link between guasars with outflows and their optical reddening due to dust
- Contributed crucial elements to LOFAR-VLBI pipeline, enabling sub-arcsecond resolution at 150 MHz

Research Interests

I am interested in understanding the effect super-massive black holes have on their own growth and their larger surroundings. My work has focused on Broad Absorption Line Quasars (BALQSOs) which contain high-velocity winds that can sometimes reach across their whole galaxy. These sources contain enhanced radio emission which is currently without a determined physical origin. My main tool for studying these sources has been the ILT, an SKA pathfinder instrument as well as large multi-wavelength surveys, particularly SDSS. Using the ILT, I showed that radio-emission from BALQSOs may be originating from wind shocks. I have skills in VLBI imaging at MHz and GHz frequencies and am working on future pipelines for this intensive data processing.

Programming Experience

- Python Proficient in Python for Data Analysis and Physics Problem Solving. Some experience in web development with Django and Flask. I have previously won prizes at Durham Hackathon for a Flask MicroLending Service and a Fake News Detecting Whatsapp Bot each created in 24 hours. I also have my own Python package with documentation, CoSpecPy (https://github.com/jwpetley/CoSpecPy), for downloading, creating and plotting composite spectra.
 - HPC Experienced with bash scripting and using torque and slurm for job submission on multiple HPC resources.
- CWL Experience developing and running Common Workflow Language pipelines. The target splitting section (split-directions.cwl) of the LOFAR-VLBI pipeline was primarily converted to CWL by myself.

LOFAR I am involved in the automated re-processing of LoTSS at high-resolution. This has involved the setup of monitoring scripts which access the LOFAR Long Term Archive to stage, download and process pointings. Staging APIs

git/GitHub Experienced with git and hosting repositories on GitHub. As well as my own projects I also regularly fork and make pull requests to other LOFAR repositories.

- C++ I took a long online course on the language in 2018 but have not had the chance to use it in a practical or work setting since
- Cloud Services I have worked with Google Cloud (NLP and AI) and AWS (EC2, S3, SageMaker) for hackathon projects and a previous internship

Machine I have completed a Diamond Light Source machine learning course. Currently planning a machine learning project to complete in 2023.

Others I have been learning R and Julia over the past year, primarily in the context of data science and machine learning.

Collaboration Membership

- LOFAR Member of LOFAR Surveys Key Science Project, Evolution of AGN and Star-Forming Galaxies working group and Long Baseline Working Group
- LOFAR2.0 Key member of the technical team for ILoTSS proposal (outcome expected Feb 2024)
 - SKA Member of the Continuum Science Working Group

Telescope Experience

e-MERLIN PI for 120 hours observed in Cycle 13

Leadership

UK SKA ECR Selected to represent the ECR community in the UK (2023), helping to organise a *Town Hall* meeting at Committee the Royal Astronomical Society in London (2024).

LOFAR-VLBI Led working groups during busy weeks (twice per year) to help advance pipeline development.

Journal Club Co-led the Durham Astronomy PhD journal club for 2022/23 and first-year journal club 2021/2022.

Conference LOC for *What drives the growth of black holes?* (Reykjavik, Iceland; Oct 2022) and *AGN Populations* Organisation *Across Continents and Cosmic Time* (Durham, UK, Jul 2024)

Citizenship

Research Active member of the quasar and LOFAR research groups at Durham University. I attend weekly meetings Groups and regularly update and contribute to the work of the group.

IDEA Regular participant in the Inclusivity, Diversity, Equity and Accessibility (IDEA) monthly discussions within Meetings the Durham Astronomy department.

Accretion Member of the Durham-Newcastle accretion alliance. A meeting that shares ideas on all forms of accretion Alliance across the departments.

Journal Clubs Regular participant in the AGN/accretion journal club within Durham and the PhD student journal club.

Scientific Presentations

USA, Jun. **AGN Winds on the Chesapeake** - Contributed - *Does the radio enhancement of BALQSOs have a* 2023 *distinct origin?*

Scotland, Jan **DEX-XIX** - Contributed - *Disentangling the drivers of radio emission in quasars* 2023

South Africa, **South African Radio Astronomy Observatory** - Invited Speaker - Determining the origin of radio Dec. 2022 emission in quasars with outflows

South Africa, **University of Cape Town** - Invited Lunchtime Speaker - *Determining the origin of radio emission in* Dec. 2022 *quasars with outflows*

Iceland, Oct. What Drives the Growth of Black Holes? Conference - Contributed - How can we determine the 2022 source of the enhanced radio detection fraction of quasars with strong winds?

Virtual, Oct. **LOFAR Early Careers Researcher Conference** - Contributed - *How can we determine the source of the* 2022 *enhanced radio detection fraction of quasars with strong winds?*

Virtual, May **Kapteyn Institute** - Invited Lunchtime Speaker - *How can we determine the source of the enhanced radio* 2022 *detection fraction of quasars with strong winds?*

Virtual, Nov. Science at Low Frequencies - Contributed Lightning Talk 2021

Public Engagement/Outreach

Celebrate Helped children ages 6-16 understand cosmology work in Durham through exploring a "Universe Maker" Science and virtual reality tours of our simulations. Space Camp Overnight camp for children aged 10 at a local school. Created model planets and moon dust before leading a stargazing session. Public Talks Mexborough and Swinton Astronomical Society, Sep. 2022 - How super-massive black holes control the galactic weather Public Talks Birmingham Astronomical Society, Oct. 2024 - Black holes and the extragalactic weather forecast Other Experience Teaching October **Postgraduate Demonstrator**, Durham University, UK. 2020-July I have been working as a postgraduate demonstrator each year since starting my PhD. At Durham this is optional but I took the initiative including through the pandemic. In particular, I have greatly enjoyed being one of two 2024 "drop-in" demonstrators for 3rd and 4th year undergraduates. In this role, I help with any programming problems these students face in their final-year projects. July 2016–July **Tutor**, *Advantage 11+*, Birmingham, UK. 2020 I have tutored children between the ages of 8 and 11 for several years. This has allowed me to: • As a leader, manage a class of 25 young students and two other tutors • Plan a series of lessons between 2 and 4 weeks long

- o Deliver short lessons on key topics in a clear and effective manner
- Communicate with parents, giving advice on what their children need to work on and how they should be studying

June 2014 Teaching Assistant, Wilson Stuart School, Birmingham, UK.

I volunteered as a teaching assistant at this Special Academy for disabled students. I worked with a class of students with very different abilities and needs. I improved:

- My confidence in responding to stressful or unusual situations (e.g. student having a seizure)
- Communication skills with the students and also teachers. I even learnt some "Makaton" sign language
- Teaching skills. How to teach a 14-year-old student practical life skills when they struggle to count past 10.

Other

July-August Summer Internship, Drone Industries Ltd., Gateshead, UK, 7 weeks.

2019 I won the chance to work for a company in the space or space technologies industry through a Santander scheme. I was mostly given tasks related to website design and structure but I managed to implement some extra features such as interactive maps combined with drone imagery using JavaScript. I also used Open-CV to help identify different types of moor plants and study their growth in drone images for the local council. I combined artificial intelligence AWS services with archive images from a local museum to pull out useful text and key aspects of their extensive collection.

October Musician, Durham, UK.

2016-Present I have played in several bands while at Durham University. I play clarinet (Grade 8 distinction), saxophones, piano (grade 7 merit) and I am learning the flute. I have been able to:

- Negotiate prices and payment with large university organisations for balls and other events
- Lead a big band of 18 people as president. Manage \sim £7000 a year as well as providing leadership and direction. • Organise a tour for 16 people to travel to Amsterdam (2019) and Prague (2022). Liaise with transport and
- accommodation providers, set up venues to perform abroad and budget based on income for the year.
- Record three albums with a band in Durham and release them online.

Languages

English Fluent

French Moderate

Native Speaker B at AS Level

Further Achievements

Postgraduate During the COVID-19 pandemic, I was elected to the role of Events Officer for post-grads in my college. Events Officer I ran successful online events both socially and for members to share their research with others across disciplines. By the end of the role I managed to run some in-person events, the highlight being a postgrad BBQ celebration.

Running I was diagnosed with Juvenile Arthritis, a genetic disease which affects my joints, when I was 15. Despite Despite this, I have been able to continue sporting activity and, in particular, running where I have been able to run Adversity half marathons (starting in 2014) and the Budapest marathon (2018). I also play, and regularly captain teams in, Ultimate Frisbee for Durham University along with football for my college. Outside university, I have been a part of and captained a team that reached the UK national championships in Ultimate Frisbee.

Duke of I have completed my Gold Duke of Edinburgh award which involved many hours of volunteering, sporting Edinburgh activity and new experiences. Prince Edward presented me with the award in 2017. Award

Publications

First Author

- 1 Petley, J. W., Morabito, L. K., Rankine, A. L. and 7 colleagues, *How does the radio enhancement of broad absorption line quasars relate to colour and accretion rate?*, MNRAS, 529, 3, 2024
- 2 Petley, J. W., Morabito, L. K., Alexander, D. M. and 6 colleagues, *Connecting radio emission to AGN wind properties with Broad Absorption Line Quasars*, MNRAS, 525.4, 5159-5174, 2022

Co-Author

- 1 de Jong, J. M. G. H. J., van Weeren, R. J., Sweijen, F. and 11 colleagues, *Into the depths: Unveiling* ELAIS-N1 with LOFAR's deepest sub-arcsecond wide-field images, A&A, 689, A80, **2024**
- 2 Arnaudova, M. I., Smith, D. J. B., Hardcastle, M. J. and 8 colleagues, *Exploring the radio-loudness of SDSS quasars with spectral stacking*, MNRAS, 528, 3, **2024**
- 3 Yue, B., Best, P., Duncan, K., and 6 colleagues, A novel Bayesian approach for decomposing the radio emission of quasars: I. Modelling the radio excess in red quasars, MNRAS, accepted, **2024**
- 4 Calistro Rivera, G., Alexander, D. M., Harrison, C. M. and 16 other colleagues, *Ubiquitous radio emission in quasars: predominant AGN origin and a connection to jets, dust and winds*, submitted to MNRAS, preprint https://arxiv.org/abs/2312.10177 **2023**
- 5 Hardcastle, M. J., Horton, M. A., Williams, W. L. and 48 colleagues, *The LOFAR Two-Metre Sky Survey* (LoTSS) VI. Optical identifications for the second data release, A&A, 678, A151, **2023**
- 6 Andonie, C. A., Alexander, D. M., Rosario, D. J and 13 colleagues, *A panchromatic view of infrared quasars:* excess star formation and radio emission in the most heavily obscured systems, MNRAS, 517.2, 2577-2598, **2022**

In Preparation

1 Petley, J. W., Morabito, L. K. and others, A high-resolution study of BALQSOs with the ILT and eMERLIN