EDITORIAL

To the ends of the spectrum

Sue Bowler, Editor.

I’m pleased to be able to bring in this issue a quick look at one of the newest fields of astronomy: high-energy astrophysics. With the advent of vast ground-based observatories, the characteristics of extremely high-energy particles and radiation can now be mapped and used to track down their mysterious sources. This issue has articles from three of the latest projects to come into operation: Auger, HESS and MAGIC. Each of these has specific tics, which they pursue in different ways, their chosen methods bringing with them considerable scientific and technical challenges. Although these are by no means the only significant projects of their type worldwide, they do offer a snapshot of the field, that will be enhanced by the completion of, for example, the seven telescopes of the Veritas project in Arizona. Together these new facilities are opening up new aspects of the universe to research. We can expect surprises, just as researchers found a whole new menagerie of objects and processes to study when astronomy first moved beyond visible light into the wider reaches of the electromagnetic spectrum. And, again, those surprises will touch on more than just astrophysical theory: understanding the very-high-energy universe demands understanding some fundamental physics, delving into processes far beyond the reach of anything on Earth. No particle accelerator can speed up atomic nuclei to the levels needed to produce the ultra-high-energy cosmic rays, for example, yet something does. Pinning down that and the other somethings that researchers suspect are out there may take some time, but it is true exploration of the universe. It is worth pausing a while to recognize the years and even decades of painstaking work undertaken by the huge international consortia that are behind the successes that we report here; scientific drive, technical expertise and considerable diplomacy in national and international relationships have all played a part, as has making the seemingly endless case for funding at all levels. All births require hard labour and mothers are said to forget the pain in the pleasure of having the new baby. Let us hope that this is the case for those involved in these new observatories, which, despite being bigger babies than most, are at the start of their lives. The best is yet to come.

On 21 September the RAS issued a press release calling for an open public debate on the future of leap seconds – and arguing that international time standards should continue to support users who need to know mean solar time. This has provoked much media interest in the UK and around the world, reports Mike Hapgood.

The background to the press release is that a debate is taking place over the future of Coordinated Universal Time (UTC). Since 1972 systems that have not been designed to follow the UTC standard have encountered problems in handling leap seconds. This has motivated a proposal to abolish leap seconds. The proponents of abolition see it as a way to eliminate these problems but have been reluctant to recognize the problems that it will cause those of us who rely on the close synchronization of UTC and UT1 – mainly astronomers and geophysicists, but there are also potential problems for business and legal users.

The present definition of UTC seeks to address our modern understanding that there are two distinct aspects to time keeping:

- high-precision absolute time-keeping based on atomic clocks;
- time-keeping based on the rotation of Earth (mean solar time).

Science learned to distinguish these two aspects during the 20th century and thus time-keeping services have evolved to address user requirements for both precise timing and mean solar time. UTC with leap seconds emerged in 1972 as a reasonable compromise to serve both needs and was recorded in an international standard under the aegis of International Telecommunications Union (ITU, 1997). The standard requires that UTC be kept within 0.9 second of UT1, universal time as determined from Earth rotation (IERS, 2003). UTC is adjusted by one second (a leap second) when the drift between UTC and UT1 approaches this limit. For example, this position was reached this summer and a leap second is now scheduled for the end of 2005. The immediate focus of the leap second debate is a meeting of national ITU representatives in Geneva on 8–11 November 2005. This will consider a formal proposal to abolish leap seconds. In a position statement submitted to the UK government, the Society has recommended that this proposal be shelved and that the ITU work to promote a broader public debate with the aim of developing a solution that satisfies needs for precision and solar time-keeping.

There are good arguments that a change in time-keeping is needed to overcome the problems that have been encountered. The irregular incidence of leap seconds cannot be handled algorithmically. Instead software must incorporate a table of leap seconds and this adds to the cost of development and maintenance. But the present proposal is not the answer. Not only does it dump problems on those of us who use UTC as a good proxy for solar time, but it also seeks to change the meaning of UTC while retaining the existing name. This is a recipe for confusion because the current meaning is deeply embedded in our technical culture through a wealth of literature (textbooks, web pages etc) and in the knowledge of working scientists and engineers. Such changes should be made explicit by a change of name. We need a better proposal for change that reduces the problems of handling leap seconds (e.g. a standard for leap second tables) and also addresses the need for solar time, e.g. by developing effective ways of disseminating solar time via the internet for use by both software and humans.

To leap or not to leap?

Further information

- RAS statement on the proposed abolition of leap seconds
  http://www.ras.org.uk/index.php?option=com_content&task=view&id=630&Itemid=2
- Steve Allen’s bibliographic gathering of references on leap seconds:
  http://www.ucolick.org/~sla/leapsecs/onlinebib.html
- IERS (International Earth Rotation and Reference Systems Service), Universal Time,
  http://www.iers.org/iers/earth/glossary/utc_cont.html

Spitzer spies cloudy ‘mountains of creation’

The Spitzer Space telescope, NASA’s powerful infrared observatory, has taken an image that echoes the Hubble Space Telescope’s 10-year-old image of “pillars of creation” in the Eagle nebula – but the Spitzer clouds are 10 times bigger.

Spitzer’s “mountains of creation” are in the region W3, in Cassiopeia and, as in the Eagle nebula, they mark intense star-formation at the peaks of dusty gas clouds, driven by the single massive star off the top right of the image. The visible light image (inset) shows the “mountains” as dark patches, rather than the complex structures that Spitzer saw.

http://www.spitzer.caltech.edu/Media/To leap or not to leap?

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