Curriculum Vitae

Personal

Name: Michael Bareford
Nationality: British
Email: michael@mbfiltered.com

Academic

Status: Research Assistant (Nov 2011 - present)
Supervisor: Professor Alan Hood
(email: alan@mcs.st-andrews.ac.uk)

Institution: Mathematical Institute
University of St Andrews
St Andrews
Fife
KY16 9SS
United Kingdom

Degrees: PhD. *The Heating of the Solar Corona by Kink Instabilities*,
Jodrell Bank Centre for Astrophysics, University of Manchester, UK, 2011
BSc. Physics with Astrophysics, Class 1, University of Manchester, UK, 2008
BSc. Computer Science, Class 2.1, University of East Anglia, Norwich, UK, 1994

Memberships: Royal Astronomical Society, Fellow, 2009
Institute of Physics, Associate Member, 2010

Publications

1. *Coronal heating by the partial relaxation of twisted loops*
Bareford, M. R., Hood, A. W., & Browning, P. K. 2013, A&A, 550, A40

2. *Relaxation and heating triggered by nonlinear kink instability: application to solar flares and coronal heating*, Browning, P. K., Bareford, M. R., & Gordovskyy, M. 2012, *Multi-scale Dynamical Processes in Space and Astrophysical Plasmas*, edited by Leubner, M. P., & Vörös, Z. Astrophysics and Space Science Proceedings, Vol. 33, pp. 69, Springer-Verlag, ISBN 978-3-642-30441-5

3. *The flare-energy distributions generated by kink-unstable ensembles of zero-net-current coronal loops*
Bareford, M. R., Browning, P. K., & Van der Linden, R. A. M. 2011, Sol. Phys., 273, 93

4. *A nanoflare distribution generated by repeated relaxations triggered by kink instability*
Bareford, M. R., Browning, P. K., & Van der Linden, R. A. M. 2010, A&A, 521, A70

Conferences, Meetings and Workshops *(selected)*
1. The 9th International Cambridge Workshop on Magnetic Reconnection 2012, Copenhagen
Presentation: Patterns of Magnetic Reconnection within Kink-unstable Coronal Loops

2. UKMHD 2012, Sheffield
Presentation: Coronal Heating by the Partial Relaxation of Twisted Loops

3. National Astronomy Meeting 2012, Manchester
Presentation: The Evidence for Taylor Relaxation in Simulations of Kink-unstable Coronal Loops

4. The Fifth Coronal Loops Workshop 2011, Palma, Mallorca
Presentation: The Hot Corona and the Significance of Magnetic Field Instability

5. National Astronomy Meeting 2010, Glasgow
Presentation: A Nanoflare Distribution Generated by Repeated Relaxations Triggered by Kink Instability

6. Joint European National Astronomy Meeting 2009, University of Hertfordshire
Presentation: The Role of Nanoflares in Coronal Heating

Seminars *(selected)*
1. *The Energy Released from Relaxing Coronal Loops*, Solar Physics and Space Plasma Research Centre, School of Mathematics and Statistics, University of Sheffield, Apr 2012

2. *Driven to Relaxation*, Solar MHD Theory Group,
School of Mathematics and Statistics, University of St Andrews, Feb 2012

Teaching Experience
1. School of Mathematics and Statistics, University of St Andrews
Teaching Assistant, Applied Mathematics, Second Semester (2012)

2. School of Physics and Astronomy, University of Manchester
Maths Tutor, Mathematics 2 and Electricity & Magnetism, Second Semester (2011)
Maths Tutor, Mathematics 1 and Dynamics, First Semester (2010)
Teaching Assistant, Programming in C++, Second Semester (2010, 2009)
Teaching Assistant, Programming in C, First Semester (2009, 2008)

Research/Employment Background

During my four years in research (three as a PhD student at Manchester) I have mostly worked on the modelling of coronal loop kink instabilities. Coronal loops are magnetic fields that pass through the diffuse outer atmosphere of the Sun. The loops begin and end at the solar surface or photosphere; hence, convection motions at these photospheric boundaries can result in a buildup of free magnetic energy within the loop. At the same time, the loop becomes more susceptible to instability. The main aim of my PhD was to investigate the distributions of energy release events that are generated when whole ensembles of loops achieve instability onset. It is thought likely that the cumulative effect of ubiquitous but small energy releases (e.g., nanoflares) could explain the coronal heating problem: i.e., the reason why coronal temperatures are orders of magnitude higher than those observed at the photosphere. The purpose of my research therefore, has been to study the plausibility of this idea by developing and running magnetohydrodynamic (MHD) models of idealised coronal loops.

My most recent paper (Bareford et al. 2013) has shown strong evidence for a defined relaxation process, otherwise known as Taylor relaxation (Taylor 1986), in various numerical simulations of marginally unstable loops. This process stipulates that an unstable loop should relax to the lowest energy state that conserves magnetic helicity and axial flux. Furthermore, the relaxed state is linear and force-free (i.e., $\nabla \times \vec{B} = \alpha\vec{B}$); hence, an upper limit for the energy released by an instability is straightforward to calculate and a comparison can be made with the energy required to heat the solar corona. The simulation results also revealed that magnetic energy is thermalised via shock heating (the contribution of Ohmic heating within current sheets is minimal). Moreover, it seems likely that these shocks are generated by plasma flows close to sites of magnetic reconnection.

In the last year I have sought to simulate more realistic loops by experimenting with such features as density stratification, convective driving, thermal conduction and radiation. Hence, the time I have spent as a research assistant at St Andrews has more or less been an extension of my PhD work, so I would be keen to move into a different but related area, such as the modelling of stellar interiors.

Previous to my research career, I was employed as a computer programmer, specialising in secure payment systems and e-commerce, over a period of ten years (1995-2005). The majority of that time was spent working for Thales e-Security Ltd (2002-05, 1996-2000), where I mainly programmed in C, C++ and Java. Since then, I have programmed in FORTRAN 77 in order to perform linear ideal MHD analyses on straightened coronal loops, and I've used a a Lagrangian-remap Fortran 90 code, called LARE3D (Arber et al. 2001), to run nonlinear MHD loop simulations. The results were analysed using gnuplot, IDL, and VisIt.

1. Arber, T. D., et al. 2001, J. Comput. Phys., 171, 151
2. Bareford, M. R., Hood, A. W., & Browning, P. K. 2013, A&A, 550, A40
3. Taylor, J. B. 1986, Rev. Mod. Phys., 58, 741