Black hole blues

Jayant Narlikar considers the rise and fall of a remedy for astrophysical ills

THE 1970s might be remembered in the history of astrophysics as the decade of the black hole. Over the past 10 years or so, theorists have analysed the remarkable properties of bent spacetime in the vicinity of collapsed objects, and observers have invoked their presence to account for a range of otherwise unexplained phenomena from the power source of quasars to the missing solar neutrinos. If you feel a need to make the Universe "closed" (that is, held together by gravity so that its present expansion will one day be halted and then turned into a collapse), if you want to explain X-ray emission from globular star clusters, if you want to explain how energy is produced in the X-ray star Cygnus X-1 then, it seems, the black hole comes to the rescue. Stephen Hawking's discovery that a black hole can also radiate energy, eventually exploding in a miniversion of the big bang in which, many cosmologists believe, the Universe was created, seemed the icing on the cake. Black holes became a patent remedy for all astrophysical ills [and, possibly, for solving the energy crisis, as Paul Davies describes on p 75].

But like most patent remedies, black holes raised more expectations than they could fulfil. Several recent investigations now seem to suggest that not every theory with a black hole at its heart is the best answer to the problem it sets out to tackle. And participants at an International Astronomical Union Meeting in Bandung, Indonesia, presented several papers indicating the growth of something of a backlash against the black hole as an astrophysical panacea.

On the cosmic scale, even if you want to invoke black holes to explain the "missing" mass needed to close the Universe, what could those black holes have been made of? The assumption is that they mark the graves of collections of ordinary matter, that is baryons. But the baryons themselves must have come, on this picture, out of the big bang. Yet present calculations of the physics of the big bang imply that if more than a few per cent of the number of baryons needed to close the Universe had been

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is that here too theorists are barking up the wrong tree.

As black holes fall out of fashion, what new trend can be discerned on the horizon? At least as far as the early Universe is concerned, interest has shifted from black holes to the grand unified theories (GUTs) of physics (*New Scientist*, vol 89, p 685). Fashions come and go in astronomy as in everyday life; like long hair the black holes (even though they have no hair) might stage a comeback. Meanwhile, the 1980s looks like being the decade of the GUTs. □

created then less deuterium than we observe in the real world would have been made. It doesn't matter whether or not the baryons then formed black holes; if there is enough matter to close the Universe it must be in the form of non-baryonic material (maybe massive neutrinos), which in essence means non-black hole material.

Coming closer to home in time and space, the claim by two different groups of astronomers that a black hole with 5×10^9 times the mass of our Sun exists in the nucleus of the giant elliptical galaxy M87 gave a great boost to black hole theories. But more recently the theorists have pointed out that the observed distribution of light from this source, and the pattern of velocities indicated by the redshift, do not fit the postulate of a black hole in M87. In similar vein, but on a more modest scale, our own Galaxy has also been supposed to harbour a black hole at its centre, but once again more recent studies of the central region of the Milky Way seem to remove the need for such an exotic object.



The galaxy Centaurus A, about 15 million light years away from us, is at the centre of a system of radio "lobes" which extend across an arc of the sky ten times greater than the angular diameter of the Moon. Conventional astrophysical thought has it that such objects are powered by massive central black holes. In the absence of any direct proof that black holes exist, however, such theories may be ill-founded

What about X-ray astronomy? The two rival theories to explain X-ray emission from globular star clusters involve either black holes with more than 100 times the mass of our Sun, or neutron stars with mass comparable to that of the Sun. A group of X-ray astronomers at Harvard University originally favoured the former idea, while a group at the Massachusetts Institute of Technology propounded the latter; now, the Harvard group has established that they were wrong and the black hole theory is untenable. After a decade of study, Cygnus X-1 remains the only really strong candidate for a black hole; and why should one, and only one, black hole exist in our Galaxy? The more likely alternative