Abstract

We stand on the threshold of a critical expansion of asteroseismology of Sun-like stars—the study of stellar interiors by observation of their global acoustic modes of oscillation. The Sun-like oscillations give a very rich spectrum allowing the internal structure and dynamics to be probed down into the stellar cores to very high precision. Asteroseismic observations of many stars will allow multiple-point tests of crucial aspects of stellar evolution and dynamo theory. Our proposed project will make a major contribution to position the field to make optimal use of the expected large quantities of data. We will conduct a comprehensive hare-and-hounds exercise, in which realistic artificial datasets will be used to assess the accuracy and precision of methods that extract the mode parameters. Accurate and precise mode parameters are a vital prerequisite for accurate inference on the stellar interiors. Crucial to our proposal is the transfer of expertise from analysis of data on the Sun (helioseismology), in particular knowledge acquired from the solarFLAG group, which has conducted similar, successful hare-and-hounds exercises for the helioseismic case; and hare-and-hounds exercises conducted as part of the preparation for the CNES COROT mission.

1. Scientific Rationale

1.1 Context

Stars with sub-surface convection zones, like the Sun, display acoustic resonant oscillations. The stochastic excitation mechanism limits the amplitudes of the modes to intrinsically weak values. However, it gives rise to an extremely rich spectrum of modes. The excited pressure (p) modes probe different interior volumes, with the radial and other low angular-degree modes probing as deeply as the core. This differential penetration of the modes allows the internal structure and dynamics to be inferred as a function of position, to extreme levels of precision not usually encountered in astrophysics. The Sun has not surprisingly been the exemplar for the development of seismic methods for probing stellar interiors. The study of the global, resonant p-mode oscillations of the Sun—the field of global helioseismology\(^1\)—recently celebrated its Silver Anniversary.

The detection of Sun-like oscillations in other stars offers the prospect of our being able to test theories of stellar evolution and stellar dynamos using many stars rather than just one (the Sun)\(^2\). A wide range of asteroseismic targets is on offer at different epochs along stellar evolutionary life cycles. The theories will therefore be subjected to a very exacting examination—how well will they be able to describe the interiors of such a cross-section of stars?

The fact that the Sun-like oscillations have such small amplitudes (e.g., several centimetres-per-second for the most prominent low-degree solar modes) has made the extension of observations to other stars very challenging. However, the ingenuity of the observers is bearing fruit\(^3\), with data on Sun-like oscillations now available for more than
fifteen stars, with the confirmed detections ranging from dwarf stars that, like the Sun, have not yet reached the end of the hydrogen core-burning phase, to evolved red-giant stars. These asteroseismic observations have been made at ground-based telescopes (using spectrographs such as CORALIE, ELODIE, HARPS, UCLES and UVES), and by satellite instruments (WIRE and MOST). With new space missions soon to be launched (e.g., COROT), others under development (e.g., Kepler) and extension of the ground-based capabilities planned (e.g., the proposed SONG asteroseismic network), we stand on the threshold of a large increase not only in the number of stars for which data are available, but also in the lengths of those datasets (which are at present typically measured in days to weeks, rather than the many-year sets available for the Sun). As such, our application to ISSI is very timely. Its aim is to make a significant contribution to position the field to make optimal use of the new, and future, asteroseismic data.

Our collaboration has heritage in the areas necessary to deliver on the proposed project: Expertise from those involved in the cutting-edge ground-based asteroseismic observations (which have led the way on the new discoveries), and the upcoming COROT space mission; leading theoreticians on the interior structures of stars, and the Sun-like oscillations; and crucial expertise from those involved in the analysis of the so-called Sun-as-a-star data. These helioseismic data come from observations that view the Sun as if it were a star. The observations do not resolve the visible disc, and are sensitive only to the low-degree modes whose oscillations have the simplest spatial structure. Owing to a lack of spatial resolution, the Sun-like asteroseismic data will be limited for the foreseeable future to these same modes. (Nature has therefore been kind to those wishing to test stellar evolution theory, in that these are the modes that probe the deep interiors, and therefore the evolutionary ‘engines’, of the stars.) The Sun-as-a-star analysis methods consequently have direct application to data collected on other Sun-like stars. Application to the asteroseismic case of knowledge acquired from years of development and refinement of the Sun-as-a-star analysis lies at the heart of our program, work that is being led by an international collaboration called the solar Fitting at Low Angular degree Group—solarFLAG. Our asteroFLAG group contains key members of solarFLAG, several of whom have already been engaged in transfer of knowledge to the asteroseismic problem through their involvement in COROT.

1.2 The Proposed Project

The input data for probing stellar interiors are the mode parameters. Accurate mode parameter data are a vital prerequisite for robust, accurate inference on the internal structure. Complicated algorithms are used to extract estimates of these parameters, usually by fitting mode structure in power frequency spectra of the observations to complicated multi-parameter models. The specific aim of the asteroFLAG project is to quantify how accuracy and precision in the extracted parameters is affected by changes in the intrinsic stellar properties, and dataset properties (e.g., length and signal-to-noise ratio).

The work will be conducted for Main Sequence stars within the framework of a hare-and-hounds exercise, an approach applied with great success in the solarFLAG work. Sets of artificial asteroseismic data will be generated by a modified version of the solarFLAG simulation code. We have considerable expertise in the generation of realistic artificial data, and solarFLAG has shown how these data can be a powerful diagnostic tool for testing the mode fitting codes. Our program represents a major extension of the hare-and-hounds exercises conducted as part of the preparation for COROT. We will be testing a larger
number of stellar models, over a finer parameter grid. We will include the effects of artificial stellar activity cycles in the data. The varying activity shifts the mode parameters, and we know from the solar case that the effects can introduce subtle unwanted bias in the results if they are not properly accounted for. In addition, we will also use our data to look at the implications for observation and analysis of multiple targets in open clusters.

The input mode parameters required to build the asteroFLAG datasets will come from stellar evolution codes. These codes will evolve Sun-like stars of different masses on the lower Main Sequence. Snapshots will be taken at several epochs, up to the end of the hydrogen core-burning phase. This will give a grid of seismic models. Datasets will then be generated using the seismic model parameters as input, with various rotation and stellar-cycle characteristics imposed, at various noise levels, dataset lengths and angles of inclination offered to the observer. The inclination, measured with respect to the rotation axis of the star, has an important impact on the visibility of different mode components, and we know from solarFLAG and other studies that poor modeling of the visibility functions can have an adverse effect on some of the fitted parameters.

The complete grid of spectra will be fitted by the fitting codes of the ‘hounds’ in the group. This will provide an unprecedented opportunity to test how up to ~10 hounds approach the same fitting problem. The fitted parameters will then be carefully analyzed to assess the output accuracy and precision, from comparison not only with the input values, but also the results from hound to hound. This will reveal common sources of systematic bias, and highlight the most favorable fitting strategies. The implications for subsequent use of the mode parameters for inferring the internal structure and dynamics will then be assessed. This will be done for the short, one to a few week datasets currently available, up to the several-month-long sets expected from COROT.

2. Project Schedule

Our schedule will contain two ISSI workshops for the whole group.

- Prior to the first ISSI workshop, working teams will be created within the asteroFLAG group. Team 1 will be responsible for the stellar evolutionary codes, and generation of the seismic inputs; Team 2 for choices made on dataset length and quality. The information from these groups will be used by Team 3 to generate the artificial asteroseismic data. Only Team 3 will have full knowledge of the content of each dataset (and as such, they will be the true ‘hares’). The hounds (Team 4) will then apply their fitting codes, with a priori knowledge limited to that available for real data. Accurate mode classification plays an important part in the parameter extraction. This is because one must fit the proper structure (which may comprise of several rotationally split components, of varying visibility) to each mode. The remit of Team 4 will therefore also cover mode identification.

- We would expect to hold the first ISSI workshop in the autumn of 2006. The working teams will have already started their activities, and this workshop will develop a clear and coordinated program for each of the teams.

- Over the first half of 2007, Teams 1 to 3 will work on generating the artificial data. At the same time, Team 4 will be provided with ‘strawman’ data, based on solarFLAG, to allow them to test modifications and developments of the fitting codes, which will be needed
for the more general asteroseismic case. They will at the same time seek to refine a
general mode-identification package.

- The artificial spectra will be fitted by Team 4, and the results analyzed by Team 3, in the
second half of 2007. The second ISSI workshop would be held in the autumn of 2007, at
which a full analysis of the results would be presented. This workshop will be concerned
with reaching clear consensus on the conclusions and implications of the results.

3. Expected Outputs

- We expect to submit several papers to refereed academic journals. For example, there
would be a paper to explain in detail the framework of the hare-and hounds exercise, and
how the artificial seismic data were generated; and several papers that will discuss the
results of the exercise, and the implications for analysis of extant, and future,
asteroseismic data on Main Sequence stars, and open clusters. These papers will be
supplemented by internal reports, with additional detail on procedures and results.
- We would aim to present an overview of the project at the major biennial
helioseismology and asteroseismology conference (SOHO18/GONG 2006/HELAS I),
being held in Sheffield (UK) in 2006 August; and to make a presentation of preliminary
results at the HELAS II Conference, being held in Göttingen in 2007 August.
- We will also seek to make the artificial datasets available to the wider asteroseismic
community, via the Virtual Observatory (by collaboration with the UK/PPARC Astrogrid
project).

4. List of Participants

T. Appourchaux (Institut d’Astrophysique Spatiale/Orsay, France)
J. Ballot (Max Planck Institut für Astrophysik/Garching, Germany)
F. Baudin (Institut d’Astrophysique Spatiale/Orsay, France)
T. R. Bedding (University of Sydney, Australia)
W. J. Chaplin (University of Birmingham, UK; coordinator)
J. Christensen-Dalsgaard (University of Aarhus, Denmark)
O. L. Creevey (High-Altitude Observatory/Boulder, USA)
Y. Elsworth (University of Birmingham, UK)
S. T. Fletcher (University of Birmingham, UK)
R. A. García (Service d’Astrophysique CEA/Saclay, France)
D. O. Gough (Institute of Astronomy/Cambridge, UK)
G. Houdek (Institute of Astronomy/Cambridge, UK)
S. J. Jiménez-Reyes (Instituto de Astrofisica de Canarias/Tenerife, Spain)
H. Kjeldsen (University of Aarhus, Denmark)
M. Lazrek (LPHEA/Marrakech, Morocco)
C. Neiner (Observatoire de Meudon/Paris, France)
R. New (Sheffield Hallam University, UK)
C. Régulo (Instituto de Astrofisica de Canarias/Tenerife, Spain)
D. Salabert (High-Altitude Observatory/Boulder, USA)
R. Samadi (Observatoire de Meudon/Paris, France)
T. Sekii (National Astronomical Observatory of Japan/Tokyo, Japan)
T. Toutain (University of Oslo, Norway)
S. Turck-Chièze (Service d’Astrophysique CEA/Saclay, France)
5. ISSI is the Preferred Implementation Site

Members of asteroFLAG have participated in other ISSI working groups, for example the currently active Phoebus Group\textsuperscript{17}. We have been impressed by the facilities, on-site support, and smooth running of the workshops. We feel that the ISSI provides an excellent working environment, free from institutional pressures and other diversions. This allows the group members to concentrate fully on the proposed project. Continuous spans of one week of such high-quality time are invaluable for enabling clearly focussed discussion and planning on a project of the type proposed by the asteroFLAG group.

6. Requested Facilities

We will require a meeting room capable of holding up to 23 scientists (the full asteroFLAG contingent), with internet access and data projection facilities. It would also be advantageous to have access to ~2 smaller rooms, to allow splinter meetings of working teams. We would like access to a small number (say 3) of ISSI PCs (having both Windows and Linux operating systems), and a local printer. Group members will bring their own laptops.

7. Requested Financial Support

We request 30 scientist-days of financial support to cover accommodation and \textit{per diem} costs of 15 scientists at each of the two proposed ISSI asteroFLAG workshops, at the usual ISSI rates. Travel costs for the team leader (Chaplin) should not exceed €750. [Note: We will meet travel costs for the participants, and accommodation and \textit{per diem} costs for numbers in excess of 15, from our own institutional funds and held grants, together with a contribution from the European Helio- and Asteroseismology Network (HELAS).]

List of References

\textsuperscript{1} Christensen-Dalsgaard J., 2002, RvMP, 74, 1073
\textsuperscript{2} Christensen-Dalsgaard J., 2003, Ap&SS, 284, 277
\textsuperscript{3} Bedding T. R., Kjeldsen H., 2003, PASA, 20, 203
\textsuperscript{4} Bedding T. R., Kjeldsen H., 2004, in: Proceedings of SOHO14/GONG 2004, ‘Helio- and Asteroseismology: Towards a Golden Future’, ed. D. Dansey, ESA SP-559, Noordwijk, Netherlands, p. 101
\textsuperscript{5} Buzasi D., 2002, in: Radial and Non-radial Pulsations of Stellar Physics, ASP Conf. Proc. Vol. 259, eds. C. Aerts, T. R. Bedding, J. Christensen-Dalsgaard, p. 616
\textsuperscript{6} Walker G., Matthews J., Kuschnig R., et al., 2003, PASP, 115, 1023
\textsuperscript{7} Baglin A., Auvergne M., Barge P., et al., 2002, in: Proceedings of the First Eddington Workshop on Stellar Structure and Habitable Planet Finding, eds. F. Favata, I. Roxburgh, D. Galadi, ESA SP-485, Noordwijk, Netherlands, p. 353
\textsuperscript{8} Borucki W. J. et al., 2005, AAS, 207, 153.01
\textsuperscript{9} SONG website URL \url{http://astro.phys.au.dk/SONG/}
\textsuperscript{10} solarFLAG website URL \url{http://bison.ph.bham.ac.uk/~wjc/Research/FLAG.html}
\textsuperscript{11} Chaplin W. J., Appourchaux T., Baudin F., et al., 2006, MNRAS, in the press
\textsuperscript{12} Appourchaux T., 2003, Ap&SS, 284, 109
\textsuperscript{13} Piau L., Ballot J., Turck-Chièze S., 2005, A&A, 430, 571
\textsuperscript{14} Ballot J., Garcia R. A., Lambert P., 2006, MNRAS, in the press
\textsuperscript{15} Di Mauro M. P., in: Proceedings of SOHO14/GONG 2004, ‘Helio- and Asteroseismology: Towards a Golden Future’, ed. D. Dansey, ESA SP-559, Noordwijk, Netherlands, p. 186
\textsuperscript{16} Lambert P., Pires S., Ballot J., Garcia R. A., Starck J.-L., Turck-Chièze S., 2006, A&A, submitted
\textsuperscript{17} Phoebus Group ISSI website URL \url{http://www.issi.unibe.ch/teams/GModes/}
Appendix 1: Full Addresses of Applicants

Thierry Appourchaux
Institut d’Astrophysique Spatiale
Batiment 121
91045 Orsay Cedex, France
Thierry.Appourchaux@ias.u-psud.fr
Phone: +33 1 69 85 86 29
Fax: +33 1 69 85 87 01

Jérôme Ballot
Max Planck Institut für Astrophysik
Karl-Schwarzschild-Str. 1
Postfach 1317
D-85741 Garching, Germany
jballot@MPA-Garching.mpg.de
Phone: +44 89 30000 2195
Fax: +44 89 30000 2235

Frédéric Baudin
Institut d’Astrophysique Spatiale
Batiment 121
91045 Orsay Cedex, France
Frederic.Baudin@ias.u-psud.fr
Phone: +33 1 69 85 86 07
Fax: +33 1 69 85 87 01

Tim Bedding
School of Physics
University of Sydney 2006
Australia
bedding@physics.usyd.edu.au
Phone: +61 2 9351 2680
Fax: +61 2 9351 7726

William Chaplin
School of Physics and Astronomy,
University of Birmingham,
Edgbaston, Birmingham B15 2TT, UK
w.j.chaplin@bham.ac.uk
Phone: +44 121 414 4599
Fax: +44 121 414 4601

Jørgen Christensen-Dalsgaard
Department of Physics and Astronomy,
University of Aarhus
Ny Munkegade, Building 520
DK-8000 Aarhus C, Denmark
jcd@phys.au.dk
Phone: +45 89 42 36 14
Fax: +45 86 12 07 40

Orlagh Creevey
High Altitude Observatory, NCAR
P.O. Box 3000, Boulder
CO 80307-3000, USA
Creevey@ucar.edu
Phone: +1 303 497 1524
Fax: +1 303 497 1589

Yvonne Elsworth
School of Physics and Astronomy,
University of Birmingham,
Edgbaston, Birmingham B15 2TT, UK
y.p.elsworth@bham.ac.uk
Phone: +44 121 414 4575
Fax: +44 121 414 4601

Stephen Fletcher
School of Physics and Astronomy,
University of Birmingham,
Edgbaston, Birmingham B15 2TT, UK
stfltech@bison.bham.ac.uk
Phone: +44 121 414 4597
Fax: +44 121 414 4601

Rafael García
Service d’Astrophysique CEA Saclay
L’Orme des merisiers, Bat. 709
91191 Gif-sur-Yvette Cedex
France
rgracia@cea.fr
Phone: +33 1 69082725
Fax: +33 1 69086577
Takashi Sekii  
National Astronomical Observatory  
Mitaka, Tokyo 181-8588, Japan  
Sekii@solar.mtk.nao.ac.jp  
Phone: +81 422 34 3712  
Fax: +81 422 34 3700

Thierry Toutain  
Institute of Theoretical Astrophysics  
Postboks 1029 Blindern  
0315 Oslo, Norway  
tierry.toutain@astro.uio.no  
Phone: +47 22 85 42 87  
Fax: +47 22 85 65 05

Sylvaine Turck-Chièze  
Service d'Astrophysique CEA Saclay  
L'Orme des merisiers, Bat. 709  
91191 Gif-sur-Yvette Cedex  
France  
turck@hep.saclay.cea.fr  
Phone: +33 1 69084387  
Fax: +33 1 69086577
Appendix 2: Brief CVs of the Applicants

Thierry Appourchaux

Professional Education
PhD in Astronomy and Space Techniques, University of Paris VI, 1984

Present Position
Head of the Solar and Stellar Physics Group of the Institut d’Astrophysique Spatiale
Directeur de Recherche of CNRS

Research Interests and Expertise
Helioseismology; search for g-modes, excitation of p- and g-modes.
Asteroseismology
Space instrumentation
More than 40 refereed papers, more than 60 conference papers

International Collaborations, Affiliations
Co-I of SOHO VIRGO investigation
Instrument Scientist of the LOI, subsystem of VIRGO
Co-I of the COROT mission (Asteroseismology and Exoplanets)
Co-I of the PICARD mission (Solar diameter and g modes)
Coordinator of Phoebus Group
Member of solarFLAG
Member of the DUC of the GONG network
Associated scientist of SOI/MDI aboard SOHO

Jérôme Ballot

Professional Education
PhD, Université Paris XI, Orsay, 2004

Present Position
Post-doctoral position, Max-Planck-Institut für Astrophysik, Garching, Germany

Research Interests and Expertise
Global helioseismology and asteroseismology
Numerical simulations of stellar interiors
6 refereed papers, 13 conference papers

International Collaborations, Affiliations
Co-I of COROT (Seismology Working Group)
Collaborator on the GOLF data analysis

Frédéric Baudin

Professional Education
Ph.D. in Physics, University of Paris XI/Orsay, 1993

Present Position:
Associated Astronomer, Institut d'Astrophysique Spatiale, France
**Research Interests and Expertise**  
Global and local helioseismology, data analysis  
44 publications including 18 refereed papers  

**International Collaborations, Affiliations**  
Co-I of the COROT mission (Asteroseismology and Exoplanets)  
Associate Scientist of GOLF  
Member of solarFLAG  
Member of Phoebus group  

**Tim Bedding**  

**Professional Education**  
PhD, School of Physics, University of Sydney, 1992  
Graduate Certificate in Higher Education, University of Sydney, 2003  

**Present Position**  
Associate Professor, School of Physics, University of Sydney  

**Research Interests and Expertise**  
Asteroseismology; Optical interferometry  
About 75 publications in refereed journals; about 80 in conference proceedings  

**International Collaborations, Affiliations**  
Member of Australian Gemini Steering Committee  
PI of two Discovery Grants from the Australian Research Council  
Member of SONG project  

**William Chaplin**  

**Professional Education**  
PhD, School of Physics & Astronomy, Birmingham, 1993  
Postgraduate Certificate in Learning and Teaching in Higher Education, University of Birmingham, 2001  

**Present Position**  
Senior Lecturer, School of Physics & Astronomy, University of Birmingham  

**Research Interests and Expertise**  
Global helioseismology, and asteroseismology  
About 60 publications in refereed journals; about 40 in conference proceedings  

**International Collaborations, Affiliations**  
Co-I of BiSON  
Coordinator for solarFLAG collaboration  
Co-I on two PPARC E-science projects (eSDO and Data Mining Algorithms)  
Member of PPARC Astrogrid Science Advisory Group  
Member of Phoebus group
Jørgen Christensen-Dalsgaard

**Professional Education**
MSc, University of Aarhus, 1975  
PhD, Department of Applied Mathematics and Theoretical Physics, Cambridge University, 1978

**Present Position**
Professor of Helio- and Asteroseismology, Department of Physics and Astronomy, University of Aarhus, Denmark

**Research Interests and Expertise**
Stellar structure and evolution  
Stellar oscillations  
Global helioseismology, and asteroseismology  
About 120 publications in refereed journals; about 170 in conference proceedings

**International Collaborations, Affiliations**
Co-I of MDI and GOLF on SOHO  
Head of Danish AsteroSeismology Centre  
Member of ESA Science Programme Committee  
Member of Board of Nordic Optical Telescope  
Member of SONG project

Orlagh Creevey

**Professional Education**
Present: PhD student Astrophysics  
Diploma de Estudios Avanzados, ‘Fisica del Cosmos’, University of La Laguna, Tenerife  
MSc, Mathematics, National University of Ireland Maynooth (NUIM), Ireland  
HDipEd Higher Diploma in Education (Teaching), NUIM

**Present Position**
PhD student of the University of La Laguna, Tenerife, Spain  
Scholarship to conduct research at HAO (NCAR), Boulder, CO, USA

**Research Interests and Expertise**
Asteroseismology of solar-like stars, Delta Scuti stars.  
Pulsating stars in binary systems  
2 refereed journal publications, 3 proceedings

**International Collaborations, Affiliations**
Collaborator of IAC, Tenerife, Spain  
Collaborator of CAUP, Porto, Portugal

Yvonne Elsworth

**Professional Education**
PhD, Victoria University of Manchester, 1976

**Present Position**
Professor of Helioseismology at the University of Birmingham  
Head of High-Resolution Spectroscopy Group, University of Birmingham
Research Interests and Expertise
Helioseismology: BiSON network that observes the Sun at low-degree
Data analysis, interpretation
About 65 publications in refereed journals, 60 in conference proceedings

International Collaborations, Affiliations
PI of the BiSON project
Co-I of eSDO PPARC E-science project
Member of solarFLAG
Member of Phoebus group

Stephen Fletcher
Professional Education
Present: PhD student, helioseismology and asteroseismology
MSci Degree (first class) in Physics and Astronomy, School of Physics & Astronomy,
Birmingham, 2002

Present Position
PhD student and post-graduate teaching assistant, School of Physics & Astronomy,
Birmingham

Research Interests and Expertise
Global helioseismology and asteroseismology
Power spectrum and time-series analysis
2 publications in refereed journals; 1 in conference proceedings

International Collaborations, Affiliations
Member of solarFLAG collaboration

Rafael García
Professional Education
PhD, in Astronomy and Astrophysics, Universidad de La Laguna, Tenerife, Spain, 1996

Present Position
Research engineer, Service d'Astrophysique CEA/Saclay, France

Research Interests and Expertise
Global helioseismology, asteroseismology
About 30 publications in refereed journals; about 60 in conference proceedings

International Collaborations, Affiliations
Co-I of GOLF/SOHO; Responsible at the CEA/Saclay for the instrument
Co-I of MDI/SOHO
Co-I of GONG
Co-I of COROT
Scientific Manager of GOLF-NG prototype
Member of solarFLAG
Member of Phoebus group
Member of the Seismology Working Group of COROT
Douglas Gough

Professional Education
PhD, University of Cambridge, 1966

Present Position
Professor of Theoretical Astrophysics, University of Cambridge, UK
Honorary Professor of Astronomy, Queen Mary and Westfield College, University of London, UK
Fellow Adjoint, Joint Institute for Laboratory Astrophysics, Boulder, USA
Visiting Professor, Department of Physics, Stanford University, USA

Research Interests and Expertise
Stellar fluid dynamics, solar and stellar structure, stellar pulsation
Helioseismology and asteroseismology, inverse theory
More than 140 refereed papers, more than 160 conference papers

International Collaborations, Affiliations
Co-I on SOI/MDI, VIRGO and GOLF on SOHO
Co-I on HMI/SDO
Member of GONG
Member of Phoebus group

Günter Houdek

Professional Education
PhD, Astrophysics, Institute for Astronomy, University of Vienna, 1997

Present Position
Postdoctoral Research Fellow, Institute of Astronomy, Cambridge

Research Interests and Expertise
Stellar fluid dynamics, solar and stellar structure, stellar pulsation
Helioseismology and asteroseismology
About 20 publications in refereed journals; about 20 in conference proceedings

International Collaborations, Affiliations
Member of GONG
Member of ENEAS

Sebastián Jiménez-Reyes

Professional Education
PhD, La Laguna University, Spain, 2001, funded by the High Altitude Observatory (Boulder, USA)
Masters Thesis, La Laguna University, Spain, 1996

Present Position
Postdoctoral Research, Instituto de Astrofísica de Canarias, Spain

Research Interests and Expertise
Sun: activity, atmosphere, helioseismology, magnetic fields, rotation
Stars: asteroseismology, eclipsing binaries, low-mass, brown dwarfs
About 20 publications in refereed journals; about 28 in conference proceedings
International Collaborations, Affiliations
Co-I of one PNE science projects
Member of HELAS
Member of GOLF-team and ECHO-team
Member of solarFLAG

Hans Kjeldsen
Professional Education
Cand Scient, MSc Astronomy from University of Aarhus, Denmark
(Hovedfag and speciale in Astronomy), 1989
PhD in Astronomy from University of Aarhus, Denmark, 1992

Present Position
Lektor (Associate Professor) at Institut for Fysik og Astronomi (Department of
Physics and Astronomy), Aarhus Universitet, Denmark

Research Interests and Expertise
Asteroseismology of main-sequence stars: solar-type stars (including the
Sun), roAp stars, delta Scuti stars and beta Cephei stars. Asteroseismology of
EC 14026 stars (sdB stars) and red giants. High-precision photometry and
spectroscopy. Time series and Fourier analysis using statistical weights.
Theoretical models of main sequence stars. Development of high-precision
instrumentation for Space (Rømer ESA EDDINGTON, COROT and Kepler satellite
missions). Astronomy education and public outreach.
51 publications in refereed journals; 69 publications in conference proceedings

International Collaborations, Affiliations
Member of European Southern Observatory Scientific Technical Committee (ESO STC)
Member of Nordic Optical Telescope Council
Member of Nordic Optical Telescope Scientific Technical Committee (NOT STC)
Member of the International Scientific Committee (CCI) of the Roque de los Muchachos
and Teide Observatories.
Co-I of COROT
Member of ENEAS
Danish AsteroSeismology Centre
Member of SONG Project

Mohamed Lazrek
Professional Education
PhD, Liège, Belgium, 1993

Present Position
Professor, UCAM, University of Marrakech, Morocco

Research Interests and Expertise
Global helioseismology, and asteroseismology; Site testing
About 20 publications in refereed journals; about 15 publications in conference
proceedings
International Collaborations, Affiliations
Co-I of IRIS
Co-I of GOLF/SOHO
Member of solarFLAG
Member of the Moroccan group in charge of the site testing in Anti-Atlas Mountains within framework of ‘ELT Design Study’ (Extremely Large Telescope)

Coralie Neiner
Professional Education
PhD in astronomy, University of Strasbour, France, 2002
PhD in astronomy, University of Amsterdam, The Netherlands, 2002
Present Position
Researcher (CR2) at the CNRS, GEPI laboratory, Observatoire de Paris-Meudon, France
Research Interests and Expertise
Asteroseismology of hot stars and solar-like stars
Expertise: spectroscopy, spectropolarimetry, modeling
About 15 publications in refereed journals; about 35 publications in conference proceedings
International Collaborations, Affiliations
Co-I of COROT
PI of a long-term PNPS program on magnetic fields in hot stars
WP manager of GAIA and coordinator of the GHOST for Gaia

Roger New
Professional Education
PhD, University of Birmingham, 1979
Present Position
Senior Academic, Sheffield Hallam University, Sheffield
Research Interests and Expertise
Global helioseismology, and asteroseismology; spectroscopy of plasmas
About 50 publications in refereed journals and 40 in conference proceedings
International Collaborations, Affiliations
Co-I of BiSON
Member of solarFLAG

Clara Régulo
Professional Education
Ph.D., Universidad de La Laguna, Tenerife, Spain, 1987
Scholarship at Instituto de Astrofísica de Canarias from 1983 till 1986
Present Position
Assistant Professor, Universidad de La Laguna, Tenerife
Research Interests and Expertise
Global helioseismology, and asteroseismology
About 45 publications in refereed journals and 40 in conference proceedings

International Collaborations, Affiliations
Participation in 12 research projects with public financing.

David Salabert
Professional Education
PhD, University of Nice-Sophia Antipolis, Nice (France), 2003
Postgraduate Certificate in Astrophysics (Majors: Imagery and Teledetection), University of Nice-Sophia Antipolis, Nice (France), 1999

Present Position
Postdoctoral Fellowship, National Center for Atmospheric Research/High Altitude Observatory, Boulder CO (USA)
After March 31st 2006: Postdoctoral Research Associate, Global Oscillation Network Group Program, National Solar Observatory, Tucson AZ (USA)

Research Interests and Expertise
Global helioseismology (both full-disc and spatially-resolved observations), and asteroseismology
About 10 publications in refereed journals; about 10 in conference proceedings

International Collaborations and Affiliations
Member of solarFLAG

Réza Samadi
Professional Education
PhD, Pierre and Marie Curie University, Paris, 2000

Present Position
Astronomer Assistant (Astronome Adjoint), Observatoire de Paris, Meudon, France

Research Interests and Expertise
Helioseismology and asteroseismology; convection in stars
17 publications in refereed journals and 16 in conference proceedings

International Collaborations, Affiliations
Co-I of COROT

Takashi Sekii
Professional Education
PhD, University of Tokyo, 1990

Present Position
Associate Professor, National Astronomical Observatory of Japan

Research Interests and Expertise
Global- and local-helioseismology, asteroseismology, inverse theory
60 publications: 20 refereed papers
International Collaborations, Affiliations
Co-Investigator of Solar-B Project
Co-Investigator of HMI/SDO Project
Member of GONG collaboration
Member of SOI/MDI collaboration
Member of solarFLAG
Member of Phoebus Group

Thierry Toutain
Professional Education
PhD Thesis, University of Paris VI, 1990

Present Position
Chargé de recherché CNRS, Observatoire de la Cône d’Azur
Research Fellow, High-Resolution Spectroscopy Group, University of Birmingham

Research Interests and Expertise
Helio and asteroseismology: data analysis
54 publications: 23 refereed papers

International Collaborations, Affiliations
Co-I of the VIRGO/SOHO experiment
Co-I of the COROT mission (Asteroseismology and Exoplanets)
Co-I of the PICARD mission (Solar diameter and g modes)
Member of solarFLAG
Member of Phoebus Group

Sylvaine Turck-Chièze
Professional Education
PhD Physics, Orsay, 1985

Present Position
Research Director CEA, Chief of the laboratory Nuclear Astrophysics and Stellar Plasmas in Service d’Astrophysique au CEA Saclay France

Research Interests and Expertise
Stellar modelling, Global helioseismology, Asteroseismology
Plasma properties and neutrino properties, Nuclear physics
More than 50 publications in refereed journals and more than 100 in conference proceedings (including invited talks): about 3000 citations

International Collaborations, Affiliations
Co-I on GOLF
GOLFNG/DynaMICS collaboration
Co-I COROT
Plasma Physics: connection with plasma physics and ITER