NEWS AND VIEWS

The Search for Pulsars

EVER since the first pulsars were discovered last year by the Cambridge radio-astronomy group, the barrage of new data that has been appearing, concerning the discovery of new pulsating sources and more recently the slowing down in the period of some of the established ones, will have conjured up vivid images of a gold rush in pulsar information. One of the characteristics of a gold rush, however, is that the searchers have a clear idea of what they are looking for, even if the exact location is not certain. Although theories and speculation abound to explain the nature of the pulsating stars, the only piece of firm analogy is that the spade has been replaced by the radio-telescope. The digging ground is the whole sky, and since the angular resolution of a present-day radio-telescope—such as at Jodrell Bank—is about one-quarter of a square degree there is plenty of scope for searchers.

The solution to the central problem of locating pulsars lies in a combination of finding the best frequency at which to operate the radio-telescope in conjunction with the best area of the sky to scan. This question is often decided by a synthesis of rational planning, inevitable extraneous factors and luck. The pulsars are known to give out signals over a range of radio-frequencies, some being strong at higher frequencies and others at lower ones. Some pulsars, particularly the more distant ones, also produce highly dispersive signals, which means that observations must be at a high frequency in order to resolve the pulses. Thus pulsar signals which are dispersive and only strong in the low frequency range will be unobservable. The angular resolution of the telescope increases as the frequency is lowered, and a radio-frequency of around 400 MHz is often considered suitable, being relatively free from extraneous interference as well.

If a search is being made for new pulsars whose frequency characteristics are basically unknown, the choice of a suitable radio-frequency is largely guesswork. The same applies to searching the sky, but there may sometimes be indications from previous work that a particular scan, for instance near the plane of the galaxy, may be profitable and that in this region the dispersion of the pulses is known to be larger. The time necessary to perform any scan is very much a function of the pulse shape under scrutiny. The original Cambridge pulsars were found by looking for signals with a large pulse width and the scan of the whole sky was made within a week, whereas in other cases a negligible area of the sky would be covered in this period.

The radio-telescope at Jodrell bank is operated by means of a computer program, so that the experimenter merely has to feed in the relevant scanning instructions and sit back and await the results. Experiments are of course preceded by careful planning, which is often several weeks' work. The analysis of the signals is also carried out on the computer, although visual methods are used as well. A typical analysis may involve plotting some fifty samples a second of the received signal over a duration of a few minutes, and then carrying out something like a Fourier analysis on the result. The exact analysis depends on the physics of the case in question, but an example is contained in a recent set of measurements at Jodrell Bank on the first four Cambridge pulsars. A plot of the time of arrival of the signal against the date does not give a straight line, and from the shape of the curve radio-astronomers can gain information about the motion of the pulsars.

ASTROPHYSICS

Meeting in Miami

from a Correspondent

PHYSICISTS who have recently devoted much of their interest to new astrophysical problems have found that these interests are not reflected in a specific division of the American Physical Society. As a result, topics in astrophysics have not, in general, been well represented at previous APS meetings. At Miami Beach in November, however, five half day sessions of contributed papers and two half day sessions of invited papers on astrophysical problems were organized for the three day meeting.

Most of the contributed papers were reports of experimental observations, with cosmic ray studies the best represented and X-ray astronomy close behind. In the cosmic ray reports, the shifting of interest toward the long neglected electron–positron component of the radiation was evident. Preliminary observations of few MeV electrons detected in satellites and few hundred MeV electrons detected in balloon-borne spark chamber experiments (and the negatron–positron ratio in both of these energy ranges) are confirming the secondary nature of these relatively low energy cosmic rays. Several contributors pointed out the value of these electrons in determining the modulation of cosmic rays in the solar cavity. These early results seem to suggest that the higher energy electrons exhibit modulation while the few MeV electrons do not.

Of the more traditional nuclear isotopic studies, which were the subject of most of the cosmic ray papers, perhaps the most interesting were the fluorine abundances reported by the groups from Chicago, Goddard and Minnesota. Fluorine is not expected to be nucleosynthesized in supernovae (the consensus prime source of cosmic rays), but should be observed at the Earth as a spallation product of intermediate mass nuclei in their passage through the interstellar medium. Previous experimental results have been consistent with virtually no detectable fluorine, indicating a much shorter path length than the average of 3–4 g/cm^2 deduced from other isotopic abundance studies. The data reported at Miami Beach now place the