ACTIVE NUCLEI AND REDSHIFT PROBLEMS

Geoffrey Burbidge
Kitt Peak National Observatory

More than 20 years ago V. A. Ambartsumian proposed that much of the activity in galaxies was dominated and even generated by their nuclei. Subsequent observational work in radio, optical and x-ray frequencies has borne out his prophecy, and major interest has centered about the nature of the machine in the galactic nucleus. The major characteristic of this machine is that it releases energy rapidly and often spasmodically by processes which are not thermonuclear in origin.

The original studies which led to the conclusion that nuclei were all important were observations of the powerful radio sources and Seyfert galaxies, and evidence for the ejection of gas from galaxies of many types. The realization that the synchrotron mechanism was the dominant radiation mechanism and the later studies of Compton radiation were fundamental in leading to the conclusion that large fluxes of relativistic particles must be generated in galactic nuclei.

In today's discussion we have heard reports of much new and detailed work on such classic objects in this field as the Seyfert galaxies NGC 1068 and NGC 4151, and the synchrotron galaxy M 87. We have also heard a good deal about models for synchrotron radiation and Compton radiation in galactic nuclei, and about relativistic motions as in radio sources deduced from the VLBI studies.

Nearly twenty years ago, it became apparent that there were two routes which could be followed to understand the processes of energy generation:

(1) was to suppose that the energy ultimately is gravitational in origin and is transformed to what we see with high efficiency. Originally it was proposed that we were dealing with the collapse of supermassive objects. Already in 1965 a number of us were arguing that such objects would lead to the formation of black holes from which it would be extremely difficult to release energy at high efficiency. By now it is continuously reiterated that the energy is released through an accretion disk about a massive black hole. This is the preferred

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explanation repeated so frequently that it is described as the black hole--as if it is known that it is there, though there is no secure evidence for its existence, and many fundamental physical problems remain when we try to make real models.

(2) This route was proposed by Ambartsumian and followed in some detail by Hoyle and Narlikar. The proposal is that it is in the nuclei that we are seeing matter energy being created. A modification of gravitational theory is required.

So far practically everyone has followed route 1 and practically no one has followed route 2. The difficulty is that the problems are really highly theoretical,--there is no way in the forseeable future of getting a handle on what is really happening at this scale either observationally or theoretically, and thus all manner of theoretical schemes can be invoked with no fear that they can be tested.

Thus whether one goes via route 1 or route 2 is a matter of taste rather than a matter of science. The common approach so far is to back away from anything radical. Consequently everyone is following route 1, though a few scientists who are both betting men and who also know something about the history of science will bet on route 2, if for no other reason than that the majority is usually wrong!

And this leads me to my second topic, the problem of the redshifts.

The advent of the age of non-thermal, high-energy astrophysics has also brought with it discoveries which may even lead to more radical rethinking of our present ideas.

Soon after the discovery of the first quasi-stellar objects, problems associated with understanding how such large photon fluxes could be emitted from very small volumes led to some speculations that the QSOs were comparatively local objects, so that their redshifts could not be of cosmological origin. In the years that followed a considerable amount of evidence has been found which tends to support this conclusion. For example, an apparent optical connection was found between NGC 4319 and the low redshift QSO Markarian 205. Further many QSOs have been found to be very close to bright, comparative nearby galaxies, far more than are expected by chance. More than 100 QSOs of the $\sim$1500 in the Hewitt-Burbidge catalogue lie near to bright galaxies. Three QSOs with large redshifts were found within 2 arc minutes of the center of one galaxy, NGC 1073. Since QSOs have a surface density on the sky of no more than 10 per square degree down to 20^{m}, the frequency of apparent association of QSOs within 10' of bright galaxies suggests very strongly that all or most of these associations are real. Also there are some very remarkable alignments of QSOs with very different redshifts.

Statistical evidence using cross correlation techniques tend to show the same effects. (During the talk Dr. Burbidge showed many slides covering the evidence summarized above.)

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Now all of these results have been questioned or doubted by many. Evidence in the other direction, e.g. that some QSOs are associated with galaxies at the same redshift, and that some QSOs are embedded in fuzz which may be the outer parts of normal galaxies at the same redshift, are adduced as evidence that QSOs have cosmological redshifts. Evidence of this kind does not of course remove other evidence, it simply means that both kinds of evidence exist.

Once again the radical point of view based on the evidence that many redshifts are non-cosmological is disregarded by most astronomers. But the evidence is powerful, and in my view it suggests very strongly that we must rethink many of our ideas concerning the extragalactic universe.

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