

CURRICULUM VITAE

DR. JAMES O'DONOGHUE

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Professional Summary

I am a planetary scientist specialising in observations of Jupiter and Saturn with the world's largest observatories. My research examines planetary upper-atmosphere processes like aurorae and Saturn's ring erosion and is widely covered by international media. I create educational animations to make astronomy accessible, with hundreds of millions of views, and have contributed to documentaries with BBC, PBS, and NHK Japan.

Research Experience

University of Reading, UK *STFC ERF Fellow & Research Associate Prof.*

November 2023 – present

- Q To understand global energy drivers at Jupiter and estimate precisely the decay rate of Saturn's rings.

Japanese Space Agency (JAXA), Japan *JAXA Fellow & Research Associate Prof.*

May 2019 – October 2023

- Q Observing Jupiter's upper atmosphere to find heat sources and investigating the detectability of H_3O^+ at Saturn.
- ✓ Discovery that Jupiter's aurorae globally heat the upper atmosphere. H_3O^+ not detected at Saturn.

NASA Goddard Space Flight Center, USA *NASA Postdoctoral Program Fellow*

January 2017 – March 2019

- Q Led a study on 'ring rain' at Saturn, supported Juno spacecraft observations.
- ✓ Estimated Saturn's rings' decay rate limits their lifetime to 300 million years.

Boston University, USA *Research Scientist*

May 2014 – January 2017

- Q Investigation into Jupiter's upper-atmospheric energy balance and Saturn's ring influence on the planet.
- ✓ Discovered Jupiter's Great Red Spot heats the upper atmosphere; Saturn's temperature too low to detect emissions.

Education

University of Leicester, UK

Ph.D. in Planetary Space Science

Thesis: *The response of gas giant ionospheres to their local space environments*

Discoveries: Saturn's rings fall into the ionosphere & differences between Saturn's northern and southern aurorae.

October 2010 – May 2014

Supervisor: Dr. Tom Stallard

Aberystwyth University

B.Sc. Planetary & Space Science

Dissertation: *A Study of Lunar Impact Flashes*

2006 – 2010

Grade: First-class hon.

Awards

Winner: Europlanet Society Prize for Public Engagement with Science.

2021

For work in creating high-quality space science animations and sharing them globally.

Finalist: American Association for Advancement of Science Award for Public Engagement with Science.

2022

Prize: Elsie Pritchard Prize for achievement in physics.

2010

Technical Skills

Programming Languages

Interactive Data Language (IDL), Python, \LaTeX and basic HTML

Digital Tools

Adobe Creative Suite, Blender 3D, MS Office 365 Suite, ChatGPT

Further Skills

Animation creation, home astronomy, digital imaging

Grants Awarded

2024 Keck Observatory award of \$14,000 as part of the award for Keck telescope time.

2023 Science and Technology Facilities Council Ernest Rutherford Fellowship over 5 years, \$850,000.

2022 Keck Observatory award of \$14,000 as part of the award for Keck telescope time.

2021 Keck Observatory award of \$12,750 as part of the award for Keck telescope time.

2020 Keck Observatory award of \$12,750 as part of the award for Keck telescope time.

2019 JAXA International Top Young Fellowship, PI, grant of \$460,000.

2018 Keck Observatory award of \$12,750 as part of the award for Keck telescope time.

2017 NASA grant NNH16ZDA001N-SSO: Solar System Observations, Science PI, \$395,969.

2017 NASA Postdoctoral Program Fellowship, PI, award of \$250,000 (not including overheads).

2017 Keck Observatory award of \$11,000 as part of the award for Keck telescope time.

2016 Keck Observatory award of \$15,000 as part of the award for Keck telescope time.

2014 NASA grant NNH13ZDA001N-PAST: Planetary Astronomy, main Co-I, \$351,052.

2012 Royal Astronomical Society (United Kingdom) travel grant of \$600.

Total: \$2,399,900

Teaching and Mentoring

Mentoring

2023 – present Ph.D. Student, University of Northumbria – External Supervisor

2020 – 2021 Undergraduate Student, Tohoku University – Research Project Support

2016 – 2017 Master’s Student, Boston University – Co-Mentor

University Teaching

2012–2014 Experimental Physics 1 (PA1900) – Led lab-based classes on telescope construction and use.

2013 Mathematical Physics 1.1 (PA1710) – Supported teaching and grading in foundational concepts.

Awarded Telescope Time

Year	Telescope	Nights (proposals)	Role	Topic
2025	W.M. Keck	1.5 (2)	Co-I	Uranus aurora drivers, Jupiter Juno support
2024	W.M. Keck	1.5	PI	Saturn: Auroras and Ring Rain with JWST
	W.M. Keck	6.5	Co-I	Jupiter: Juno support
	JWST Cyc 3	2.5 (2)	Co-I	Saturn and Uranus: auroral drivers
2023	JWST Cyc 2	1.9	Co-I	Jupiter: upper atmosphere study
	NASA IRTF	4.0 (2)	Co-I	Jupiter, Uranus: energy crisis, ionosphere study
2022	W.M. Keck	1.0	PI	Exoplanet: aurora/ionosphere detection attempt
	W.M. Keck	6.0 (2)	Co-I	Jupiter, Uranus: Juno support, aurora mapping
	JWST Cyc 1	2.6	Co-I	Giant planets: early release science
2021	W.M. Keck	1.0	PI	Saturn: H ₃ O ⁺ detection attempt
	W.M. Keck	1.0	PI	Exoplanet: aurora/ionosphere detection attempt
	NASA IRTF	7.0 (2)	Co-I	Jupiter, Uranus: Juno support, aurora mapping
2020	W.M. Keck	1.0	PI	Saturn: ring rain search
	NASA IRTF	2.0	PI	Exoplanet: aurora/ionosphere detection attempt
	NASA IRTF	10.0 (2)	Co-I	Saturn, Jupiter: aurorae, Ganymede shadow
2019	NASA IRTF	2.5 (2)	Co-I	Saturn, Jupiter: ring rain, Juno support
2018	W.M. Keck	1.5	PI	Jupiter: Juno support
	W.M. Keck	1.5	Co-I	Jupiter: Juno support
	NASA IRTF	3.0	PI	Jupiter: Juno support
2017	W.M. Keck	1.5	PI	Jupiter: Juno support
	NASA IRTF	5.0 (2)	Co-I	Jupiter: Juno support
2016	W.M. Keck	2.0	PI	Jupiter: Juno support
	NASA IRTF	1.0	PI	Mars: H ₃ ⁺ search
	W.M. Keck	1.5	Co-I	Saturn: Cassini support
	NASA IRTF	2.0	Co-I	Jupiter: Juno support
2015	Gemini N.	3.0	Co-I	Saturn: solar influence on ionosphere
	NASA IRTF	6.0	PI	Jupiter: low-latitude heating
	NASA IRTF	8.5 (4)	Co-I	Saturn, Jupiter, Uranus and Titan
2014	W.M. Keck	2.0	Co-I	Saturn: Cassini support
	Gemini N.	4.0	Co-I	Saturn: auroral energy flows
	NASA IRTF	16.5 (3)	Co-I	Saturn, Jupiter: Cassini, Hisaki support
2013	W.M. Keck	4.0	Co-I	Saturn: Cassini support
	NASA IRTF	8.5 (2)	Co-I	Jupiter, Saturn: Cassini, Hisaki support

	Gemini N.	2.0	Co-I	Uranus: energy drivers in upper atmosphere
2012	NASA IRTF	5.5	PI	Jupiter: global ionosphere mapping
2011	NASA IRTF	18.0	Co-I	Jupiter, Saturn, Uranus: various topics
Total:		151.9 (50)		

Peer Reviewed Journal Publications

36. **J. O'Donoghue**, L. Moore, T. Stallard, B. Kurth, et al. A potential planetary-scale auroral heat transport event observed at Jupiter following a solar-wind compression. *Geophys. Res. Lett.*, submission Nov 2024.
35. Melin, H., **O'Donoghue, J.**, Moore, L., et al. Ionospheric irregularities at Jupiter observed by JWST. *Nat. Astron.* 8, 1000–1007, doi:10.1038/s41550-024-02305-9, 2024.
34. Agiwal, O., Cao, H., Hsu, H-W., Moore, L., .. **O'Donoghue, J.** [6], et al. Current Events at Saturn: Ring-Planet Electromagnetic Coupling. *Planet. Sci. J.* 5, 134, doi:10.3847/PSJ/ad4343, 2024.
33. Bockelee-Morvan, D., Lellouch, E., Poch, O., Quirico, E., .. **O'Donoghue, J.** [7], et al. Composition and thermal properties of Ganymede's surface from JWST/NIRSpec and MIRI observations. *Astronomy & Astrophysics* 681, p. A27, doi:10.1051/0004-6361/202347326, 2024.
32. Cao, X., Chu, X., Hsu, H-W., Cao, H., .. **O'Donoghue, J.** [6], et al. Science return of probing magnetospheric systems of ice giants. *Front. Astron. Space Sci.* 11:1203705. doi:10.3389/fspas.2024.1203705, 2024.
31. Wang, R., Stallard, T. S., Melin, H., Baines, K. H., .. **O'Donoghue, J.** [6], et al. Asymmetric ionospheric jets in Jupiter's aurora. *J. Geophys. Res. Space Phys.* 128, 12, doi:10.1029/2023JA031861, 2023.
30. **J. O'Donoghue**, Stallard, T., What the Upper Atmospheres of Giant Planets Reveal. *Remote Sensing*, 14, 6326, doi:10.3390/rs14246326, 2022.
29. Chowdhury, M. N., Stallard, T. S., Baines, K. H., Provan, G., .. **O'Donoghue, J.** [6], et al. Saturn's weather-driven aurorae modulate oscillations in the magnetic field and radio emissions. *Geophys. Res. Lett.*, doi:10.1029/2021GL096492, 2022.
28. **O'Donoghue, J.**, Moore, L., Melin, H., Stallard, T. S., et al. Global upper-atmospheric heating on Jupiter by the polar aurorae. *Nature*, doi:10.1038/s41586-021-03706-w, 2021.
27. Moore, L., Moses, J. I., Melin, H., Stallard, T. S., .. **O'Donoghue, J.** [5], et al. Atmospheric implications of the lack of H_3^+ detection at Neptune. *Phil. Trans. R. Soc. A.* 37820200100, doi:10.1098/rsta.2020.0100, 2020.
26. Yurchenko, S. N., Tennyson, J., Miller, S., Melnikov, V. V., .. **O'Donoghue, J.** [5], et al. ExoMol line lists – XL. Rovibrational molecular line list for the hydronium ion (H_3O^+). *Monthly Notices of the Royal Astronomical Society*, 497(2), Pages 2340–2351, doi:10.1093/mnras/staa2034, 2020.
25. **O'Donoghue, J.**, Moore, L., Connerney, J. E. P., Melin, H., et al. Observations of the chemical and thermal response of 'ring rain' on Saturn's ionosphere. *Icarus*, 322, Pages 251–260, doi:10.1016/j.icarus.2018.10.027, 2019.
24. Moore, L., Melin, H., **O'Donoghue, J.** [5], et al. Modelling H_3^+ in planetary atmospheres: effects of vertical gradients. *Phil. Trans. R. Soc. A.* 377, 20190067, doi:10.1098/rsta.2019.0067, 2019.
23. Ray, L. C., Lorch, C. T. S., .. **O'Donoghue, J.** [5], et al. Why is the H_3^+ hot spot above Jupiter's Great Red Spot so hot? *Phil. Trans. R. Soc. A.* 377, 20180407, doi:10.1098/rsta.2018.0407, 2019.
22. Melin, H., Fletcher, L. N., Stallard, T. S., .. **O'Donoghue, J.** [5], et al. The H_3^+ ionosphere of Uranus: decades-long cooling and local-time morphology. *Phil. Trans. A.*, doi:10.1098/rsta.2018.0408, 2019.
21. Stallard, T., Baines, K., Melin, H., Bradley, T., .. **O'Donoghue, J.** [6], et al. Local-time averaged maps of H_3^+ emission, temperature and ion winds. *Phil. Trans. A.*, doi:10.1098/rsta.2018.0405, 2019.
20. Moore, L., Galand, M., Kliore, A., Nagy, A., .. **O'Donoghue, J.** [5], et al. Saturn's ionosphere: ring rain and other drivers. *In book chapter: Saturn in the 21st Century*, Cambridge University Press, doi:10.1017/9781316227220, 2018.
19. Hsu, H. W., Schmidt, J., Kempf, S., Postberg, F., Moragas-Klostermeyer, G., Seiß, M., Hoffmann, H., Burton, M., Ye, S., Kurth, W. S., Horanyi, M., Khawaja, N., Spahn, F., Schirdewahn, D., **O'Donoghue, J.** [7], Moore, L., Cuzzi, J., Jones, G. H., Srama, R. In situ collection of dust grains falling from Saturn's rings into its atmosphere. *Science*, 362 (6410), 2018.
18. Stallard, T., Burrell, A. G., Melin, H., Fletcher, L. N., Miller, S., Moore, L., **O'Donoghue, J.** [6], et al. Identification of Jupiter's magnetic equator through H_3^+ ionospheric emission. *Nat. Astron.*, 2(7), doi:10.1038/s41550-018-0523-z, 2018.

17. Melin, H., Fletcher, L. N., Stallard, T. S., Johnson, R. E., **O'Donoghue, J.** [5], Moore, L., Donnelly, P. T. The quest for H_3^+ at Neptune: deep burn observations with NASA IRTF iSHELL. *Monthly Notices of the Royal Astronomical Society*, 474(3), Pages 3714-3719, doi:10.1093/mnras/stx3029, 2018.
16. **O'Donoghue, J.**, Moore, L., Connerney, J. E. P., Melin, H., et al. Re-detection of the ionospheric H_3^+ signature of Saturn's "ring rain". *Geophys. Res. Lett.*, 44(11), Pages 11762-11769, doi:10.1002/2017GL075932, 2017.
15. Stallard, T., Melin, H., Miller, S., **O'Donoghue, J.** [6], et al. Great Cold Spot in Jupiter's upper atmosphere. *Geophys. Res. Lett.*, 44(7), Pages 3000-3008, doi:10.1002/2016GL071956, 2017.
14. Moore, L., **O'Donoghue, J.**, Melin, H., Stallard, T., et al. Variability of Jupiter's IR H_3^+ aurorae during Juno approach. *Geophys. Res. Lett.*, 44, Pages 4513-4522, doi:10.1002/2017GL073156, 2017.
13. **O'Donoghue, J.**, Moore, L., Stallard, T. S., Melin, H., et al. Heating of Jupiter's upper atmosphere above the Great Red Spot. *Nature*, 536(7615), Pages 190-192, doi:10.1038/nature18940, 2016.
12. Stallard, T., Clarke, J. T., Melin, H., Miller, S., Nichols, J. D., **O'Donoghue, J.** [6], et al. Stability within Jupiter's polar auroral 'Swirl region' over moderate timescales. *Icarus*, 268, 145-155, doi:10.1016/j.icarus.2015.12.044, 2016.
11. **O'Donoghue, J.**, Melin, H., Stallard, T. S., Provan, G., Moore, L., Badman, S. V., Cowley, S. W. H., Baines, K. H., Miller, S., Blake, J. S. D. Ground-based observations of Saturn's auroral ionosphere over three days: trends in H_3^+ temperature, density and emission with Saturn local time and planetary period oscillation. *Icarus*, 263, 44-55, doi:10.1016/j.icarus.2015.04.018, 2016.
10. Melin, H., Badman, S. V., Stallard, T. S., Cowley, S. W. H., Dyudina, U., Nichols, J. D., Provan, G., **O'Donoghue, J.** [7], Pryor, W. R., Baines, K. H., Miller, S., Gustin, J., Radioti, A., Tao, C., Meredith, C. J., Blake, J. S. D., Johnson, R. E. Simultaneous multi-scale and multi-instrument observations of Saturn's aurorae during the 2013 observing campaign. *Icarus*, 263, 56-74, doi:10.1016/j.icarus.2015.08.021, 2016.
9. Stallard, T. S., Melin, H., Miller, S., Badman, S. V., Baines, K. H., Brown, R. H., Blake, J. S. D., **O'Donoghue, J.** [6], Johnson, R. E., Bools, B., Pilkington, N. M., East, O. T. L., Fletcher, M. Cassini VIMS observations of H_3^+ emission on the nightside of Jupiter. *J. Geophys. Res. Space Physics*, 120, 6948-6973, doi:10.1002/2015JA021097, 2016.
8. Moore, L., **O'Donoghue, J.**, Mueller-Wodarg, I., Galand, M., Mendillo, M. Saturn ring rain: Model estimates of water influx into Saturn's atmosphere. *Icarus*, 245, 355-366, doi:10.1016/j.icarus.2014.08.041, 2015.
7. Mousis, O., Fletcher, L. N., .. **O'Donoghue, J.** [6], et al. Scientific rationale for Saturn's in situ exploration. *Planetary and Space Science*, 104, 29-47, doi:10.1016/j.pss.2014.09.014, 2014.
6. Melin, H., Stallard, T. S., .. **O'Donoghue, J.** [5], et al. On the anti-correlation between H_3^+ temperature and density in giant planet ionospheres. *Mon. Not. R. Astron. Soc.*, doi:10.1093/mnras/stt2299, 2013.
5. **O'Donoghue, J.**, Stallard, T. S., Melin, H., Jones, G. H., .., et al. Conjugate observations of Saturn's northern and southern aurorae. *Icarus*, 229, 214-220, doi:10.1016/j.icarus.2013.11.009, 2013.
4. **O'Donoghue, J.**, Stallard, T. S., Melin, H., Jones, G. H., Cowley, S. W. H., Miller, S., Baines, K. H., Blake, J. S. D. The domination of Saturn's low-latitude ionosphere by ring 'rain'. *Nature*, 496(7444), 193-195, doi:10.1038/nature12049, 2013.
3. Melin, H., Stallard, T. S., S. Miller, T. R. Geballe, L. R. Trafton, **O'Donoghue, J.**, Post-equinoctial observations of the ionosphere of Uranus. *Icarus*, 223(2), 741-748, doi:10.1016/j.icarus.2013.01.012, 2013.
2. Stallard, T. S., Melin, H., S. Miller, **O'Donoghue, J.** [6], et al. Temperature changes and energy inputs in giant planet atmospheres: what we are learning from H_3^+ . *Phil. Trans. Roy. Soc.*, 370, 5213-5224, doi:10.1098/rsta.2012.0028, 2012.
1. Melin, H., Stallard, T. S., S. Miller, Gustin, J., Galand, M., Badman, S. V., Pryor, W. R., **O'Donoghue, J.** [7], Brown, R. H., Radioti, A., Tao, C., Meredith, C. J., Blake, J. S. D., Johnson, R. E. Simultaneous Cassini VIMS and UVIS observations of Saturn's southern aurora: Comparing emissions from H, H_2 and H_3^+ at a high spatial resolution. *Geophys. Res. Lett.*, 38, L15203, doi:10.1029/2011GL048457, 2011.

Invited Talks: Conferences and Seminars

2024 Keynote speaker at a Department of Meteorology event, University of Reading.

2024 Graduate Student Invited Seminar Speaker, Boston University (US).

2024 Talk at the International Space Science Institute (ISSI), Bern, Switzerland, 'Jupiter's non-auroral Upper Atmosphere'.

- 2024** Seminar for Department of Meteorology, University of Reading.
- 2023** Talk at Japan Geoscience Union (JpGU), Investigations of Giant Planet Upper Atmospheres: Past, Present and Future’.
- 2023** Talk for JAXA/ISAS Diversity Promotion, The Experience of Researching Internationally’.
- 2022** Seminar at JAXA/ISAS Coffee Talk, A planetary-scale heat wave in Jupiter’s upper atmosphere’.
- 2022** Talk at ISSI, Bern, Switzerland, New and future observations of Saturn and insights for Jupiter, Uranus and Neptune’ as part of ‘ring-planet interactions’ meeting.
- 2021** Seminar at JAXA/ISAS Planetary Exploration Workshop, Future Science at the Outer Planets’.
- 2021** Keynote Speaker for Outer Planet Systems, EuroPlanet Science Congress (EPSC), What the upper atmospheres of Giant Planets reveal’.
- 2021** Talk at EPSC, Global upper-atmospheric heating at Jupiter by the recirculation of auroral energy’.
- 2021** Award-acceptance talk at EPSC for the Europlanet Prize for Public Engagement.
- 2021** Talk at Royal Astronomical Society, Observational evidence for upper-atmospheric heat transfer to Jovian equatorial latitudes from the auroral regions’.
- 2020** Seminar at Japan Science Communication Forum, ‘Animated Science Communication’.
- 2019** Seminar at Earth–Life Sciences Institute, Tokyo, ‘Saturn’s Rings and Jupiter’s Great Red Spot: an animated discussion’.
- 2018** Seminar at Catholic University of America, Revealing the inner-workings of Saturn’s Rings and Jupiter’s Great Red Spot with ionospheric measurements’.
- 2018** Talk at EPSC, Ground-based observations of Giant Planet upper atmospheres’.
- 2017** Seminar at NASA Goddard Space Flight Center, ‘Heating of Jupiter’s upper atmosphere by the Great Red Spot’.
- 2016** Talk at American Geophysical Union (AGU) conference, Searching for sources of planet-wide heating in Jupiter’s upper atmosphere: new clues from the Great Red Spot’.
- 2016** Seminar at University of New Hampshire, Ground-based observations of Jupiter and Saturn: aurora, ring rain and Jupiter’s Great Red Spot’.
- 2015** Seminar at Georgia Institute of Technology, Observations of gas giant ionospheres’.
- 2015** Talk at Magnetospheres of the Outer Planets (MOP) conference, Ground-based observations of planetary aurorae’.
- 2013** Talk at ISSI, Bern, Switzerland, part of the second ‘Comparative Jovian Aeronomy’ meeting on ‘Saturn’s ring rain’.
- 2012** Talk at ISSI, Bern, Switzerland, Saturn’s auroral energy balance’ as part of Comparative Jovian Aeronomy’ meeting.

Public Engagements and Media Appearances

- 2024** Documentary appearance for BBC’s Solar System with Prof. Brian Cox, Episode 5, Strange Worlds.
- 2024** Documentary appearance, on location in the Canary Islands, for PBS NOVA in the USA, Strange Worlds.
- 2024** Led NASA Observe the Moon Night at University of Reading: audience 200 in person, 1,100 online.
- 2024** Delivered two public lectures at the Royal Astronomical Society, Burlington House, London.
- 2023** Consultant and featured expert, Space chapter of Britannica’s Encyclopedia Infographica.
- 2023** Animation featured in Cosmic Front, a documentary by NHK (Japan).
- 2022** Animation featured in Are You Smarter than a 5th Grader (Japan edition).
- 2022** Created fly-by animations for the BepiColombo mission’s June 2022 flyby of Mercury.
- 2022** Organised Observe the Moon Night, serving as JAXA–NASA liaison.
- 2022** Chaired Hayabusa2 and Beyond live event for JAXA, British Science Museum.
- 2021** Organised Observe the Moon Night, serving as JAXA–NASA liaison.

- 2021** Created fly-by animations for BepiColombo's August 2021 flyby of Venus.
- 2021** Co-hosted live Uranus-observing event with the Royal Astronomical Society.
- 2021** Co-organised public outreach broadcast, JAXA Institute of Space and Astronautical Science Open Day.
- 2020** Presented seminar at American School in Japan, An Animated Tour of the Solar System.
- 2019** Hosted an exhibit using animations at JAXA Institute of Space and Astronautical Science Open Day.
- 2019** Appeared in Strip the Cosmos, Discovery Channel documentary on Saturn's rings.
- 2018** Appeared in Space's Deepest Secrets, Science Channel documentary on Saturn's rings.
- 2017** Interviewed by The New York Times on historic Juno spacecraft close-up images of the Great Red Spot.
- 2017** Appeared in NHK Japan's Cosmic Front, discussing Jupiter's Great Red Spot.
- 2016** Press release after Nature publication on Jupiter's Great Red Spot, featured by over 100 news outlets.
- 2014** Volunteer for BBC's Stargazing Live, promoting the study of Jupiter and Saturn.
- 2014** Invited speaker at Stratford-upon-Avon Astronomical Society, Saturn's Ring Rain.
- 2014** Participated in Live at the Observatory at the Keck telescope, with live Q&A for an audience of 1,000.
- 2013** Invited appearance on BBC Radio Leicester as a panel expert on space.
- 2013** Press release on Nature publication on Saturn's ring rain discovery; covered by over 100 news outlets.
- 2012** Conducted live outreach from NASA's Infrared Telescope Facility (IRTF) to schools and universities.

Training

- 2024** MediaFirst media interview training. Including mock TV, radio, print news interviews.
- 2024** Writing for REF workshop at University of Reading.
- 2023** James Webb Space Telescope Proposal Workshop.
- 2020** Coursera course in *Python For Everybody* by the University of Michigan.
- 2012** STFC Summer school in Solar System Plasmas at Armagh Observatory
- 2010** STFC Summer school in Solar Physics at Leeds University