Solar Phys (2010) 265: 1–3
DOI 10.1007/s11207-010-9615-3

Preface

M.M. Bisi · A.R. Breen · L. van Driel-Gesztelyi · C.H. Mandrini

Received: 16 July 2010 / Accepted: 16 July 2010 / Published online: 3 August 2010

This topical issue (TI) of *Solar Physics* presents papers given at or associated with the first International Workshop on "Remote Sensing of the Inner Heliosphere", held at Yr Hen Coleg (The Old College) of Aberystwyth University in Wales (UK) from 5 to 9 May 2009. This workshop built on the successful series of interplanetary scintillation (IPS) workshops held in Toyokawa, Japan in 2007 and in Pushchino, Russia in 2006, as well as the earlier

Remote Sensing of the Inner Heliosphere
Guest Editors: M.M. Bisi and A.R. Breen

M.M. Bisi
Center for Astrophysics and Space Sciences, University of California, San Diego, 9500 Gilman Drive #0424, La Jolla, CA 92093-0424, USA
e-mail: Mario.Bisi@aber.ac.uk

M.M. Bisi · A.R. Breen
Institute of Mathematical and Physical Sciences, Aberystwyth University, Penglais Campus, Aberystwyth, Ceredigion, SY23 3BZ, Wales, UK

A.R. Breen
e-mail: azb@aber.ac.uk

L. van Driel-Gesztelyi (✉)
Observatoire de Paris, LESIA – CNRS UMR 8109, 92195 Meudon Cedex, France
e-mail: Lidia.vanDriel@obspm.fr

L. van Driel-Gesztelyi
University College London, Mullard Space Science Laboratory, Holmbury St. Mary, Dorking, Surrey, RH5 6NT, England, UK

L. van Driel-Gesztelyi
Konkoly Observatory of Hungarian Academy of Sciences, Budapest, Hungary

C.H. Mandrini
Instituto de Astronomía y Física del Espacio, CONICET-UBA, CC. 67, Suc. 28, 1428 Buenos Aires, Argentina
e-mail: mandrini@iafe.uba.ar

low frequency radio observations workshop in San Diego, CA, USA in 2004. For the 2009 meeting, following the success of the Solar Mass Ejection Imager (SMEI) on the *Coriolis* satellite and the *Solar TErrestrial RElations Observatory* (STEREO) Heliospheric Imagers (HIs), the decision was made to widen the remit to embrace all methods of remote-sensing observations covering the inner heliosphere.

The meeting was held in the immediate aftermath of the International Heliophysical Year (2007 – 2009) and the Whole Heliosphere Interval (2008) and in the year which marked the 400th anniversary of Galileo's sunspot observations and the 150th anniversary of Carrington and Hodgson's independent observations of a white-light solar flare – the event which marks the start of the sciences of solar and space physics. The previous year had been the 50th anniversary of Parker's epochal paper on the formation of the solar wind; so this was a most suitable time to review our state of knowledge and look forward to future science directions.

The types of remote-sensing observations available for probing the solar atmosphere and inner heliosphere range from direct observations of non-thermal solar radio emissions, through observations of X-ray and extreme-ultraviolet (EUV) coronal emissions, observations of photospheric white light scattered by electrons in the corona and solar wind, observations of radio waves from distant astronomical sources scattered by density irregularities in the solar wind, and radio emissions from particles accelerated on interplanetary shocks to direct imaging of the impact of solar disturbances in planetary atmospheres – aurorae.

Of these techniques, the longest-established is observation of the solar corona via scattering of photospheric light during eclipses, followed by solar radio emissions, and then IPS. The discovery of IPS itself came as something of an accident, resulting originally from the simultaneous suggestions in 1951 by teams of scientists in the UK and the USSR that it should be possible to study the outer corona of the Sun using metre-wave radio observations of distant astronomical sources, with density variations in the corona producing an apparent broadening of the radio source. These studies led to the realisation by a team led by A. Hewish that the unusual fluctuations observed in the apparent strength of compact sources, detected during high precision radio sky surveys in the early 1960s, could be produced by scattering from density irregularities in the solar wind. Hewish's group at Cambridge subsequently developed these studies of "interplanetary scintillation" into a powerful tool for probing solar-wind structure across a wide range of heliocentric distances and heliographic latitudes, revealing clear differences in the characteristics of solar wind at polar and equatorial latitudes. The Cambridge group was also the first to combine observations from two or more telescopes, an approach developed considerably at San Diego – initially by J.W. Armstrong and later by W.A. Coles – through the 1970s, 1980s, and 1990s which led to significant improvements in the accuracy of solar-wind velocity estimates. Other IPS researchers – including the Cambridge group from the 1970s and the group at Ootacamund (Ooty) Radio Telescope (ORT) – adopted a different approach: combining measurements of IPS from many different sources made with large single antennas to build up sky maps of solar wind structure; while the team at Nagoya University developed an intermediate approach, combining measurements from four large arrays. The group at Pushchino observatory continued to plough an entirely independent furrow, using low-frequency observations and very large antennas. Much excellent science was done by the various IPS groups during this period, but the field had become rather fragmented and as a result its impact on the wider science community was reduced. The proposals for a new generation of radio observatories aired in the early 2000s – leading eventually to the LOw Frequency ARray (LOFAR) and the Murchison Widefield Array (MWA) developments – served as a spur to bring the community together, leading to the meetings at San Diego, Pushchino, and Toyokawa.

IPS today is still as relevant and unique as it was when it was first discovered and developed. It provides a perfect complement to white-light observations of the solar wind using

wide-field imagers (such as those on *Coriolis* and STEREO) and is a potent source of information on the "evolution" of the solar wind between the corona and the planets. In future, it will be essential in providing global context for *in-situ* measurements from near-Sun spacecraft such as *Solar Orbiter* and *Solar Probe Plus*.

There are active research groups around the world taking and using IPS data for scientific research: at University of California San Diego (UCSD), USA; at Solar-Terrestrial Environment Laboratory (STELab/STEL), Japan; at Ooty, India; at Aberystwyth University, Wales (UK); and at Pushchino observatory, Russia; while an entirely new IPS facility in Mexico (MEXART) has recently become operational and saw its first-light IPS analyses during the workshop. In the very near future, the new and very powerful MWA and LOFAR systems will begin taking data, with MWA being the first southern-hemisphere-based IPS-capable system.

The broad aims of the Workshop were to continue discussions on IHY collaborations and progress (specifically WHI and the current solar minimum, and to decide on a list of transient events for further study as a community – in particular, such events as the 13 May 2005 coronal mass ejection). A further aim was to aid the ease and speed with which data from the different experiments and facilities operated by members of the IPS – and the wider remote-sensing community – could be shared. This had led to a pathway being determined for the development of a unified and accessible format for IPS data which is suitable for wider dissemination. The meeting also discussed developments at MWA and LOFAR and how they could be exploited for IPS and Faraday rotation (FR), co-ordinated observations with SMEI/STEREO|HIs and other white-light imaging systems and *in-situ* comparisons and modelling, and how the different data sets can complement each other to further our understanding of the physics controlling the "evolution" of the solar wind as it expands out into interplanetary space. The meeting also served to cement the close collaborative ties between various IPS and remote-sensing groups developed following the previous workshops.

The organising committee for the workshop were Drs. Andrew R. Breen (Aberystwyth University), Mario M. Bisi (UCSD, now at Aberystwyth University), and Richard A. Fallows (Aberystwyth University). The workshop received generous support from sponsors and supporters – primarily the European Office of Aerospace Research and Development (EOARD) of the United States Air Force Office of Scientific Research (AFOSR), US Air Force Research Laboratory (AFRL) http://www.london.af.mil/, and the US National Science Foundation (NSF) http://www.nsf.gov/. Their support alone made possible the truely international character of the workshop and was an essential contribution to its success. The workshop venue, conference facilities and support were provided by Aberystwyth University, providing an excellent – and architectually unique – setting for the meeting. Presentations and notes from the meetings have been archived on Aberystwyth University webpages and can be accessed here: http://heliosphere-2009.dph.aber.ac.uk/Talks/.

Finally, we would like to thank the authors for the influx of extra papers from those not able to attend the Workshop in 2009 as well as the papers from those in attendance, and to convey a special thanks to the team of referees who worked very hard in making sure the papers contained within this TI of *Solar Physics* on "Remote Sensing in the Inner Heliosphere" are of outstanding scientific quality. Since, again, this is a relatively-small community and the pool of referees with the necessary expertise to ensure good-quality science and fairness throughout the refereeing stages was also small. We are very happy with the papers in this TI and are pleased that they collectively cover many remote-sensing techniques, observations, modelling, and comparisons with *in-situ* measurements (where available), all the way from near the Sun's "surface" out to beyond 1 AU.