at X-ray energies is becoming increasingly common, although the implied link in the title of the session "X-ray bursters and Globular Clusters" was rather controversial. Walter Lewin (Massachusetts Institute of Technology) argued strongly that, although two of the bursting sources were almost certainly within globular clusters, the connection between the others and globular clusters was by no means proven and that the distribution of bursters within the galaxy is unlike that of the globular clusters. Jerry Ostriker (Princeton University) disagreed and argued, perhaps less convincingly but no less strongly, that the two distributions are remarkably similar. Lewin went on to discuss individual bursting sources of extraordinary complexity from MXB 1743-29 which bursts only once a day or so to MXB 1728-34 which is known as the 'rapid burster' producing bursts of X rays some 5,000 times a day. As more and more details of the bursting behaviour accumulate, it becomes more difficult for theorists to find a convincing explanation of the phenomena. Don Lamb (University of Illinois) was given the problem of finding something intelligent to say on the theoretical aspects of the bewildering observational results. He discussed a variety of possibilities including bursts of nuclear burning on the surfaces of neutron stars, and accretion events involving material held up by the magnetosphere of a neutron star sporadically going unstable and crashing to the surface.

Part of the limelight at the session on Neutron Stars was stolen by J. Trümper (Max-Planck-Institut, Munich) who had flown in especially to announce data obtained in a balloon flight looking at Hercules X-1 in the energy range 20–120 keV. It had been thought previously that the X-ray spectrum of Hercules X-1 did not extend significantly above about 30 keV. Trümper reported that the source had been seen well above 30 keV and the X-ray pulses (with a period of 1.24 s) were seen up to energies as high as 70 keV. Moreover, he presented evidence for an emission feature in the spectrum above 40 keV which he interpreted as an emission line due to cyclotron radiation at an energy of 53 keV—there is no other likely reason for the production of an emission line at this energy. If this is true, it implies that Hercules X-1 is indeed a magnetised neutron star and that the magnetic field is in the region of $2\text{–}5\times10^{12}$ gauss (depending primarily on which harmonic of the gyrofrequency the emission is supposedly produced). Following this talk, Leventhal (Bell Laboratories) reported on γ-ray balloon observations of the Crab Nebula made to detect γ-ray lines. He gave evidence for a strong γ-ray line at an energy of 400 keV and speculated that this might be the 510 keV electron–positron annihilation line redshifted from the surface of the Crab pulsar: the redshift would imply that the pulsar is a neutron star of mass 1.4 solar masses, a value highly favoured on stellar evolutionary grounds.

Low mass X-ray binaries were discussed by Anne Cowley (University of Michigan) in the session on Close Binary Stars. The most intriguing source recently discovered to emit X rays is the star AM Herculis. This was already known to be a "nova-like variable", implying that a large amount of flickering is present in the optical light. It has since been found to display a 3-h period, probably due to orbital motion, in optical light and in radial velocity and to emit soft X rays which vary with the same period. Most remarkably, the optical light is highly circularly polarised (5–10%) with the degree of polarisation changing on the same 3-h period. It seems that this polarised light can only be due to cyclotron emission, implying the presence in the system of a magnetic field with a strength of over 10^8 gauss.

The second morning was devoted to quantum theory in strong gravitational fields. Stephen Hawking (Cambridge University) spoke on black holes and unpredictability. Inside a black hole, there is always a singularity which is a place where space and time come to an end and all the laws of physics break down. Provided the black hole can prevent any information about the singularity from leaking out, however, any observer not in a black hole would not be affected by the breakdown of predictability which occurs at the singularity. This "cosmic censorship" is endangered by Hawking's discovery that quantum effects allow particles and radiation to tunnel out of black holes. This radiation has an added degree of randomness over and above that associated with quantum mechanics. Equivalently, he concluded, one could say that "new random information is entering our universe from regions (either singularities or 'worm holes' leading to other universes) about which we have no knowledge".

In the session on Gravitational Theories Larry Smarr (Harvard University) gave a talk with the ominous sounding title "Computer Generated Space-Times". He reported on a continuing effort to solve Einstein's field equations in their full time-dependent form by means of numerical methods. One of the aims of this research would be, for example, to study the collision of two black holes with a view to discovering how much energy is radiated away in the form of gravitational radiation.

Irwin Shapiro (Massachusetts Institute of Technology) opened the session on quasars with a talk entitled

Membrane-bound proteins

from I. B. Holland and R. H. Pritchard

MEMBRANE-associated proteins are hard to study. They will probably be insoluble in aqueous solvents, there is often no simple assay for them and consequently they will probably defy purification. Studying their function may not be a simple matter either. The way a protein which facilitates transport of a small molecule across a membrane works will need to be investigated with the protein *in situ* or attached to an artificial membrane. Silhavy *et al.* (*Proc. natn. Acad. Sci. U.S.A.* **73**, 3423; 1976) have found a new way of studying these proteins using the sophisticated box of tricks available to the *Escherichia coli* geneticist. They selected rare variants of this bacterium in which a gene coding for a protein involved in transport of maltose, and thought to be membrane bound, was fused to a gene coding for an easily assayable enzyme (β-galactosidase). The fused genes made a fusion protein which had the NH_2-terminal end of the transport protein and the COOH-terminal end of β-galactosidase. This hybrid protein had β-galactosidase activity which could be used to show that it was located in the cytoplasmic membrane. Thus an enzyme normally found in the cytoplasm had been carried to the membrane suggesting that the maltose transport protein is indeed membrane bound and that its COOH-terminus is not needed for this binding to occur.

Silhavy *et al.* hope to use their technique to investigate the structural features of proteins which lead them to associate with membranes. Their experimental strategy may be equally useful in identifying otherwise non-assayable proteins and for histochemical studies.

Unfortunately, in organisms with underdeveloped or emerging genetic technologies it will not be possible to engineer the variants required to make fusion proteins. This may only be a temporary difficulty in the exploitation of a promising idea.