Hubble telescope eyes a younger universe

New evidence that the universe is significantly younger than its oldest stars, reported this week by scientists using the Hubble Space Telescope, puts cosmologists in a bit of a bind. This apparent paradox, indicated earlier by several ground-based studies, may force scientists to revise some details of the Big Bang theory of the universe's birth and evolution.

"The Big Bang [as a concept] is not in trouble, but details of the standard form of the theory may be in trouble," says study coauthor Barry F. Madore of NASA's Jet Propulsion Laboratory in Pasadena, Calif. An international team led by Wendy L. Freedman of the Carnegie Observatories in Pasadena details its work in the Oct. 27 NATURE.

The researchers stress that their findings, based on a new determination of the expansion rate of the universe, rely on data from only one galaxy. In its study, the team has begun realizing a key goal of the orbiting telescope — calculating the Hubble constant, a measure of the expansion rate of the universe (SN: 10/8/94, p.232). Researchers use this much-debated number to calculate the age and size of the cosmos.

Observing a key group of stars, called Cepheid variables, in the spiral galaxy M100, Freedman's group now reports that the Hubble telescope has measured the distance to that galaxy, a resident of the Virgo cluster. The exact location of M100 in Virgo remains uncertain, but from the telescope's observations, the researchers calculate that the galaxy lies between 50 and 62 million light-years from Earth.

Even at this distance, the cluster lies too close to our galaxy to indicate directly the universe's expansion. But using the distance between Virgo and our galaxy as their unit of measure, researchers have calculated the relative distance of galaxy clusters that lie far enough away to provide a measure of the Hubble constant.

As first reported in SCIENCE NEWS 3 weeks ago, the team calculates a Hubble constant of 80 kilometers per second per megaparsec; because of observational uncertainties, the team's value ranges between 63 and 97. Several other groups have reported similar values. However, Allan R. Sandage of the Carnegie Observatories and his colleagues continue to find evidence for a much lower Hubble constant and thus an older universe.

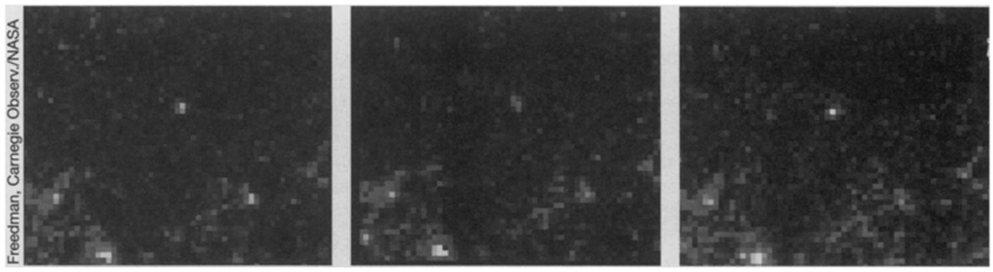
Depending on the density of the universe, a Hubble constant of 80 indicates an age of 8 to 12 billion years, Madore says. However, some ancient groupings of stars, called globular clusters, apparently formed 16 billion years ago.

A young universe also may pose problems for theories about the formation and evolution of large-scale structures in the cosmos, notes Michael S. Turner of the Fermi National Accelerator Laboratory in Batavia, Ill.

He cites several worrisome implications of Freedman's Hubble study. The local universe, he notes, may have a different expansion rate than more distant parts of the cosmos, contrary to standard theory. Alternatively, Turner notes, the universe could be older than the Hubble constant implies — if expansion has accelerated since the Big Bang. This would require a parameter that Albert Einstein rejected nearly 80 years ago — a "cosmological constant" that creates a repulsive force opposing gravity.

Turner adds that a Hubble constant of 80 would indicate that the cosmos has so little matter it will expand forever, rather than possessing a "critical density" in which it has just enough mass to teeter between collapse and expansion.

In a critical density universe, subatomic fluctuations in density enlarge rapidly in the first fraction of a second of the universe — an episode known as inflation — and later evolve into large-scale structures such as clusters of galaxies. In a lower-density cosmos, theorists don't know exactly how structure arose from tiny fluctuations, Turner says. — *R. Cowen*



Hubble images of a Cepheid variable star (in center of photos) in the galaxy M100.

Baboons offer promising model for AIDS

Baboons injected intravenously with one type of HIV, the AIDS-causing virus, show persistent infection and eventually develop the disease. These findings may lead to the first primate model for AIDS, say the researchers who conducted the study.

"We're very excited," says molecular biologist Susan W. Barnett of Chiron Corp. in Emeryville, Calif. "It's a very powerful model." Barnett worked with a team of scientists led by Jay A. Levy of the University of California, San Francisco.

Levy, Barnett, and their colleagues turned to HIV-2, a type of HIV first discovered in West Africa. They had failed to cause AIDS in baboons with HIV-1. HIV-2 is considered less aggressive than HIV-1, the dominant AIDS-causing virus in the United States (SN: 9/17/94, p.187).

In 1988, the researchers injected a single baboon with a strain of HIV-2 isolated from a West African patient. Within a few weeks, the animal developed antibodies to the virus, a sign of infection. Within 18 months, the baboon's blood showed a decline in CD4 T lymphocytes, the white blood cells whose destruction signals the onset of AIDS in humans.

In January 1992, the team gave four additional baboons the same strain of HIV-2. Like humans infected with this virus, the animals developed swollen lymph nodes and showed persistent evidence of antibodies circulating in the bloodstream.

After 2 years, one of the four baboons went on to develop severe weight loss and AIDS. The animal suffered from a type of pneumonia that often afflicts children with AIDS and from skin tumors that resemble those seen in Kaposi's sarcoma, the bluish-colored growths that often afflict people with AIDS.

Another baboon in that group is progressing toward AIDS. It already has skin tumors and is losing CD4 T lymphocytes, Levy points out.

In January 1993, Levy's group injected three more baboons with a different strain of HIV-2, this one taken from a patient in Gambia. All three show signs of ongoing viral infection. That finding suggests that baboons will prove vulnerable to many different strains of HIV-2, a key requirement if researchers are to use this model to test AIDS vaccines. The researchers describe their results in the Oct. 28 SCIENCE.

The team has since injected three healthy baboons with blood taken from a previously infected animal. By cycling the virus through the baboons' bodies, the researchers hope to create a more vicious HIV-2.

"There's been a real need to find a model [on which we] can test the human virus," Levy says. Researchers had successfully inoculated chimps and monkeys with HIV-1, but those mild infections do not lead to AIDS.

In addition to vaccine research, the team says, the baboon model might help doctors find better therapies for Kaposi's sarcoma and other ailments that plague humans with AIDS. — *K.A. Fackelmann*