EDINBURGH MATHEMATICAL SOCIETY - RESEARCH SUPPORT FUND

Name of Applicant: Dr. Radostin Dimov Simitev

Postal address: Department of Mathematics, University of Glasgow, University Gardens, Glasgow, G12 8QW.

Telephone: 0141 330 6882

E-mail address: r.simitev@maths.gla.ac.uk

Project title and brief description:

Title: *Magneto-Inertial Convection in Rotating Spheres*

Brief Description: This is an application for support of the visit of Prof. F.H. Busse to the Department of Mathematics, University of Glasgow from 14 April 2009 to 24 April 2009. The following activities will take place:

Research project: The applicant (RS) and the visitor (FHB) will collaborate on a research project of mutual interest. Work has already begun and we will use the time for a focused face-to-face discussion of outstanding issues and to summarize results for publication.

Seminars: The visitor, Prof. Busse, is a scientist of high-caliber and there is much interest from the Scottish Fluid Dynamics and MHD community to have him visit Scotland. He has received invitations from the Universities of Glasgow, Strathclyde and St. Andrews to give seminars in the short period he will be in the country. For additional details see the case for support.

Dates:

Date of event requiring support: Visit from 14 April to 24 April 2009.
Date when payment from Fund required: Before 14 April.
Latest date by which decision required: By 5 April 2009.

Total Sum Requested: GBP 800,-.

This amount will cover

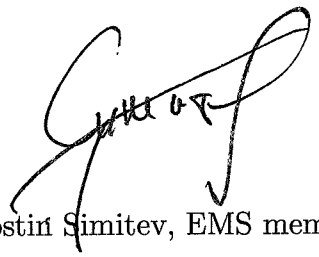
(a) Hotel accommodation for the period at an average price of GBP 45 per night.

(b) Flight and other travel expenses for the return trip of Prof. Busse from Bayreuth, Germany to Glasgow. The price of flight tickets is estimated to approximately GBP 300, due to the fact that flights will need to be booked soon before the trip.

Definite payment or guarantee:

Other financial contributions: None

Declaration: I have read the Application procedure and Notes.



/Radostin Simitev, EMS member/ March 11, 2009

Case for Support

1 Applicant: Dr. R.D. Simitev – brief personal data

Publications: 16 peer-reviewed research papers.
Membership: Member of the Edinburgh Mathematical Society since 2006.
Profesional Appointments:
Lecturer, Department of Mathematics, University of Glasgow since 2006.
Post-Doctoral Fellow, Department of Mathematical Sciences, University of Liverpool, 2004–2006.
Further Education:
PgCert in Academic Practice, University of Glasgow, 2008.
PhD, "Convection and magnetic field generation in rotating spherical shells", University of Bayreuth, Germany, 2004.
MSc in Theoretical Physics, University of Sofia, Bulgaria, 2000.
Research interests: Convection in rotating systems, Magnetohydrodynamics, Mathematical Biology.
Research activity in the last five years: After obtaining my Doctoral degree in 2004 I have workde in two rather different fields of Applied Mathematics. One field is Mathematical Physiology where I study *propagation of electrical waves in cardiac tissue*. Another field of main interest, relevant to this application, is *Fluid Dynamics and Dynamo Theory*. Below is a list my four latest publications. The fifth paper is particularly relevant to the research project in this application.

Simitev, R., Busse F.H., Bistability and hysteresis of dipolar dynamos generated by turbulent convection in rotating spherical shells, EPL, 85, 19001, DOI:10.1209/0295-5075/85/19001, 2009.

Busse, F.H., Simitev, R., Toroidal flux oscillations as possible causes of geomagnetic excursions and reversals, Phys. Earth Planet. Inter., 168(3-4), pp. 237-243, DOI:10.1016/j.pepi.2008.06.007, 2008.

Plaut, E., Lebranchu, Y., Simitev, R., Busse, F.H., On the Reynolds stresses and mean fields generated by pure waves - Applications to shear flows and rotating convection , J. Fluid Mech. 602, pp. 303-326, DOI:10.1017/S0022112008000840, 2008.

Biktashev, V.N., Suckley, R., Elkin, Y.E, Simitev, R., Asymptotic analysis and analytical solutions of a model of cardiac excitation , Bull. Math. Biol., 70(2), pp. 517-554, DOI:10.1007/s11538-007-9267-0, 2008.

Busse, F.H., Simitev, R., Inertial convection in rotating fluid spheres , J. Fluid Mech. , 498, pp. 23-30, DOI:10.1017/S0022112003006943, 2004.

2 Visitor: Prof. F.H. Busse - brief personal data

Address: Institute of Physics, University of Bayreuth, Bayreuth, D-95440, Germany.
Publications: More than 330 peer-reviewed research papers and 8000 citations (ISI Web of Knowlegde).

Editorial service:

Associate Editor of GEOPHYSICAL AND ASTROPHYSICAL FLUID DYNAMICS.

Member of the Editorial Board of

JOURNAL OF APPLIED MATHEMATICS AND PHYSICS,
JOURNAL OF ENGINEERING MATHEMATICS,
EUROPEAN JOURNAL OF MECHANICS B/Fluids.

Former Editor / Ass. Editor

PHYSICA D,
JOURNAL OF FLUID DYNAMICS.

Awards and distinctions:

2008 Fluid Mechanics Prize of the European Mechanics Society.
2002 Lewis Fry Richardson Medal of the European Geophysical Society.
2000 Fluid Dynamics Prize of the American Physical Society.
1998 Emil Wiechert Medal of the German Geophysical Society.
Since 1993 Foreign Associate of the National Academy of Sciences of the U.S.
Since 1988 Honorary Foreign Member of the American Academy of Arts and Sciences.

Professional Appointments:

Professor Emeritus in Theoretical Physics, University of Bayreuth, Bayreuth, Germany since 1984.

Professor in Residence, Institute of Geophysics and Planetary Physics, and Department of Earth and Space Sciences, UCLA, Los Angeles.

Membership in professional bodies:

Fellow, American Geophysical Union.
Fellow, American Physical Society.
Former member, German Geophysical Society.

3 Project

Magneto-Inertial Convection in Rotating Spheres

Inertial convection refers to the buoyancy driven motions in the form of inertial waves in rotating systems. The analysis of these motions is important for the understanding of the dynamics of planetary cores and stellar atmospheres. Critical Rayleigh numbers and associated wavenumbers and frequencies for the onset of inertial convection can be determined analytically for simple, but relevant configurations such as rotating fluid spheres. This has been demonstrated by the work of Zhang (1994, 1995) and of Busse and Simitev (2004).

When a magnetic field permeates the electrically conducting fluid in a rotating system, the dynamics of the inertial waves is modified by the action of the Lorentz force. Malkus (1967) has shown that the analytical expressions for inertial waves in a rotating fluid sphere can be extended for applications to magneto-inertial waves. The proposed project is concerned with the extension of such an analysis to buoyancy driven convection. As in the case of inertial convection thermal buoyancy and dissipation effects will be treated as perturbations in the equation governing

magneto-inertial waves. Analytical and semi-analytical expressions for the critical Rayleigh numbers and the associated wavenumbers and frequencies for the onset of magneto-inertial convection in rotating spheres can thus be derived through extensions of the methods of Busse and Simitev (2004). Since magneto-inertial convection waves are preferred in low Prandtl number fluids in contrast to convection in the form of thermal Rossby waves in fluids with Prandtl numbers of the order unity, it can be expected that the theory of magneto-inertial convection will be relevant for understanding the dynamics of rotating stars with strong magnetic fields.

References:

F.H. Busse and R. Simitev, Inertial convection in rotating fluid spheres. *J. Fluid Mech.*, **498**, 23-30 (2004)

W.V.R. Malkus, Hydromagnetic planetary waves, *J. Fluid Mech.* **28**, 793-802 (1967)

K. Zhang, On coupling between the Poincaré equation and the heat equation. *J. Fluid Mech.*, **268**, 211-229 (1994)

K. Zhang, On coupling between the Poincaré equation and the heat equation: no-slip boundary condition. *J. Fluid Mech.*, **284**, 239-256 (1995)

4 Seminars

Prof. Busse has received invitations to present the following seminars while in Scotland:

- Department of Mathematics, University of Glasgow
- Department of Mathematics, University of Strathclyde
- Department of Mathematics, University of St. Andrews

External expressions of interest and support for these events are appended overleaf.

External Expressions of Interest and Support

Email correspondence with staff at the universities of Strathclyde and St. Andrews and further expressions of interest are appended in support.

- From the University of Strathclyde

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From dtp@maths.strath.ac.uk Mon Mar  9 16:42:51 2009
Date: Mon, 9 Mar 2009 16:24:21 +0000 (GMT)
From: David Pritchard <dtp@maths.strath.ac.uk>
To: Radostin Simitev <rs@maths.gla.ac.uk>
Subject: Re: Visit of Prof F.H. Busse

Dear Radostin,

Excellent --- thank you! As someone who's done a bit of work on thermal
convection, I appreciate how big a name Prof. Busse is in the field, so it'd
be exciting if we can bring him over to Scotland. Let me know if there's
anything else we can do to help!

Best regards,

David

--
 Department of Mathematics, University of Strathclyde,
 Livingstone Tower, 26 Richmond Street, Glasgow G1 1XH
 +44(0)141 5483819 | www.maths.strath.ac.uk/~aas05108/

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 registered in Scotland, number SC015263.


On Mon, 9 Mar 2009, Radostin Simitev wrote:

>
> Dear All,
>
> Thank you for the enthusiasm. I will let you know as
> soon as it is clear if he is visiting or not.
>
> Otherwise, Wednesday 22 April looks good to me.
>
> Thanks again!
>
> Radostin
>
> On Mon, 9 Mar 2009, Steve Webb wrote:
>
> > That sounds great. I'm away on both those dates, but
> > that isn't a problem.
> > Steve
> >
> > Quoting David Pritchard <dtp@maths.strath.ac.uk>:
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> >
> > > Dear Stephen,
> > >
> > >
> > > If there's any chance of getting Prof Busse over here for a seminar,
> > > I'd be very keen. We don't have any colloquia on during the period
> > > he'd be around, so if it were convenient for him and for
> > > Glasgow, perhaps we
> > > could invite him to speak on Wednesday 22 April? (Wednesday 15 April
> > > would also be possible, but speaking selfishly I'd prefer the 22nd
> > > because I'll be away on the 15th!)
> > >
> > > (Steve, does this sounds OK to you?)
> > >
> > > Cheers,
> > >
> > >
> > > Dave
> > >
> > > --
> > > Department of Mathematics, University of Strathclyde,
> > > Livingstone Tower, 26 Richmond Street, Glasgow G1 1XH
> > > +44(0)141 5483819 | www.maths.strath.ac.uk/~aas05108/
> > >
> > > The University of Strathclyde is a charitable body,
> > > registered in Scotland, number SC015263.
> > >
> > >
> > > On Mon, 9 Mar 2009, Stephen Wilson wrote:
> > >
> > > >
> > > > Dear Radostin (cc David and Steve)
> > > >
> > > > Busse is a certainly "megastar" and I'm sure his work will be of
> > > > interest to several people here.
> > > >
> > > > I'm forwarding your request to our colloquium organisers (Steve
> > > > Webb and Davit Pritchard) who are best placed to judge how
> > > > best to proceed.
> > > >
> > > > Best wishes
> > > >
> > > > Stephen
> > > >
> > > > **
> > > > Professor Stephen K. Wilson   tel : + 44 (0) 141 548 3820
> > > > Head of Department   fax : + 44 (0) 141 548 3345
> > > > Department of Mathematics   e-mail : s.k.wilson@strath.ac.uk
> > > > University of Strathclyde   internet:
> > > > www.maths.strath.ac.uk/~caas57/
> > > > Livingstone Tower
> > > > 26 Richmond Street
> > > > Glasgow G1 1XH
> > > > United Kingdom

> > > > **
> > > >   The University of Strathclyde is a charitable body,
> > > >   registered in Scotland, number SC015263.
> > > > **

- From the University of St. Andrews

Date: Mon, 9 Mar 2009 17:31:27 +0000
From: Alan Hood <alan@mcs.st-and.ac.uk>
To: Radostin Simitev <rs@maths.gla.ac.uk>
Cc: David Dritschel <dgd@mcs.st-and.ac.uk>, Eric Priest
<eric@mcs.st-and.ac.uk>
Subject: Re: Visit of Prof F.H. Busse

Dear Radostin,

We would be delighted to invite Prof Busse over to give a seminar.
Thanks for thinking about us and thanks for doing the application.

Best wishes,

Alan

Professor Alan Hood
School of Mathematics and Statistics

Department of Mathematics
University of Strathclyde
26 Richmond Street
Glasgow G1 1XH
Scotland

University of Strathclyde Glasgow

10 March 2009

To whom it may concern,

Proposed visit to Scotland by Professor F. H. Busse

I am writing in support of the application for funding for the proposed visit to Scotland by Professor F. H. Busse (University of Bayreuth). In the event that this visit receives funding, the Department of Mathematics at Strathclyde will invite Professor Busse to deliver a seminar to the Department and to other interested staff and students as part of our main Colloquium series.

Professor Busse is among the most eminent researchers in the world on the topic of thermal convection as well as on the transition to turbulence: there are a number of members of staff and postgraduate students in this Department who work on these and related topics and so would benefit greatly from an opportunity both to hear him speak and to meet him in person. I believe that such a visit would also help to maintain the international profile and reputation of Scottish research in applied mathematics. I strongly encourage the Edinburgh Mathematical Society to support the proposed visit if at all possible.

Yours faithfully,

Stephen Wilson.

Professor Stephen K. Wilson
(Head of Department)

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