

James McLaughlin

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Research Interests & Future Plans

I am an applied mathematician, primarily interested in problems in the area of magnetohydrodynamics (MHD). My research involves solving nonlinear, three-dimensional, coupled systems of partial differential equations, under various physical assumptions. I approach these problems using both analytical techniques and a variety of numerical methods (including parallel computing).

Currently, I am interested in applying the MHD equations to problems in solar and astrophysical plasmas. I have a particular interest in MHD wave behaviour in inhomogeneous media. My current research involves numerical modelling of MHD wave activity in solar active regions and solar plumes, along with their comparison to satellite data. I am also investigating the drifting of heating layers in nonlinear phase mixing.

In the near future, I would like to investigate nonlinear MHD mode conversion around a magnetic null point, study impulsive excitation in numerical simulations of active regions, and construct a three-dimensional numerical model of a solar plume that incorporates the important physical mechanisms (including gravitational stratification, wave propagation driven by magnetoconvection, coupling to the solar wind at high altitudes and a realistic representation of the solar atmosphere). Whilst investigating these numerical models, my philosophy is to build up the model incrementally, with an emphasis on understanding the underlying physical processes at each step.

Qualifications & Career History

Jan 2010 – present	Lecturer	<u>Northumbria University</u> School of Computing, Engineering & Information Sciences
Jan 2007 – Dec 09	Research Fellow	<u>University of St Andrews</u> Jul 2007 – Dec 09: Leverhulme Trust Grant (PI: Dr Ineke De Moortel) Jan 2007 – Jun 07: STFC Rolling Grant
Jan – Dec 2006	Research Scientist	<u>NASA Goddard Space Flight Center /</u> <u>Catholic University of America</u> (Maryland, USA)
2002 – 2005	Ph.D. (Applied Mathematics)	<u>University of St Andrews</u> Solar & Magnetospheric Theory Group (School of Mathematics & Statistics) Supervisor: Professor Alan Hood Viva passed on 15 Dec 2005
1998 – 2002	M.Sci. (JH) Mathematics and Physics	<u>Durham University</u> : First Class

Publications

Total publications: 12 (since 2004) see separate List of Publications for full details.
9 in refereed journals, 3 in conference proceedings (**10 / 12** first author).
Involved in both national & international (USA, Poland) collaborations.

Presentations & International Conference Contributions

6 Invited seminars – 23 Contributed talks – 10 Poster presentations, including:

Dec 2008	<u>Solar Cycle 24</u> (Napa Valley, USA)	contributed
Oct 2008	<u>Division of Mathematics</u> (University of Dundee)	invited
Oct 2008	<u>Centre for Fusion, Space & Astrophysics</u> (University of Warwick)	invited
Jun 2008	<u>UK MHD 2008 Meeting</u> (Manchester, England)	contributed
Mar 2008	<u>National Astronomy Meeting</u> (Belfast, Northern Ireland)	contributed
Feb 2008	<u>Department of Applied Mathematics</u> (University of Sheffield)	invited

See http://computing.unn.ac.uk/staff/rnwp2/JAM_research_visits.html for full details.

Research Grants

01/07/07 – 30/06/10	Leverhulme Trust Grant PI: Dr Ineke De Moortel & I am the named PDRA.
01/06/07 – 15/07/07	RSE Cormack Vacation Scholarship for my summer student: J. Ferguson.
09/07/07 – 20/07/07	RAS Travel Grant to attend SOHO 19 conference.

Lecturing & Supervising Experience

Jan 2010 – present	Calculus: 1st year undergraduate course (MS0262) <u>Northumbria University</u> . Total contact hours (up to Jan-2010): 20. Duties include lecturing to approximately 60 first year undergraduates (preparation and delivery), setting and marking exam and seminar questions.
Spring 2008 & 2009	Applied Mathematics : 2nd year undergraduate course (MT2003) <u>University of St Andrews</u> . Total contact hours: 40 (over two years). Duties include lecturing to approximately 100 undergraduates, setting and marking exam questions, tutorial questions and continuous assessments.
Summer 2007	Supervision of summer student: <u>Judy Ferguson</u> (funded by a RSE Cormack Vacation Scholarship I obtained). Project resulted in publication of McLaughlin, Ferguson & Hood (2008) .
Spring 2006	Teaching Assistant: Electromagnetism <u>Catholic University of America</u> Duties include: lecturing 10 final year undergraduates. Total contact hours: 4.
2002 – 2005	Undergraduate Mathematics Tutor <u>University of St Andrews</u> .

Public Understanding and Promotion of Science

Jan 2008	Wrote magazine article for St Andrews In Focus magazine (~25,000 readers) " <i>The Sun and its Effect on the Earth and on Space Travel</i> ".
Nov 2007	Public lectures for International Heliophysical Year . Lectures presented at Universities of St Andrews & Dundee.
Sept 2007	Presented selection of physics experiments at renaming of Easington Community School as Easington Community Science College (Sunderland).
May 2006	Operated booth promoting space science for Space Week 2006 (Maryland, USA). Involved explaining solar research & demonstrating telescopes to local residents.
Sept 2004	Organised public lecture for school children & local residents (~150). given by Professor John Brown (Astronomer Royal for Scotland).
Mar 2004	Presentation to local school children " <i>Introduction to the Sun</i> " (St Leonard's School, St Andrews) during National Science Week 2004 .

Other Relevant Information

I have coordinated a multi-spacecraft observing campaign to investigate solar plumes. I am the lead author of this observing programme, which involves the collaboration of 7 space-based instruments.

The details can be found under **Solar Joint Observing Program 216**:

sohowww.nascom.nasa.gov/soc/JOPs/jop216.txt

and **Hinode Observing Program 98**:

www.isas.jaxa.jp/home/solar/hinode_op/hop.php?hop=0098

I organise and chair a MHD waves subgroup meeting (i.e. a journal club) within the St Andrews Group.

Active member of local organising committee for **STFC Advanced Summer School 2007** (University of St Andrews). Role involved creating website & administrative duties, planning & chairing sessions.

I have refereed papers for the Astronomy & Astrophysics journal.

Excellent working knowledge of **FORTRAN 77 & 90, IDL, MAPLE, MPI, SolarSoft** and **LaTeX**, as well as Microsoft **Word, Excel** and **Powerpoint**.

- Experience in using both Windows and LINUX operating systems.
- Computing Skills Certificate (Computer Science Department, Durham University).
- Various numerical methods studied and implemented during research career.

(2006 – present) **AAS/SPD** Affiliate Member.
(2006 – present) Member of the **American Geophysical Union**.
(2002 – present) Fellow of the **Royal Astronomical Society**.
(1998 – present) Associate Member of the **Institute of Physics**.

For Research References

Professor Alan Hood (former Ph.D. supervisor)
School of Mathematics & Statistics
North Haugh
University of St Andrews
St Andrews
Fife, KY16 9SS
alan@mcs.st-and.ac.uk

Professor Leon Ofman (American collaborator)
Catholic University of America
NASA-Goddard Space Flight Center
Code 671, Greenbelt, MD 20771, USA
Leon.Ofman@nasa.gov

For Teaching References

Professor Bernard Roberts
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North Haugh
University of St Andrews
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List of Publications : James McLaughlin

In Refereed Journals : 9

- 1) **McLaughlin, J.A.** & Hood, A.W. (2004)
[MHD wave propagation in the neighbourhood of a two-dimensional null point](#)
Astronomy & Astrophysics, **420**, 1129-1140
- 2) **McLaughlin, J.A.** & Hood, A.W. (2005)
[MHD wave propagation in the neighbourhood of two null points](#)
Astronomy & Astrophysics, **435**, 313-325
- 3) **McLaughlin, J.A.** & Hood, A.W. (2006a)
[MHD wave propagation in the neighbourhood of two dipoles](#)
Astronomy & Astrophysics, **452**, 603-613
- 4) **McLaughlin, J.A.** & Hood, A.W. (2006b)
[MHD mode coupling in the neighbourhood of a 2D null point](#)
Astronomy & Astrophysics, **459**, 641-649
- 5) **McLaughlin, J.A.**, Ferguson, J.S.L. & Hood, A.W. (2008)
[3D MHD coronal oscillations about a magnetic null point: Application of WKB theory](#)
Solar Physics, **251**, 563-587
- 6) **McLaughlin, J.A.** & Ofman, L. (2008)
[3D MHD wave behavior in active regions: Individual loop density structure](#)
Astrophysical Journal, **682**, 1338-1350
- 7) Gruszecki, M., Murawski, K. & **McLaughlin, J.A.** (2008)
[Influence of a dense photospheric-like layer on vertical kink oscillations of a curved coronal slab](#)
Astronomy & Astrophysics, **489**, 413-418
- 8) **McLaughlin, J.A.**, De Moortel, I., Hood, A.W. & Brady, C.S. (2009)
[Nonlinear fast magnetoacoustic wave propagation in the neighbourhood of a magnetic X-point: Oscillatory reconnection](#)
Astronomy & Astrophysics, **493**, 227-240
- 9) Pascoe, D.J., De Moortel, I. & **McLaughlin, J.A.** (2009)
[MHD wave activity in a 3D coronal loop: importance of attack angle](#)
Astronomy & Astrophysics, **505**, 319-327

Impact Factors

(according to Web of Science):

Astrophysical Journal	= 6.41
Astronomy & Astrophysics	= 4.26
Solar Physics	= 2.48

In Conference Proceedings : 3

10) **McLaughlin, J.A.** & Hood, A.W. (2004)

Fast MHD wave propagation in the neighbourhood of a two-dimensional null point
Proceedings of SOHO 13: Waves, Oscillations and Small-Scale Transient Events in the Solar Atmosphere: A Joint View from SOHO and TRACE, **ESA SP-547**

11) **McLaughlin, J.A.** & Hood, A.W. (2005)

Preferential Heating in the neighbourhood of a two-dimensional null point
Proceedings of SOHO 15: Coronal Heating, **ESA SP-575**

12) **McLaughlin, J.A.** & Ofman, L. (2006)

3D MHD models of waves in active regions: Application to coronal seismology
Proceedings of SOHO 17: 10 Years of SOHO and Beyond, **ESA SP-617**

PhD Thesis

James Alexander McLaughlin (2005)

MHD wave propagation in the neighbourhood of coronal null points
Supervisor: Professor Alan Hood, Submitted: 1 Nov 2005, Viva: 15 Dec 2005
University of St Andrews: School of Mathematics and Statistics