NEWS AND VIEWS

Nonvelocity Redshifts in Galaxies?

WHAT could be more confusing for astronomers than nonvelocity redshifts in quasars? It now seems that there may be nonvelocity redshifts in normal galaxies. The first claim that quasar redshifts were not caused by Doppler velocities of recession (H. Arp, *Science*, **151**, 1214; 1966) was met with general disbelief. Some theoreticians considered models for gravitational redshifting mechanisms, but these models foundered on the difficulties of large masses and sharp gravitational gradients in the strong gravitational fields which would smear out the observed spectral features in the quasars. So the disbelief in nonvelocity redshifts deepened.

In spite of this inhospitable theoretical climate, some observational claims were made that there was increasing evidence that quasars were closer than their redshift distances. As if the whole matter were not bad enough, some evidence, advanced from the very beginning, had not only quasars but some radio galaxies and compact galaxies also showing spuriously high redshifts. Finally, evidence was put forward that some fairly normal companion galaxies had excess redshifts (H. Arp, *Nature*, **225**, 1033; 1970). Almost nobody took this new heresy seriously enough to even debate it and only the mildest of controversy ensued (B. M. Lewis, *Nature Physical Science*, **230**, 13; 1971; and H. Arp, **231**, 103; 1971).

The embarrassing subject did not, however, go away; early work on the Virgo cluster of galaxies by E. Holmberg had indicated increasing redshifts with fainter galaxies at the same distance, and additional independent measures by W. Tifft at the University of Arizona were interpreted by him as showing nonvelocity redshifts for many of Virgo cluster members. Later Tifft concluded that many Coma cluster galaxies also showed excess redshift. The Finnish astronomer, T. Jaakkola, has now independently reviewed the redshift data for groups and clusters of galaxies, and on page 534 of this issue of *Nature* he concludes that the spirals, and particularly the Sc spirals, show systematically higher redshifts than ellipticals and S0 galaxies at the same distance.

The importance of Jaakkola's results and the really staggering difficulty involved is that the anomalously redshifted spectra refer to galaxies composed of stars and gas presumably of the same kind as the lower redshifted galaxies. What could be different about a star in an Sc galaxy compared with one in an E galaxy that would give the former an intrinsic relative redshift?

If the observations are correct, and if the interpretation of nonvelocity redshift is correct, there are only two possibilities. First, that conventional physics by some presently unknown and complex model of particle or plasma scattering can give some galaxies excess redshifts relative to others; or, second, that physics at some times and places (one galaxy) is different from physics at another time and place (the other galaxy). There was, perhaps, a small movement starting in this last direction (H. Arp, *Nature*, **223**, 386; 1969), but then Hoyle and Narlikar (*Nature*, **233**, 41; 1971) entered the theoretical arena. They accepted the anomalous galaxy redshifts and investigated a physics where mass was conformally invariant, producing a theory which they claim will pass all the conventional observational tests of relativity. It allows a gravitational constant which is a function of time—as in early theories considered by Dirac and Jordan.

Although it has not been specifically formulated in the Hoyle and Narlikar theory, the possibility has been opened that the mass particles which constitute the atoms in the stars that make up different galaxies could couple to the mass field of the universe differently as a function of time and place. The atoms made up of the smaller mass particles would then radiate their characteristic lines at longer wavelengths. This theory could furnish a start in understanding the Jaakkola results and all the anomalous results which led up to them. On the other hand, the acceptance of anomalous redshifts for certain kinds of galaxies on the strength of the observational evidence alone would furnish a powerful reason for accepting the new mass coupling theories.

The sweeping and fundamental changes involved in accepting this more Machian view of the universe and physics are so drastic that astronomers will no doubt proceed very sceptically and slowly; but an increasing number of workers are becoming impressed with the observations. The most recent evidence on quasars gives additional support to nonvelocity redshifts. In one case, the long base line radio observations on the quasar 3C 279 show its parts to be separating at ten times the velocity of light if it is at its redshift distance. Only very special models could prevent its having to be much closer than its redshift distance in order to preserve the velocity of light as a physical limit. In another case, H. Arp has shown the quasar Markarian 205 to be connected by an actual luminous filament to the much lower redshift spiral galaxy NGC 4319 (*Astrophys. Lett.*, **9**, 1; 1971). It has been argued that there is continuity of physical parameters between quasars and other kinds of galaxies. If nonvelocity redshifts must be accepted for quasars, then their acceptance for more normal galaxies may be a step more possible.

If these observational inductions are accurate, astronomers may be at a basic turning point in understanding of physical laws. This has vast implications and, if that is the case, the next few years are likely to be very exciting for both observational and theoretical astronomy.