In this issue

Solar physics

Although there are many exotic objects available for study, the seemingly pedestrian Sun exhibits a variety of phenomena that defy contemporary theoretical understanding. Aside from its intrinsic interest both scientifically and as the source of life on Earth and of the planetary environment, the proximity of the Sun makes it the fundamental testing ground for virtually all astrophysical techniques. The signal-to-noise associated with the collection in one second of solar photons is comparable to that from a similar source at one parsec in 1000 years. Hence we are able to analyse solar data (for example in the polarimetric, spectral, temporal, or spatial domain) to a very considerable extent. We can resolve regions on the Sun only 150 km across with the latest spacecraft and ground-based instrumentation. It is these factors which, for example, have resulted in solar physics giving birth to atomic and nuclear spectroscopy in astrophysics, to cosmic magnetometry, to neutrino astrophysics, and to asteroseismology.

The Sun poses a profound scientific challenge to the physicist. We look no further than the sunspot or the intensely filamentry structure of the photospheric magnetic field, or the spicules, or the effective magnetic diffusion that is so essential for understanding the solar dynamo, or the peculiar internal rotation inferred from helioseismology, or the heat source that maintains the expanding gas in the coronal hole, or the generation and acceleration of the solar wind, or the variation of solar brightness with the level of solar activity to name a few of the more obvious solar mysteries.

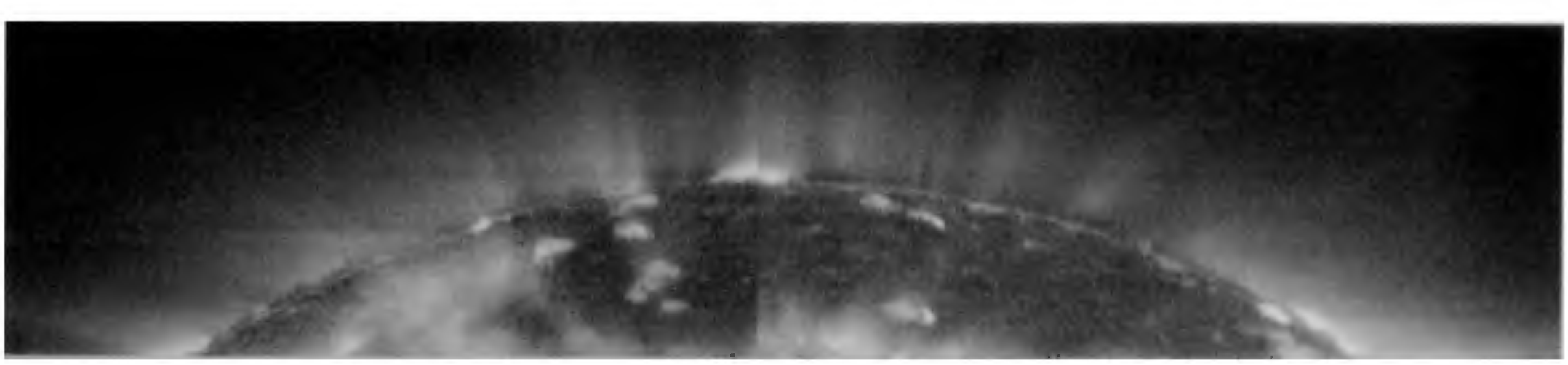
Obviously this special section on Solar Physics cannot justifiably cover a comprehensive view of the Sun from its deep interior to the outer atmosphere. Nonetheless, the intention is to present an authoritative overview of the subject and its future direction for the next millennium by eminent workers in the field. 'The physics laboratory in the sky', by Parker (**page 1445**) sets the stage, describing how the Sun challenges the experimental physicist to develop increasingly sophisticated tools for investigation and the theoretical physicist to see both new facets and extensions to basic laws of physics.

The ringing Sun provides a new diagnostic tool of the solar interior, 'Just like any musical instrument, Sun also oscillates in a number of characteristic modes whose frequencies are determined by the internal structure and dynamics', so says Chitre and Antia on 'Seismic Sun' (**page 1454**). In much the same manner as the geophysicists are able to study the layers of Earth from seismic disturbances, the helioseismic tool furnished by the rich spectrum of velocity fields observed at the solar surface probes the Sun's internal layers to an extraordinary degree of precision. Christensen-Dalsgaard and Thompson present our current knowledge on 'Rotation of the solar interior' (**page 1460**), mainly from helioseismic experiments conducted on the spacecraft *SOHO* (Solar and Heliospheric Observatory). The results show interesting conflict with earlier theoretical predictions, indicating that the Sun is a host of complex dynamical phenomena, so far hardly understood. This has important consequences for our ideas about the stellar evolution and models for the solar magnetic field.

The time-distance helioseismology is a new promising method for probing 3-D structures and flows beneath the solar surface, which is potentially important for studying the birth of active regions in the Sun's interior and for understanding the relation between the internal dynamics of active regions and chromospheric as well as coronal activity. This technique is presented by Kosovichev and Duvall in their article 'Solar tomography' (**page 1467**), giving new results of an active region observed in January 1998 MDI/*SOHO*. In his article on 'The solar dynamo', Choudhuri (**page 1475**) describes the characteristics of solar magnetic field, the basic idea of dynamo theory and its current status.

The subject of solar neutrinos deals with many seemingly independent aspects, both in its theoretical basis (involving nuclear, atomic and particle physics, as well as stellar evolution) as well as an experimental basis (involving chemistry, nuclear physics, geochemistry, and astronomy). For many physicists, solar neutrinos constitute the low-energy frontier of high-energy physics. That the Sun shines by nuclear fusion reactions is one of the most important results from solar neutrino research which is summarized by Bahcall in his article 'Solar neutrinos: An overview' (**page 1487**).

The article by Kalkofen and Ulmschneider on 'The dynamics and heating of the quiet solar chromosphere'



Polar coronal hole with bright points and polar plumes observed by SUMER/ *SOHO* in the EUV light (Mg X at 625 Å).

(page 1496), deals with how waves are responsible for the characteristic features of the solar chromosphere. 'But the active Sun is surely a very important factor in our life,' so says Švestka in his article on 'Solar activity: An overview' (**page 1503**), describing the main characteristics of the active Sun—the different active phenomena, the 11-year cycle of their appearance, and their influence on the environment of our Earth.

Phillips and Dwivedi in their article on 'Probing the Sun's hot atmosphere' (**page 1511**), present some recent progress in our understanding of the physics of the solar atmosphere in the light of observations from the spacecraft (*SOHO*, *Yohkoh* and TRACE) as well as from the ground-based eclipse measurements. The last article of this section on 'A new Sun: Probing solar plasmas in the extreme-ultraviolet light from SUMER on *SOHO*', by Dwivedi, Mohan and Wilhelm (**page 1521**), presents new results on density-temperature structure, and evidence of hot ions and relatively cool electrons in coronal holes, the 'blue' Sun, magnetic reconnection, abundance anomalies and sunspot transition region oscillations, providing vital clues on how magnetic energy feeds its million-degree hot corona and the solar wind.

In conclusion, this section on our Dynamic Sun provides an up-to-date solar physics research, and the future direction in the next millennium, which has been possible with the kind support of all the authors, and I can hardly thank them enough.

B. N. Dwivedi

Genetics of HWE: Epileptic fit triggered during a hot water bath

Few things can be more disconcerting than someone suddenly going into an epileptic seizure (more commonly described as a 'fit') right in front of you. The panic and agony of the onlookers will be all the greater if the affected person is a child. What can be worse than a fit being triggered, during the course of an affectionate (or otherwise) bath, simply because moderately hot water is poured on the head of the child? But, then, notwithstanding all her glory, Nature has a tendency to bowl, once in a while, such devious googlies.

Epilepsy of course has been known from ancient times. Hot Water Epilepsy (HWE), on the other hand, has been known only for the past thirty years or so. Some forms of epilepsy are widely believed to be inherited. This, together with the fact that more than one HWE patient is often seen in the same family, suggests the possibility of a genetic basis. On **page 1407** of this issue, Sinha *et al.* describe a preliminary analysis of their ongoing work dealing with this unusual neurological disorder.

Though clinicians are well aware of HWE, the syndrome does not seem to be widely known. This is surprising, since it does not seem to be uncommon, accounting for almost 7% of all epilepsy cases, and with an overall prevalence of about 60 cases per one lakh population, at least in some of the districts of Karnataka. Children, unfortunately, are more frequently affected. The seizures last for one to three minutes, and occur at the beginning or end of the bath. The authors provide a disturbing yet captivating description of the phenomenon. When water between 40 to 50 degrees Celsius is poured on the head, one sees a 'dazed look, a sense of fear, irrelevant speech, vertigo'. On the other hand, some adult patients 'reported a sense of intense pleasure' which made them continue pouring 'hot water over the head until they lost consciousness'!

The authors have described six pedigrees (family history spanning three to five generations) obtained while studying a group of 279 patients during a four-year period. In five of them, where more than one sib was affected, the parents were normal. Thus, a simple, single locus autosomal dominant inheritance as well as sex-linked inheritance can be ruled out. The data is consistent with autosomal recessive inheritance, though one would naturally expect such a complex phenomenon to be under the influence of more than one gene.

The importance of this article is that it brings 'Hot Water Epilepsy' to the attention of a much larger number of people. This would help in identifying more cases and thus building a bigger database, which is essential for a thorough understanding of the phenomenon. More critically, families likely to be at risk can be advised to look out for the presence of HWE. At least from a naive point of view, Nature has provided an unbelievably easy way of preventing a seizure – the simple precaution of not pouring hot water on the head is enough! Nevertheless, determining the biological basis of this syndrome is a very challenging and worthwhile goal. The authors have made a tantalizing remark about being in the process of 'developing a rat model system to conduct classical and molecular genetic studies on HWE'. This approach promises to lead to a better understanding of this troubling epileptic syndrome. For more curious facets of HWE, like its association with other forms of epilepsy, its higher prevalence amongst communities practising consanguineous marriages etc., see page 1407 of this issue.

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