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Editorial

Our nearest star, the Sun, has an invaluable influence on our everyday life. Solar activity drives Space Weather which affects terrestrial weather and distorts communications and navigation systems. The investigation of various plasma processes in the solar interior, its atmosphere and Space Weather phenomena helps us achieve a better understanding of how they are related to each other and how we can protect our technological society. Only recently, thanks to the modern hi-resolution space- and ground-based observations as well as to state-of-the-art numerical and analytical modeling, we have taken significant steps towards the understanding of large and small scale plasma processes which occur in the Sun's interior, highly magnetised solar atmosphere, and further out in the corona. However, several "big questions" such as coronal heating, the role of MHD waves in solar atmosphere energy transport, the origin and acceleration of solar wind, and the mechanisms responsible for the triggering of solar flares and Coronal Mass Ejections remain unsolved. Another very important aspect of solar exploration is exploiting this 'natural space laboratory' to investigate issues related to astrophysical plasmas and interactions between complex magnetic structures and plasma. It provides an insight leading to a better understanding of laboratory plasma processes and high-energy fusion experiments.

The idea to publish this Special Issue was discussed at the Indo-UK seminar (funded by Royal Society and DST and organised by Dr. V. Fedun and Dr. A. K. Srivastava) at ARIES, Nainital, 26–28 March 2014 and received much support from the participants. This meeting addressed a variety of problems concerning solar physics and was attended by like-minded scientists from both solar communities. In this Special Issue we present a collection of state-of-the-art reviews as well as scientific articles that were presented and discussed during this meeting.

- The processes in the sub-surface zones of the Sun and Sun-like stars are of great importance in terms of the generation of seed magnetic field, its transport through the convection zone and thus creation of the surface magnetism. The interior plasma conditions also led to the excitation of various global wave modes tapping down the signature at the surface of the Sun, and were used to diagnose the physical conditions of the interior of the Sun and similar stars. The two articles by A. R. Choudhuri (*JAA*, **36**(**1**), 5, 2015) and B. Pintér (*JAA*, **36**(**1**), 15, 2015) are devoted to the critical assessment of flux-transport solar dynamo and helioseismic oscillations to address the dynamics and transport processes of the solar interior.
- Helioseismology provides us with important information on the internal structure and rotation of the Sun from the surface to the core. Similar to this, asteroseismology studies the internal structure of pulsating stars by analysing their frequency spectra. The extensive review by S. Joshi and Y. Joshi (*JAA*, **36**(**1**), 33, 2015) highlights the progress made in the theoretical and observational asteroseismology in recent years. The authors also comment on future prospects of the "Nainital-Cape Survey" project in the light of the new optical 3.6-m telescope recently installed at Devasthal (ARIES).

- We still do not have a detailed answer on the question of where the Sun's surface magnetic field originates from? The observational study of the temporal variation of Ca-K line profile of the Sun during Solar Cycles 22 and 23 by G. Sindhuja & J. Singh (*JAA*, **36**(**1**), 81, 2015), provides knowledge about the solar irradiance variation with the magnetic cycle. This important analysis will enable a better understanding of the solar cycle origin and solar dynamo modelling.
- It is known that the solar cycle exhibits North–South asymmetry. A similar asymmetry has been studied by N. G. Gyenge *et al*. (*JAA*, **36**(**1**), 103, 2015) in the case of the distribution of solar macrospicules, which will have future consequences on small-scale flux-transport processes from sub-photopsheric.
- The precursor study of solar flares is addressed by M. B. Korsos *et al*. (*JAA*, **36**(**1**), 111, 2015) which is the least understood phenomena but may shed newer light on the triggering processes of solar flares and related eruptions. It is well known that such flaring regions associate with huge flux-rope eruptions, which may further lead to the formation of Coronal Mass Ejection. If such eruptions are Earth-directed, then they can potentially create the Space Weather effects.
- The articles by P. Pagano *et al*. (*JAA*, **36**(**1**), 123, 2015) and B. Filippov *et al*. (*JAA*, **36**(**1**), 157, 2015) are devoted respectively, to the numerical and observational aspects of the solar magnetic flux-ropes in the solar corona and their dynamical behaviour.
- The fast solar wind is emanated from polar coronal holes, and its origin from chromospheric layers is still a challenge to understand. The review by B. N. Dwivedi & K. Wilhelm (*JAA*, **36**(**1**), 185, 2015) describes the polar plumes and their association with the wind.
- MHD waves play a vital role in the heating processes and dynamics of the highly magnetised Sun's atmosphere (see e.g., Banerjee *et al*., *SolPhys*, 2007; Wedemeyer-Böhm *et al*., *Nature*, 2012; Mathioudakis *et al*., *SSR*, 2012). The analysis of their propagation can be utilised in diagnosing the localised physical conditions and a better understanding of various linear and non-linear wave phenomena in the complex magnetic structures (see Andries *et al*. *SSR*, 2009; Ruderman & Erdelyi, *SSR*, 2009). The articles by M. K. Griffiths *et al*. (*JAA*, **36**(**1**), 197, 2015), B. Dwivedi & A. K. Srivastava (*JAA*, **36(1)**, 225, 2015), and I. Zhelyazkov (*JAA*, **36**(**1**), 233, 2015) are focussed on the topic of MHD seismology, accurate magnetic fields determination in gravitationally stratified loops using kink waves, study of Kelvin–Helmholtz instability in solar jets and CMEs, and a new numerical code "SAMUG" based on Graphics Processing Units (GPU) to model MHD waves and transients in the solar atmosphere.

India and UK have long-lasting bilateral collaborations in solar physics and space research. The UK community has a strong heritage in these fields, while the growing Indian solar physics community is becoming well established with a good balance of senior and upcoming young solar scientists. Senior solar physicists Prof. S. M. Chitre, Prof. S. Hasan and Prof. B. N. Dwivedi pursued their early career scientific research in close association with various solar and plasma physics groups in the UK, e.g., in Cambridge, Oxford and Glasgow between the 60s and 80s. This later extended to the period 90s–2010 by Prof. D. Banerjee (IIA, Bangalore), Dr. D. Tripathi (IUCAA, Pune), Dr. A. K. Srivastava (IIT-BHU), Dr. A. Sarkar (IISER-Kolkata) and Dr. S. Subramanian at different institutions in the UK, e.g., Armagh

Observatory, Mullard Space Science Laboratory (UCL), Universities of Cambridge and Sheffield. UK research groups such as The Solar Physics and Space Plasma Research Centre (led by Prof. R. von-Fáy Siebenbürgen (a.k.a. Erdélyi)) at the University of Sheffield have made significant contributions to the development of Indo-UK solar physics research and related endeavours. Scientists from India and UK are jointly involved in instrument development, bilateral international projects, seminars and workshops. Currently, Indian scientists are working on the ADITYA-I space mission to study the solar corona, a 2-m class National Large Solar Telescope (NLST), and Multi-Application Solar Telescope (MAST) in which the UK solar physicists are a part of various science teams. This has led to a dynamic exchange of knowledge, which has had a fruitful impact on the growing solar physics research in both countries.

The publication of this Special Issue is another breakthrough under the umbrella of the Indo-UK research cooperation. We sincerely hope that this collection of articles will prove valuable to the solar physics community.

March 2015 **V. Fedun, A. K. Srivastava, R. Erdelyi & J. C. Pandey**
Guest Editors

Cover Picture: (*Top-left and bottom-right*) Three-dimensional snapshots of the MHD wave propagation in an open magnetic flux tube excited by torsional driver. (*Top-right and bottom-left*) SDO/AIA 304 A EUV images showing various plasma jets at diverse spatial scales; flux-rope and overlying loops in AR11295 (Srivastava *et al*., *ApJL*, 2013). We thank the Computational Information Systems Laboratory at the National Center for Atmospheric Research for providing the VAPOR analysis tool.