ASTROPHYSICS

Quasars: Lagging Left-Outs

Many small unwinding processes within the universe are believed to be taking place, possibly modifying the theory that the universe is expanding uniformly—By Ann Ewing

➤ THE EXPANDING UNIVERSE actually holds many regions of similar but much smaller expansions within it.

These small regions are the lagging left-outs of the super-dense matter that exploded to form today's expanding universe. They are known as quasars, short for quasi-stellar radio sources.

Quasars are believed the most energy-laden heavenly objects known. They look like ordinary stars in a large telescope, yet pour out such stupendous amounts of light and radio waves that their output rivals galaxies containing millions upon millions of stars.

However, quasars are so far distant that they would not be observable as ordinary galaxies even through the 200-inch telescope, which was used to identify the first of the 100 or so now known. The 120-inch at Lick Observatory and the 84-inch at Kitt Peak National Observatory are also now being used in the search for more quasars.

The most recent counts of quasars indicate that these puzzling objects are more numerous at the most remote distances than would be expected if the universe were in a steady state, and not expanding. This increased number of far-distant quasars thus seems to confirm that the universe was much smaller and very dense some six billion to seven billion years ago.

The picture of a universe uniformly expanding may be replaced with one in which, besides the large-scale stretching out, there are also many unwinding processes on a smaller scale. This new portrait of the cosmos was painted at the American Physical Society meeting in New York by Dr. Y. Ne'eman of Tel Aviv University, Israel.

Prof. I. D. Novikov of the Astronomical Council of the U.S.S.R. Academy of Sciences had the same idea at about the same time.

Although quasars thus seem to provide answers to very important questions with respect to the universe as a whole, their own structure is not yet explained. They are believed to consist of a relatively concentrated core containing matter between 100 million times and several tens of billions of times as dense as the sun.

This core emits a bluish light that was one key to the discovery of quasars a few years ago. It evidently undergoes some violent processes causing changes in its light output that may take place within a few months or several years.

The core, which is believed to be less than three light years in size, is surrounded by a less dense region with a radius of about 20 light years that is the source of most of the various spectral lines so far identified as having been highly shifted toward the red. Radio emissions come from more extended and dilute isolated regions spread over some tens or hundreds of millions of light years, usually connected together by wispy or jet-like structures that show on photographs.

The difficulty in understanding quasars is due to the fact that the equations of general relativity show that a core as massive as Dr. Ne'eman reported would collapse very quickly because of the mutual attraction of its various parts.

Gravitation in such a core would be so strong that the result would be a dead, dark star, an unobservable huge chunk of highly collapsed matter instead of the most luminous object known.

Drs. Ne'eman and Novikov believe that quasars are kept from collapse, and may be slowly expanding, due to the same phenomenon that accounts for the expansion of the universe. The Ne'eman-Novikov picture of the universe gives an evolutionary effect, with a higher occurrence of quasars in the past, as now seen at the farthest reaches of the cosmos.

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ASTROPHYSICS

'Quarks' May Be Source Of Quasars' Energy

➤ THE MYSTERIOUS nuclear particles called "quarks," which have not yet been detected but might nevertheless be basic building blocks of the atom's core, could be the source of the tremendous energy generated by the puzzling star-like objects known as quasars.

This theory was suggested in London by Dr. Franco Pacini, who is now at the Astrophysical Institute in Paris. Only relatively few stars would be in the super-dense state necessary for quarks to react with antiquarks.

Such primordial matter would be much more dense than the most concentrated material now known, found in white dwarf stars, some of which are a million times more dense than the sun.

White dwarf stars are approaching the end of their stellar life. However, Dr. Pacini suggests, at the very end of stellar evolution, quarks can serve as nuclear fuel at the even higher densities occurring when the stars turn into cosmic cinders.

Quarks, if they exist, would have a charge either one-third or two-thirds that of an electron. The electron charge is considered a basic unit and no nuclear particle with a fraction of this charge has yet been detected.

Nevertheless, scientists have theorized that the truly basic building blocks of the universe might be quarks.

Since all matter as known on earth is considered to have an antimatter twin, the super-dense stars would also contain antiquarks. If quarks do exist, they have masses of at least five billion electron volts, Dr. Pacini reported in Nature 209:389, 1966. A quark is a made-up word used by the late James Joyce and borrowed by physicists to describe a possible nuclear particle.

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GEOPHYSICS

Wobbles in Earth's Motion Change Climate

➤ SLIGHT WOBBLES in earth's motion as our planet revolves around the sun caused the climate changes, known as ice ages, that have now been quite accurately charted for the last 200,000 years.

A new theory to explain these major features of climate change was reported by Dr. Wallace S. Broecker of Columbia University's Lamont Geological Observatory, Palisades, N.Y.

Dr. Broecker reported in Science 151:299, 1966, that his theory "provides a reasonable explanation of the observed fluctuations" of temperatures during the last 200,000 years.

To work out his theory, Dr. Broecker assumes that the interaction of temperature levels between the atmosphere and the ocean has only two stable states, glacial and interglacial. Rapid transitions between these states are triggered when solar radiation levels are at their very highest. However, fluctuations about either of these two stable states occur in response to smaller changes in radiation levels that are not large enough to cause the rapid transitions.

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Australian News and Information Bureau

MILLS CROSS REFLECTOR—One of the most powerful giant radio telescopes in the world, located at the Molonglo Radio Observatory in Australia, has two mile-long cylindrical parabolas of wire mesh to collect signals and bounce them to a central aerial system. It was designed by Prof. Bernard Yarnton Mills of the University of Sydney.