Universe expansion: Accelerating?

Our notion of the expanding universe has been with us unconsciously forever, consciously for the last 50 years, ever since Edwin Hubble discovered the universal recession of the galaxies. Throughout that half-century cosmologists have debated whether the universe is open or closed—whether it will expand forever, or whether it will eventually collapse to the point from which it supposedly began.

The important parameters, mainly the density of matter in the universe and the velocity of galactic recession—especially possible variations of the recession over time—have not been well enough known to make a decision. Late last year four astronomers— J. Richard Gott III and James Gunn of Caltech, David N. Schramm of the University of Texas and Beatrice M. Tinsley of the University of California at Santa Cruz—put together all the latest evidence and made what they considered an extremely strong case for an open universe (SN: 12/21-28/74, p. 390).

Tinsley, reviewing the matter at this week's meeting of the American Physical Society in Washington, informs us that they have been surprised by events. New data indicate not only an openness, but a definite acceleration to the expansion.

Traditionally there are two options, depending on the density of matter. One, the bound-space option, has the expansion gradually slowing down, eventually stopping, followed by recollapse. The other, the infinite-space option, has the expansion going on forever. The first is called hot death; the second, cold death. The observational question is whether the universe is dense enough to provide sufficiently strong mutual gravitational attraction to reverse the expansion. In either case, as long as gravity is the only long-range force operating, the expansion will always decelerate. The traditional question is whether the deceleration is large enough to stop and reverse the expansion in a finite time.

Using a figure of 50 kilometers per second per megaparsec for the Hubble constant, which relates the velocities of galaxies to their distances (and, incidentally, gives an age of 20 billion years for the universe), Tinsley proceeds to count up the density. Contributions come from the luminous matter we can see, the unseen matter we can estimate from the dynamics of galaxy clusters and deuterium that may be left over from the big bang. The total yields something between one-tenth and one-twentieth of the mass needed to close the universe under the best present values of the other parameters. This is where the work stood in December. Now comes the big surprise.

Gunn and a colleague studied the brightnesses of ancient (distant) galaxies to determine whether the expansion rate has been constant over time or how it has changed. Their data indicate that the expansion has steadily been accelerating.

"I don't understand," says Tinsley. It seems that some repulsion must be at work. Mathematically, it brings us back to a solution Einstein discarded (for other reasons, however), which contains an added term, the so-called cosmological constant. Physically, this constant can be interpreted as a very long-range repulsive force operating between galaxies or as a realization of the stress-energy, the pressure and energy of the vacuum. (In relativistic physics, where space is a participant in the action instead of an inert abstract frame, even vacuum can have such material attributes as stress and energy.)

Historically, in this picture, it would seem, the universe begins with a big bang; the expansion decelerates at first under the influence of gravity, then when the universe is big enough, the long-range force takes over and the expansion accelerates. □

Research on fetuses: Moratorium ends

"In abortion, we condone procedures which subject the fetus to dismemberment, salt-induced osmotic shock or surgical extirpation. No experimentation so far imagined would do the same. . . . Yet wholesale acceptance of the procedures of *abortion* and rejection of those of *experimentation* is the current moral stance of the federal government." Thus, the illogicality of the situation surrounding fetal research is illuminated by Willard Gaylin and Mark Lappe of the Institute of Society, Ethics and the Life Sciences in the May ATLANTIC. The illogicality of the situation has also been under study for the past four months by the members of the National Commission for the Protection of Human Subjects of Biomedical and Behavioral Research. The result of that discussion: a set of recommendations, issued this week, that calls for the relegalization of research on living human fetuses.

Two years ago, the National Institutes of Health stopped funding research on live human fetuses. Last year Congress, with the backing of antiabortion groups, imposed a moratorium on fetal research and established a commission to investigate and make recommendations on such research. The commission's report calls for an immediate end to the moratorium and sets forth guidelines under which research on the fetus may be conducted, supported and even encouraged by the Department of Health, Education and Welfare.

The first two recommendations cover therapeutic research—that which might be helpful or even life-saving to subjects of an experiment. Such research, when applied to a pregnant woman or to a fetus, is encouraged by the commission—provided it is conducted within appropriate medical standards, that risk to the fetus is kept at a minimum and that informed consent has been obtained from the pregnant woman (or both parents, if the research is directed at the fetus).

Nontherapeutic research, that which will probably not help the subject but which might lead to valuable information, may be conducted or supported (but not encouraged) by HEW, the commission says, with a variety of provisions. Such research, the report says, should always take place within existing guidelines and with informed consent of the pregnant woman and without objection from the father. In addition, says the report, investigation on pertinent animal models and nonpregnant humans (when appropriate) should have preceded such research.

The most controversial issues—research on a fetus outside the womb or on a fetus scheduled for abortion—were addressed in several recommendations. The purpose of such research, the commission said, should be the development of important knowledge that cannot be obtained by alternate methods. Abortion procedures should not be changed in the interest of research alone. No intrusion which alters the possibility of survival is to be made into the fetus. And the fetus under research should be less than 20 weeks gestational age.

Research representing special problems related to the interpretation and application of the new guidelines may be conducted, the commission says, if approved by a national ethical review body—which the commission charges HEW with establishing. This body, the commission adds, should encourage public participation in the review process as well as the airing of public attitudes. The recommendations would become effective as soon as the secretary of HEW, Caspar W. Weinberger, sets forth regulations based on them. They would affect almost all fetal research, since most of it is federally funded. □