Our galaxy may be expanding too

The expansion of the universe is an old topic in astronomy, but the expansion of our galaxy is something new. Yet that is what is deduced by a Scottish astronomer, S. V. M. Clube of the Scottish Royal Observatory. To reach the conclusion that the galaxy is expanding required an analysis of the proper motions of 8,790 stars, which was carried out at the Lick Observatory. The results are published in the MONTHLY NOTICES OF THE ROYAL ASTRONOMICAL SOCIETY (Vol. 161, p. 45).

The work involved the motions of the stars with respect to extragalactic nebulas. It produced velocities for stars near the sun that indicate a slow motion away from the galactic center. This finding leads Clube to conclude that the Doppler shifts in the spectral lines of hydrogen and hydroxyl seen in the nucleus of our galaxy are due to the sun's motion away from the center of the galaxy rather than an inward velocity of the clouds that contain those gases. If so, the sun's velocity away from the center comes out to 35 kilometers per second.

If such an expansion is indeed going on, then the spiral structure of our galaxy is a transient rather than a long-term phenomenon and will be destroyed in about a hundred million years. The stars in the galaxy are ten times older than that. Therefore, the fact that we see so many spiral galaxies in the universe argues that such expansion waves must be frequent phenomena in other galaxies.

Before the expansion began our galaxy was probably a more compact object rather like a Seyfert galaxy. Also the energy and mass transferred in such an expansion are comparable to those involved in outbursts of Seyfert galaxies. All this leads the NEW SCIENTIST to inquire (May 5): "Could it be that here at last is the vital piece of evidence linking compact galaxies, spirals and ellipticals in an evolutionary chain?"

The finding could even account for the gravitational waves observed by Joseph Weber of the University of Maryland. It implies that between 50 and 100 times the mass of the sun is moving outward past the sun's position every year. Motion of that much mass could produce the waves that Weber observes.

All in all the suggestion of a galactic expansion is an astounding one. If it gains widespread acceptance, it will change many beliefs about the astrophysics of the galaxy. □

The peculiar properties of a rotating, relativistic string

When the particles of particle physics are classified according to the forces they respond to, the largest class by far is the one that includes neutrons and protons. The particles in this class—collectively called hadrons—respond to the forces of the strong interaction, the interaction that holds atomic nuclei together. Other hadrons are the mesons and a large number of hyperons, unstable particles heavier than the proton.

Physicists have been trying to make models in which all the various hadrons appear as excited states of one fundamental entity.

Now a new model is gaining attention. It regards the hadrons as excited states of an extended one-dimensional object that might be called a "string." First suggested by Yoichiro Nambu of the University of Chicago, the dynamical details have been worked out by several physicists. One of them, Charles B. Thorn of Massachusetts Institute of Technology, described it at the meeting of the American Physical Society in Washington.

The hadron string has some properties not normally found in real strings: When there is no tension in the hadron string, it shrinks to a geometrical point and has no mass. When there is tension in it, it has length and mass. Yet its ends are not tied to anything. Thus the only way it can have length and mass is to rotate about its center, like a pinwheel. The "centrifugal force" of the rotation provides length and tension.

The tension is strong at the center of the string and gradually drops to zero at the ends. The ends, having no tension, are massless. In particle physics anything massless must move at the speed of light. As the string rotates, therefore, the ends move at the speed of light, and a basic relationship is determined. The angular velocity of the rotation times half the length of the string, which defines the linear speed of the ends, equals the speed of light.

From this relationship it comes about that the total energy of the string, which is related to the tension, is proportional to its length. The angular momentum comes out proportional to the square of the energy.

This, Thorn points out, is exactly what appears in nature. If one plots the observed hadrons on a graph of angular momentum versus energy squared (a so-called Chew-Frautschi plot), they appear to lie along straight lines as directly proportional quantities should. Since we are dealing here with the world of quantum physics, not all the points on a line can be occupied. The quantum world proceeds in discrete jumps, and only those points that correspond to integral values of angular momentum in terms of Planck's constant can be occupied. If the same kind of plot of the rotating string is made, it looks similar to the plot of the actual hadrons. The plot of the string contains several parallel lines. The first line corresponds to simple rotation of the string; the others, to motions in which the string also wiggles.

Although the string model "incorporates most of the really striking qualitative features of hadronic physics," Thorn admits that it has some serious omissions: The string contains neither electric charge nor strangeness (an important quality of some hadrons, the so-called strange particles). Also it does not provide for half-integral values of spin, which nature certainly does. Thorn sees reason to hope, however, that these features can be worked into a more sophisticated version of the string model, and he concludes that with this model "we may indeed be on the road to a real understanding of why the hadrons behave as they do."