CV - Tom Elsden

Email: te55@st-andrews.ac.uk
Address: School of Mathematics and Statistics, University of St Andrews, St Andrews, UK, KY16 9SS
ORCID: https://orcid.org/0000-0002-1910-2010
Personal webpage: https://telsden.github.io/

This front page provides a concise form of my CV. Details e.g. publication list, follow in later pages.

Employment & Education

- *Sep 2022 - Present*: Lecturer in Mathematics and Statistics, University of St Andrews.
- *Oct 2021 - Aug 2022*: Leverhulme Early Career Research Fellow and Rankin-Sneddon Fellow, University of Glasgow.
- *Oct 2019 - Sep 2021*: Leverhulme Early Career Research Fellow, University of Leicester.
- *June 2016 - Sep 2019*: Post Doctoral Research Assistant on a Leverhulme Research Project Grant, University of St Andrews.
- *Sep 2012 - June 2016*: PhD in Applied Mathematics, University of St Andrews.
- *June 2011 - Aug 2011*: Research Experience for Undergraduates (REU) Programme, Harvard Smithsonian Centre for Astrophysics.
- *Sep 2008 - June 2012*: MMath (Hons) Mathematics - First Class, University of St Andrews.

Research Area and Activity

My research focusses on large scale plasma waves, known as ultra-low frequency (ULF) waves, in Earth's magnetosphere - the space around the Earth dominated by the Earth's magnetic field. These waves are an important aspect of space weather, driving aurora and radiation in near-Earth space. I use computational magnetohydrodynamic (MHD) modelling to understand and predict the role of ULF waves in Earth's magnetospheric system.

I have written 30 research papers (27 published, 1 accepted, 2 in review), with 12 as first author and 8 as second author, in leading journals for my field such as:

- Journal of Geophysical Research (JGR): Space Physics (18),
- Geophysical Research Letters (GRL)(3),
- Frontiers in Astronomy and Space Science (4),
- Invited single author review to appear in Oxford Research Encyclopedia of Planetary Science,
- Invited book chapter in AGU Geophysical Monograph Series.

I have delivered over 35 external research talks, over 20 of which have been invited talks. I have regularly organised sessions at national and international conferences, as well as co-organising the largest UK summer school in my field, funded by STFC in 2023.

Grants, Appointments and Memberships

- 2019 - 2022, Leverhulme Early Career Fellowship entitled *Resonating Magnetic Field Lines: A Process for Energy Transfer at Earth/Mercury*, University of Leicester, £93000.
- STFC Knowledge Exchange Institutional Award entitled *Sharing the History and Science of Total Solar Eclipses*, £16000.
- UK liaison to the US Geophysical Environment Modelling (GEM) community.
- Core member of 2 International Space Science Institute (ISSI) teams from 2019-2024.
- Lead of public outreach activities in mathematics and statistics, University of St Andrews.
- Fellow of the Royal Astronomical Society.
- Regular reviewer for journals JGR Space Physics, GRL and Frontiers in Astronomy and Space Science and grant applications for STFC.

Publications

2025

30. Adnane Osmane, Jasmine Sandhu, **Tom Elsden**, Oliver Allanson, Lucile Turc, Radial Diffusion Driven by Spatially Localized ULF Waves in the Earth's Magnetosphere, *submitted* to Geophysical Research Letters.
29. Wright, A. N., **Elsden, T.**, Degeling, A., Mann, I. R., Ozeke, L., Yeoman, T., Sandhu, J., Takahashi, T., Poloidal Field Line Resonances Driven by a Fast Wave, *submitted* to Geophysical Research Letters.
28. **Elsden, T.**, Ultra Low Frequency Waves of Earth's Magnetosphere – Review Article, (*accepted* by Oxford Research Encyclopedia of Planetary Science).

2024

27. Archer MO, Pilipenko VA, Li B, Sorathia K, Nakariakov VM, **Elsden T** and Nykyri K (2024) Magnetopause MHD surface wave theory: progress & challenges. Front. Astron. Space Sci. 11:1407172. doi: 10.3389/fspas.2024.1407172
26. Wright, A.N., Hartinger, M.D., Takahashi, K. and **Elsden, T.** (2024). Alfvén Waves in the Earth's Magnetosphere. In Alfvén Waves Across Heliophysics, A. Keiling (Ed.). doi:10.1002/9781394195985.ch10
25. Allanson O, Ma D, Osmane A, Albert JM, Bortnik J, Watt CEJ, Chapman SC, Spencer J, Ratliff DJ, Meredith NP, **Elsden T**, Neukirch T, Hartley DP, Black R, Watkins NW and Elvidge S (2024) The challenge to understand the zoo of particle transport regimes during resonant wave-particle interactions for given survey-mode wave spectra. Front. Astron. Space Sci. 11:1332931. doi:10.3389/fspas.2024.1332931

2023

24. Sandhu, J. K., Degeling, A. W., **Elsden, T.**, Murphy, K. R., Rae, I. J., Wright, A. N., et al. (2023). Van Allen Probes observations of a three-dimensional field line resonance at a plasmaspheric plume. Geophysical Research Letters, 50, e2023GL106715, doi:10.1029/2023GL106715
23. Hartinger, M. D., **Elsden, T.**, Archer, M. O., Takahashi, K., Wright, A. N., Artemyev, A., et al. (2023). Properties of Magnetohydrodynamic normal modes in the Earth's Magnetosphere. Journal of Geophysical Research: Space Physics, 128, doi:10.1029/2023JA031987
22. Takahashi, K., **Elsden, T.**, Wright, A. N., & Degeling, A. W. (2023). Polarization of magnetospheric ULF waves excited by an interplanetary shock on 27 February 2014. Journal of Geophysical Research: Space Physics, 128. doi:10.1029/2023JA031608
21. Wright, A., & **Elsden, T.** (2023). Resonant Fast-Alfvén Wave Coupling in a 3D Coronal Arcade. Physics, 5(1), 310-321. doi:10.3390/physics5010023
20. **Elsden, T.** & Southwood, D. J. (2023). Modeling features of field line resonance observable by a single spacecraft at Saturn. Journal of Geophysical Research: Space Physics, 128, doi:10.1029/2022JA031208
19. Fogg, A. R., Lester, M., Yeoman, T. K., Carter, J. A., Milan, S. E., Sangha, H. K., **Elsden, T.** et al. (2023). Multi-instrument observations of the effects of a solar wind pressure pulse on the high latitude ionosphere: A detailed case study of a geomagnetic sudden impulse. Journal of Geophysical Research: Space Physics, 128, doi:10.1029/2022JA031136

2022

18. **Tom Elsden**, Matthew K James, Jasmine K Sandhu, Clare Watt, RAS Specialist Discussion Meeting Report, Astronomy & Geophysics, Volume 63, Issue 5, October 2022, Pages 5.26–5.30, doi.org/10.1093/astrogeo/atac066
17. **Elsden, T.**, Wright A and Degeling A (2022) A review of the theory of 3-D Alfvén (field line) resonances. Front. Astron. Space Sci. 9:917817. doi: 10.3389/fspas.2022.917817
16. Sakurai, T., Wright, A. N., Takahashi, K., **Elsden, T.**, Ebihara, Y., Sato, N., et al. (2022). Poleward moving auroral arcs and Pc5 oscillations. Journal of Geophysical Research: Space Physics, 127, doi:10.1029/2022JA030362
15. Wright, A. N., Degeling, A., **Elsden, T.** (2022). Resonance Maps for 3D Alfvén Waves in a Compressed Dipole Field, Journal of Geophysical Research: Space Physics, 127, 10.1029/2022JA030294.

14. **Elsden, T.**, Wright, A. N. (2022). Polarization Properties of 3-D Field Line Resonances, Journal of Geophysical Research: Space Physics, 127, doi:10.1029/2021JA030080.
13. **Elsden, T.**, Yeoman, T.K., Wharton, S. J., Rae, I. J., Sandhu, J. K., Walach, M.-T., James, M. K., Wright, D. M. (2022). Modeling the Varying Location of Field Line Resonances During Geomagnetic Storms, Journal of Geophysical Research: Space Physics, 127, doi:10.1029/2021JA029804.
12. Allanson, O., **Elsden T.**, Watt, C., Neukirch, T. (2022). Weak Turbulence and Quasilinear Diffusion for Relativistic Wave-Particle Interactions via a Markov Approach. Frontiers in Astronomy and Space Sciences, 14 January 2022. doi:10.3389/fspas.2021.805699.

2021

11. Sandhu, J. K., Rae, I. J., Staples, F. A., Hartley, D. P., Walach, M.-T., **Elsden, T.**, Murphy, K. R. (2021). The roles of the magnetopause and plasmapause in storm-time ULF wave power enhancements. Journal of Geophysical Research: Space Physics, 126, doi:10.1029/2021JA029337
10. Southwood, D. J., Cao, H., Shebanits, O., **Elsden, T.**, Hunt, G., Dougherty, M. (2021), Discovery of Alfvén Waves Planetward of Saturn's Rings, Journal of Geophysical Research: Space Physics, 125, doi:10.1029/2020JA028473.

2020

9. **Elsden, T.**, A. N. Wright, (2020), Evolution of High-m Poloidal Alfvén Waves in a Dipole Magnetic Field, Journal of Geophysical Research: Space Physics, 125, doi:10.1029/2020JA028187.
8. Wright, A. N., **Elsden, T.** (2020), Simulations of MHD wave propagation and coupling in a 3-D magnetosphere, Journal of Geophysical Research: Space Physics, 125, doi:10.1029/2019JA027589.

2019

7. **Elsden, T.**, A. N. Wright, (2019), The Effect of Fast Normal Mode Structure and Magnetopause Forcing on FLRs in a 3D Waveguide, Journal of Geophysical Research Space Physics, 124, doi:10.1029/2018JA026222.

2018

6. Wright, A. N., **Elsden, T.**, K. Takahashi, (2018) Modeling the Dawn/Dusk Asymmetry of Field Line Resonances, Journal of Geophysical Research Space Physics, 123, doi:10.1029/2018JA025638.
5. **Elsden, T.**, A. N. Wright (2018), The Broadband Excitation of 3D Alfvén Resonances in a MHD Waveguide, Journal of Geophysical Research Space Physics, 123, doi:10.1002/2017JA025018.

2017

4. **Elsden, T.**, A. N. Wright (2017), The Theoretical Foundation of 3D Alfvén Resonances: Time Dependent Solutions, Journal of Geophysical Research Space Physics, 122, doi:10.1002/2016JA023811.

2016

3. Wright, A. N., **Elsden, T.** (2016), The Theoretical Foundation of 3D Alfvén Resonances: Normal Modes, Astrophysical Journal, 833, 230, doi:10.3847/1538-4357/833/2/230 .
2. **Elsden, T.**, A. N. Wright, M. D. Hartinger (2016), Deciphering satellite observations of compressional ULF waveguide modes, Journal of Geophysical Research Space Physics, 121, doi:10.1002/2016JA022351.

2015

1. **Elsden, T.**, A. N. Wright (2015), The use of the Poynting vector in interpreting ULF waves in magnetospheric waveguides, Journal of Geophysical Research Space Physics, 120, doi:10.1002/2014JA020748.

Key Experience

Grants

- Leverhulme Early Career Fellowship, held at the University of Leicester (Oct 2019 - Sep 2021) and the University of Glasgow (Oct 2021 - Sep 2022), £93000.
- Institute of Mathematics and its Applications QJMAM conference travel fund, April 2019, £400.

Lecturing and Tutoring

University of Glasgow

- Semester 2, 2021/2022, Lecturer Mechanics 2E - second year mathematics course. Responsible for delivering half of the lecture material through recorded online lectures as well as setting part of the final exam.
- Semester 1, 2021/2022, Lecturer Mathematics 1C - first year introductory mathematics course. Online lectures using Zoom, Microsoft One Note and Microsoft Teams. Online continuous assessment prior to each lecture provided through WebAssign quizzes.

University of St Andrews

- Lecturer for 4th year undergraduate course MT4112 - Computing in Mathematics, Semester 1, 2017. This involved setting and marking coursework and the final exam. Received excellent feedback on the module evaluation questionnaire, with an overall score of 1.38 on a 1 (good) to 5 (bad) scale.
- Undergraduate tutor for multiple courses in mathematics such as introductory 1st and 2nd year mathematics, applied mathematics, computing with Python and multivariate calculus. Assisted in the running of several large computing 'labs' at sub-honours level.

Conference Session Organisation

- Co-organiser, session: 'Observations and modelling of the effects of solar wind pressure pulses on the terrestrial magnetosphere', European Geophysical Union (EGU) General Assembly, 23rd-27th May, 2022.
- Lead organiser: 'Planetary Ultra-Low Frequency Waves: Theory, Modelling and Observations', Royal Astronomical Society Specialist Discussion Meetings, 11th March 2022: YouTube link.
- Co-organiser: 'Space weather and plasma processes: From the Sun to the Earth', National Astronomy Meeting, Bath, UK (virtual), 19th-23rd July 2021.
- Lead session organiser: 'Connecting MHD Wave Research from the Sun to the Magnetospheres', National Astronomy Meeting, Lancaster, UK, 30 June - 4 July 2019.
- Invited session organiser and speaker, Geospace Environment Modelling (GEM), Santa Fe, NM, USA, 22-28 June 2019.

Invited Talks

- University of Dundee, Mathematics Seminar - 24th Jan 2022.
- Magnetosphere Online Seminar Series, organised by American Geospace Environment Modelling community, 16th Aug 2021, available on Youtube here.
- Northumbria University, Solar/Space Physics Research Group - 15th Jun 2021.
- Imperial College London, Space Physics Group Seminar - 18th Jun 2020.
- University of St Andrews, Solar Group Seminar - 12th Feb 2020.
- American Geophysical Union Fall Meeting, San Francisco, USA - 9th Dec 2019.
- University of Warwick, Centre for Fusion, Space and Astrophysics Seminar - 7th Feb 2019.
- University College London, Mullard Space Science Lab (MSSL), Space Plasma Physics Group Seminar - 9th Oct 2018.
- University of Leicester, Radio Space Plasma Physics Group Seminar - 26th Sep 2018.
- STFC Advanced Summer School in Solar, Solar-Terrestrial and Solar-Planetary Physics, University of Southampton, talk on MHD Waves - 11th Sep 2018.
- University of Dundee, Mathematics Seminar - 12th Mar 2018.
- University of Glasgow, Astronomy Seminar - 1st Feb 2018.
- Russian-British Seminar of Young Scientists, Irkutsk, Russia - 18th Sep 2017.
- University of Cambridge, Department of Applied Mathematics and Theoretical Physics, Astronomy Seminar - 8th May 2017.

Memberships and Professional Roles

- UK liaison to the US Geophysical Environment Modelling (GEM) community. This involves writing a yearly report on relevant UK research for dissemination to GEM researchers worldwide.
- Core member of the International Space Science Institute (ISSI) team investigating 3D Alfvén resonances (Aug 2019 - Aug 2022).
- Core member of the application for the International Space Science Institute (ISSI) team on 'Magnetohydrodynamic surface waves at Earth's magnetosphere (and beyond)'.
- Reviewer for *Journal of Geophysical Research: Space Physics*, *Nature Communications*, *Geophysical Research Letters*, *Frontiers in Astronomy and Space Sciences* and *Earth, Planets and Space*.
- Fellow of the Royal Astronomical Society.
- Member of the American Geophysical Union.
- Honorary Research Fellow, University of St Andrews, Nov 2019 - Aug 2022.

Employment and Education

University of Glasgow — Glasgow, UK

Rankin-Sneddon Fellowship *Oct 2022 – Sep 2024*

Independent research position funded by the University of Glasgow, which will begin once I have finished the final year of my Leverhulme Early Career Fellowship.

Early Career Fellowship - Leverhulme Trust *Oct 2021 – Sep 2022*

Fellowship Title: Resonating Magnetic Field Lines: A Process for Energy Transfer at Earth/Mercury.

University of Leicester — Leicester, UK

Early Career Fellowship - Leverhulme Trust *Oct 2019 – Sep 2021*

Fellowship Title (as above)

University of St Andrews — St Andrews, UK

Post Doctoral Research Assistant *Jun 2016 – Sep 2019*

Project Title: Synthesis of real and virtual Space Weather data.
Line Manager: Dr Andrew N. Wright.
Funded by the Leverhulme Trust for 3 years.

PhD *Sep 2012 – Jun 2016*

Thesis title: Numerical Modelling of Ultra Low Frequency Waves in Earth's Magnetosphere.
Thesis supervisor: Dr Andrew N. Wright.
Viva Examiners: Prof David Southwood, Prof Alan Hood.
Fully funded by STFC.

MMath (Hons) Mathematics (Fast Track)- 1st Class *Sep 2008 – Jun 2012*

Dissertation title: Structure of Magnetic Separators and 3D Magnetic Neutral Points.
Dissertation supervisor: Prof Clare Parnell.

Academic Prizes *Sep 2008 – Jun 2012*

Deans' list 2009-2012 for averaging first class grades every year.
Duncan Prize for performance in Applied Mathematics in Senior Honours.

Harvard Smithsonian Centre for Astrophysics — Cambridge (MA), USA

REU (Research Experience for Undergraduates) *Jun 2011 – Aug 2011*

Worked with Dr Steve Saar for 10 weeks as part of the solar physics REU programme studying the statistical properties of X-Ray bright points in the solar corona. The research was presented at the 2012 American Astronomical Society Meeting.

Further Experience

Selected Conferences and Courses

- American Geophysical Union (AGU) Fall Meeting, Virtual, 13-17 Dec 2021 (2 first author posters, 3 co-author posters, 1 co-author presentation).
- Autumn Magnetosphere Ionosphere Solar Terrestrial (MIST) UK Meeting, Virtual, 25-26th Nov 2021 (Talk).
- Scientific Assembly of IAGA (International Association of Geomagnetism and Aeronomy), hosted virtually by the Indian National Science Academy, 21-27 Aug. (2 Talks)
- International Space Science Institute (ISSI) workshop (virtual), Bern, Switzerland, 9-13 Aug 2021. (Talk)
- Geospace Environment Modelling (GEM) workshop (virtual), Santa Fe, NM, USA, 25-30 July 2021. (2 Talks)
- National Astronomy Meeting, Bath, UK, 19-23 Jul 2021. (Talk)
- Royal Astronomical Society Specialist Discussion Meeting 'Space Weather Energy Pathways and Implications for Impacts', Virtual, 8 Dec 2020 (Poster).
- AGU Fall Meeting, Virtual, 1-17 Dec 2020 (Poster).
- MIST Autumn Meeting, UK, Virtual, 19-20 Nov 2020. (Poster)
- AGU Fall Meeting, San Francisco, USA, 9-13 Dec 2019.
- GEM, Santa Fe, NM, USA, 17-23 Jun 2018. (Talk)
- MIST Spring Meeting, Southampton, 26-28 Mar 2018. (Talk)
- Numerical Techniques in MHD Simulations, Cologne Germany, 16-18 Aug 2017. (Talk)
- National Astronomy Meeting, Hull, UK, 2-6 Jul 2017. (Talk)
- Geospace Environment Modelling (GEM), Portsmouth VA, USA, 18-23 Jun 2017. (Talk)
- Global Modelling of the Space Weather Chain, Helsinki, Finland, 23-28 Oct 2016. (Talk)
- ISSS-12: School for Space Simulations, Prague, Czech Republic 3-10 July 2015. (Poster)
- BUKS 2015 - MHD Waves and Instabilities, Budapest, Hungary, 25-29 May 2015. (Talk)
- Geospace: Cluster/MAARBLE/Van Allen Probes, Rhodes, Greece, 15-20 Sep 2014. (Talk)
- Message-Passing Programming with MPI, Edinburgh Parallel Computing Centre, 2-4 Jul 2014.
- STFC Advanced Solar Physics Summer School, MSSL (UCL), Surrey, 2nd-6th Sep 2013.
- STFC Introductory Solar Physics Summer School, Armagh Observatory, Northern Ireland, 16th-21st Sep 2012.

Computing

- Proficient in Fortran 90, Interactive Data Language (IDL), Message Passing Interface (MPI) parallelisation , Linux operating system and LaTex.
- Experience with Python (completed online course of SciPy lectures) and Maple.
- Experience with running large scale numerical simulations on large parallel architectures.

Public Outreach

- Lecture at Perth Grammar School, Perth, 26th Oct 2018, discussing mathematics at University to final year pupils.

- Lecture at St Ninian's High School, Glasgow, 12th Sep 2018, titled 'Applied Mathematics in Space/ What can you do with Maths?'. Over 300 5th and 6th year mathematics pupils attended.
- Organised a workshop at a STEM Fair at St Ninian's High School, Glasgow, 13th Mar 2018, discussing mathematics with high school pupils.
- William Bright Society Lecture, Glenalmond College, Perthshire, Scotland, 22nd Nov 2017. This is the school's academic enrichment programme, the lecture was titled 'Applied Mathematics in Space' and was attended by around 80 high school pupils aged 11-17.
- Developed and organised a 'maths busking' event as part of Maths Week Scotland, 11-17th Sep 2017. This involved designing mathematical puzzles and taking them to the streets of St Andrews and engaging members of the public.
- Participated in and gave a lecture at the Highland maths weekend at Lagganlia, Scotland in November 2016. This involved around 50 final year high school students studying mathematics, listening to and interacting with experts in various STEM subjects.

References

- Prof Tim Yeoman, School of Physics and Astronomy, University of Leicester, University Road, Leicester, UK, LE1 7RH, email: yxo@leicester.ac.uk (Previous line manager at Leicester)
- Dr Andrew Wright, School of Mathematics and Statistics, University of St Andrews, North Haugh, St Andrews, UK, KY16 9SS, email: anw@st-andrews.ac.uk (PhD supervisor and previous line manager at St Andrews)
- Prof Ian Strachan, Head of School of Mathematics and Statistics, University of Glasgow, University Place, Glasgow G12 8QQ, email: Ian.Strachan@glasgow.ac.uk (Current line manager at Glasgow)