Enlightening gamma-ray bursts
Ralph Wijers of the Institute of Astronomy at Cambridge.

About once a day, space-based observatories see a short, bright flash of gamma rays from a seemingly random location in the sky—a gamma-ray burst (GRB). Since their discovery 30 years ago, their continued invisibility at other wavelengths has enshrined them among the great mysteries of astrophysics.

Finally, the veil has lifted, through observations at other wavelengths. The Italian–Dutch BeppoSAX satellite located a GRB on 28 February quickly to approximate precise time for the first time. This enabled astronomers on La Palma to obtain images of it within 21 hours, as a 21st magnitude, rapidly fading object. The second detection of an optical counterpart, at Kitt Peak, was for the burst of 8 May. This time, a spectrum taken with the Keck telescope showed absorption lines at redshifts 0.77 and 0.835. So this burst (and, by Ockam’s razor, all bursts) is at cosmological distances from us, settling the dispute over whether GRBs are in our galaxy or far outside it.

The implication is that GRBs are the most luminous objects in the universe during their brief moment of glory. The currently favoured model attributes these events to relativistic versions of supernovae: 10^{52} erg of energy is suddenly released into a very small volume by an unidentified event. This energetic “fireball” then expands ultrarelativistically, with a Lorentz factor of 300 or so. When it ploughs into the surrounding gas it decelerates and radiates its kinetic energy away in gamma rays. When the burst wave slows down to lower Lorentz factors, it produces the X-ray and optical afterglows.

If GRBs are caused by compact stellar remnants, their rate is likely to track the star formation rate in the universe. The flux distribution of GRBs matches this, implying that a few percent of GRBs are beyond redshift 4 and their redshift distribution resembles that of quasars.

We can expect more excitement in the near future as a few exciting branches of astrophysics come together, for example in the detection of the X-ray afterglow of GRB 970616 by the Rossi XTE satellite after a concerted effort by the RXTE and BATSE teams.

Young massive stars and their environments
Robin Williams, Jonathan Tedds and Melvin Hoare report from a workshop on Flow Interactions in Star-forming Regions held at the University of Leeds on 11 June 1997.

The formation and early evolution of young massive stars remains one of the most fascinating problems in astrophysics—a fit subject for a lively one-day meeting.

Massive stars form deep in the cores of molecular clouds, when some threshold to collapse is passed. Anthony Whitworth of the University of Cardiff showed the results of numerical simulations involving colliding clouds, which matched the complexity of many star-forming complexes. But Tom Hartquist, on sabbatical at UCL, revisited the problem of the heating of molecular clouds subject to a pressure increase, and found that this may well discourage star formation rather than enhance it.

As a massive star turns on, the wind from the star, or perhaps the surface of a surrounding accretion disk, will interact with ambient, possibly inflowing, gas. Observations of the cavities and shocks generated by these omnipresent outflows were presented, as well as constraints on the magnetic field structure via Zeeman splitting in OH masers. When these stars become hot enough, they ionize the dense surrounding gas producing ultracompact H II regions. The clumsy medium surrounding a star may play an important role in adding mass to the stellar wind to confine these regions. Models of this process explain the wide range of observed shapes. Attention was drawn to the preponderance of cometary shaped H II regions, especially their kinematics and the astrochemistry of the dense molecular cores at their apex where the next generation of stars may arise.

A particular focus of the meeting was the nearest—and best observed—star formation region, Orion. In this well-resolved region, puzzles found elsewhere are magnified. “Bullets” of ionized gas seem to be driven from the central star at high velocities, generating spectacular fingers of emission in their wake (see picture). Michael Burton of the University of New South Wales showed the latest Hubble Space Telescope images of the “bullets”, while Jonathan Tedds of the University of Leeds presented UK Infrared Telescope measurements of the dynamics and excitation of hot molecular hydrogen in the corresponding fingers. A major challenge from the studies is to better understand these crucial feedback processes in the cycle of star formation in molecular clouds.

The programme of the meeting and onward links are at “http://ast.leeds.ac.uk/~rjrw/Meeting.html”.

The UK Planetary Forum
Karl Mitchell reports on the start of a timely community initiative.

Since the space race began, planetary research has been dominated by the US and the former USSR. Lacking the centralization of the American Astronomical Society’s Division of Planetary Science, or the huge financial reserves of NASA, research in the UK has seemed limited to disparate groups lurking in far corners of university departments, with low budgets and endless enthusiasm.

Despite this, the UK has continued to involve itself in planetary missions such as Cassini–Huygens and Mars 96, and high-impact papers are being released by UK scientists in all areas of research.

The reorganization of the research councils, however, left many planetary scientists feeling more isolated. Individuals with radically different backgrounds, such as geochemists and magnetospheric physicists, now found their work classified together as a sub-branch of astronomy under PPARC. It is not clear that PPARC will even consider proposals concerned only with planetary surface geology or photogrammetry.

Following several conversations between individuals at University College London (UCL) and Lancaster, it was decided that the formation of a national organization of planetary scientists was necessary. So Dave Hawksett, David Heath and I began to contact all those we thought would be keen to be involved and, over a period of several months in 1996, the Planetary Forum emerged. It soon became evident that such an organization was of great demand by all that fell under the PPARC’s planetary science classification.

The first meeting, on 28 February 1997, was arranged in collaboration with the UCL Planet Centre, attracting about 50 planetary scientists, discussing some 30 planetary scientists. It was universally hailed as a success, as well as being a thoroughly enjoyable event. Informative talks from Jan-Peter Muller, Michele Dougherty, Lionel Wilson, Fred Taylor and Monica Grady were followed by a lively discussion about the future of planetary sciences in the UK, chaired by Lionel Wilson. A consensus was reached that we should attempt to model ourselves on the MIST (magneto-sphere, ionosphere, and solar-terrestrial physics) community in its success over the past three decades.

On 6 May, Fred Taylor chaired the second meeting at Oxford University, preceding the annual Halley Lecture. Representatives of 10 groups gave talks on their involvement in planetary missions, followed by a discussion of public awareness and future missions. Following the Halley Lecture, this year by Tony McDonnell on comets, now familiar faces met in unseasonably cold conditions in the Turf Tavern to discuss the day’s work.

Over the past few months a feeling of community has developed, and the Planetary Forum is now able to provide a structure for planetary activities in the UK. Such an achievement would have been impossible without the enthusiastic support of the UK’s planetary scientists, and in particular the hard work of our local representatives. Karl Mitchell organizes the Planetary Forum from Lancaster University. More information can be found at “http://msslsx.mssl.ucl.ac.uk/planetary/” or e-mail “k.l.mitchell@lancaster.ac.uk”.

Bullets of ionized gas stream out in Orion. (M Burton [UNSW] and AAO.)