Dr David J. Turner CV

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A postdoctoral research associate who specializes in the creation of general, open-source, research software for X-ray astrophysics, and its application to the measurement of galaxy cluster properties.

Research Positions

Michigan State University — East Lansing, USA
Research Associate — 2022–**Current**

Education

University of Sussex — Brighton, UK
Ph.D. in Astronomy, Advisor: Professor Kathy Romer — 2018–2022

University of Sussex — Brighton, UK
1st Class MPhys in Astrophysics — 2014–2018

Skills

- **Galaxy Cluster Science:** I am an expert in multi-wavelength analyses of galaxy clusters; constraining their mass, temperature, density, and relations between them. This provides information on the scatter of the total mass with respect to these different properties; very important to successfully constrain cosmology using galaxy clusters.
- **X-ray Expertise:** I have extensive experience of working with, and analysing, X-ray data. I've mostly worked on galaxy clusters, but have also worked on the X-ray emissions of 'Pea' galaxies. I am extremely familiar with *XMM* data products, as well as analysis of photometric and spectroscopic X-ray data.
- **Combining Real Data and Simulations:** My work on creating realistic simulated *XMM* observations of galaxy clusters, as well as the work I do using real observations, has given me a lot of experience leveraging both real and simulated data to produce interesting results. I have made artificial *XMM* observations of Illustris-TNG, the 300 Project, and BAHAMAS clusters.
- **Software Engineering:** With over twelve years of experience in programming, ten years of Python experience, and 8 years of using XSPEC, I am an extremely capable programmer. Not only do I have the ability to write complex code, but I also have the attendant skills in GitHub, writing tests, and writing documentation, that allow me to make a piece of software sustainable and useful to the community.
- **Data Science and Machine Learning:** My PhD funding was provided by the Data Intensive Science Centre, and aims to give Physics PhD researchers skills in data science and machine learning, and as such we've been given extra training in data science, scalable computing, and machine learning.

Ongoing Research

LoVoCCS ICM properties and relations
LoVoCCS is creating 2D weak-lensing mass maps for 147 local clusters - I am providing X-ray properties (global, radial, & 2D maps) and scaling relations.

X-ray Masses of Galaxy Clusters
Measuring masses for the XCS catalog. We have 1000s of candidates, so automation is vital. Created the largest set of X-ray cluster masses.

Galaxy groups exhibiting OVI absorption
Finding X-ray counterparts to optically-selected groups; linking X-ray properties to whether warm-phase ICM is detected by background quasar absorption.

Large-scale X-ray analysis of LOFAR sources
Applying XGA software to the LOFAR catalogs to measure X-ray properties for over 10000 radio sources. A valuable catalog of radio/X-ray properties for a large sample.

Locating Pea Galaxies with Machine Learning
An ensemble approach to identifying Pea Galaxies with SVM + deep learning. Supported by NVIDIA grant. X-ray properties to be measured once sample complete.

Multi-wavelength Cluster Scaling Relations
Scaling relations (including MORs) using *XMM* and DES data. These feed into DES cluster cosmology efforts, and help prepare for LSST-DESC work.

Open Source Astrophysics Software

Xga - General X-ray Analysis
Python module to make complex analyses (e.g. spectral, radial) of X-ray data simple. Supports *XMM* & *eROSITA*, with other missions coming soon.

Daxa - Multi-mission X-ray data archives
Python module for easy acquisition, reduction, and management of multi-mission X-ray astrophysics datasets - enabling access for non-experts.

Teaching

- **Course Author and Teaching Assistant** at University of Sussex — Spring 2019/2020 & Autumn 2020/2021
  Co-authored the new introductory Python course, including assessments and the course book
- **Course Instructor** at DISCUS - University of Sussex — Spring 2020
  AstroCAST Python Training for Kenyan Government Officials and the Kenyan Red Cross

Scholarships and Awards

- Doctoral Open Research Prize — 2022
- NVIDIA Academic Grant - Quadro RTX 8000 GPU — 2021
- DISCNet-STFC PhD Studentship — 2018–2022
- Junior Research Associate Funding — 2017
- Sussex Funded Research Placement (8 weeks) — 2016
- Sussex Funded Research Placement (4 weeks) — 2015

Relevant Conferences and Talks Given

- **The X-ray Universe:** Gave a talk on hydrostatic mass measurements of galaxy clusters using my Xga software.
- **Talk at University of Michigan:** Invited to give a talk to the galaxy cluster research group - presented on my analysis of eFEDS clusters with *XMM*, the temperature calibration that was produced, and the Xga package.
- **Talk at AIfA:** Invited to give a talk to the cluster group at Argelander Institute for Astronomy. Focusing on recent work on *eROSITA*-*XMM* temperature calibrations and cluster mass measurements of an SDSS selected sample.
- **Cluster Mass 2021:** Presented a flash talk/poster on a new sample of SDSS hydrostatic masses measured by `XGA`.
- **LSST UK 2021 Meeting:** Presented a poster on a new sample of DES-Y3 hydrostatic masses measured by `XGA`.
- **National Astronomy Meeting 2021:** I organised and convened a session to bring together cluster observers and simulators. It was a great success and attracted talks on cutting edge research from many areas of cluster science.
- **Talk at MPE:** Gave a 40 minute talk to the high-energy astrophysics group at the Max Planck Institute for Extraterrestrial Physics, giving an overview of XCS with a particular focus on my cluster mass measurements.
- **DES Biannual Meeting 2019:** Held at the University of Sussex, and organised by the research group that I am a part of. I gave a two minute 'spotlight' talk on my research into the X-ray properties of Pea galaxies.
- **Athena UK 2019 Meeting:** Hosted at MSSL. Attended talks on state of *Athena*, and planned capabilities.
- **New Results in X-ray Astronomy 2019:** Hosted at MSSL. Gave a talk on my artificial observations of simulated clusters, as well as my work on measuring hydrostatic masses and how it could be applied to cluster cosmology.
- **DES Biannual Meeting 2019:** Held at the University of Pennsylvania, I gave a two minute 'spotlight' talk presenting some preliminary scaling relations measured from my artificial observations of simulated clusters.

- **National Astronomy Meeting 2019:** Gave a talk on my realistic artificial observations of simulated galaxy clusters, and measurements made from the simulated data. Also attended many of the sessions at this conference.
- **DES Y3KP Meeting 2019:** Attended meeting in Barcelona, where we were preparing for DESY3 cosmology.
- **DES Biannual Meeting 2018:** This took place at Unicamp in Brazil, where I gave a talk to the cluster working group about my work on realistic artificial observations of simulated galaxy clusters.

Publications

1. D. J. Turner et al., "The XMM Cluster Survey: Automating the estimation of hydrostatic mass for large samples of galaxy clusters I – Methodology, Validation, Application to the SDSSRM-XCS sample", *submitted to MNRAS*
2. D. J. Turner et al., "The *XMM* Cluster Survey: An independent demonstration of the fidelity of the eFEDS galaxy cluster data products and implications for future studies", *arXiv*
3. D. J. Turner et al., "Xga - A module for the large-scale scientific exploitation of X-ray data", *arXiv*
4. D. J. Turner et al., "Daxa - Traversing the X-ray desert by Democratising Archival X-ray Astronomy", *Draft*
5. D. J. Turner et al., "An X-ray view of galaxy groups in the line of sight of UV-bright quasars - comparing X-ray properties to absorption detection of warm-hot gas", *in prep.*
6. D. J. Turner et al., "LoVoCCS III - X-ray properties and scaling relations of 58 clusters with individual 2D weak-lensing mass maps", *in prep.*
7. D. J. Turner et al., "X-ray properties of all LOFAR sources with an XMM detection", *in prep.*
8. D. S. Pillay, et al., "A Multiwavelength Dynamical State Analysis of ACT-CL J0019.6+0336", *published in MDPI Galaxies* - **Supplied X-ray data products, contributed to paper, and was made second author.**
9. C. J. Burke, et al., "Variability-Selected Dwarf AGNs in the Dark Energy Survey Deep Fields", *submitted to MNRAS*, arXiv:2111.03079 - **Supplied *XMM* confirmation of AGN, X-ray properties, contributed to text of paper.**
10. P. A. Giles et al., "The *XMM* Cluster Survey: XMM-Newton Observations of the SDSS DR8 redMaPPer Cluster Catalogue", *submitted to MNRAS* - **Calculated and supplied upper limit X-ray luminosities.**
11. P. A. Giles et al., "XXL: The $L_X - \sigma_v$ relation of galaxy groups and clusters detected in the XXL and GAMA surveys", *accepted to MNRAS* - **Calculated and supplied upper limit X-ray luminosities.**
12. V. Wetzell et al., "Velocity Dispersions of Clusters in the Dark Energy Survey Y3 redMaPPer Catalog", *submitted to MNRAS*, arxiv.org/abs/2107.07631 - **Calculated and supplied upper limit X-ray luminosities.**
13. T. M. C. Abbott et al., "The Dark Energy Survey Data Release 2", *published in ApJ* - **On DES Observing Team**

Additional Experience

- **Co-founder and Director:** I co-founded a limited company called Grapheel during my undergraduate degree, though we ceased operations last year. It was a not-for-profit company trying to create technologies that would allow blind and visually impaired students/researchers to interact with their work in a more natural manner. Working on our app increased my knowledge of web-based programming languages, and I also had the chance to work with new smart materials in our work to create new actuators. My communication skills benefited from making pitches to investors (we were shortlisted for funding twice) and writing documentation for aspects of the company.
- **Observing:** In my first year as a PhD student I was part of a team from the University of Sussex DES group that was able to run the DES observations on the Blanco telescope at CTIO in Chile. It was my first time observing so I spent most of my time learning the different observing roles, though I was the run manager on one of the nights.
- **Outreach:** I enjoy educating the public about cutting edge research, and have been involved in outreach for DES and JWST. I helped coordinate social media coverage for the DES Y1 Cosmology release in August 2017, and co-organised/ran the DES end of nights social media campaign, marking the end of our observations on DECam. I volunteered for Soapbox Science Brighton, an event where female researchers gave talks to the public about their fields of study to promote women in the sciences.
- **Data Science:** Due to the current pandemic, the Director of Student Experience for the Physics department at the University of Sussex has been running surveys to gauge the feeling in the student body in the autumn term. I was employed by the department to concatenate, reduce, and analyse the results of the surveys so that the faculty members could understand how the students were feeling and adjust their teaching accordingly.