Clouds of Matter Between the Galaxies

The most fundamental open question in cosmology is whether the universe is open—or whether it is closed. If there is enough matter in the universe, the mutual gravitational attraction of it all will eventually stop the present expansion and start a recollapse. If there is not enough matter, the expansion will continue forever, and there is no limit on the universe's size.

The visible matter is not enough to close the universe. Even if one adds the invisible matter now known, such as the interstellar gas clouds, there is not enough. So astronomers now ask whether the space between galaxies is totally empty or whether there are invisible gas clouds in intergalactic space. The discovery of X-ray sources in some clusters of galaxies, sources too extended and amorphous to be satisfactorily identified with individual galaxies in the clusters, has led some astrophysicists to the conclusion that intergalactic clouds exist.

Now, a study of quasar spectra, reported to the National Science Foundation by Robert E. Williams and Ray J. Weymann of the University of Arizona, nominates a particular cloud for the status of intergalactic cloud and gives a dynamical and numerical argument why it should be.

The finding, NSF says, is believed to represent the most solid evidence yet for the existence of substantial amounts of matter between the galaxies.

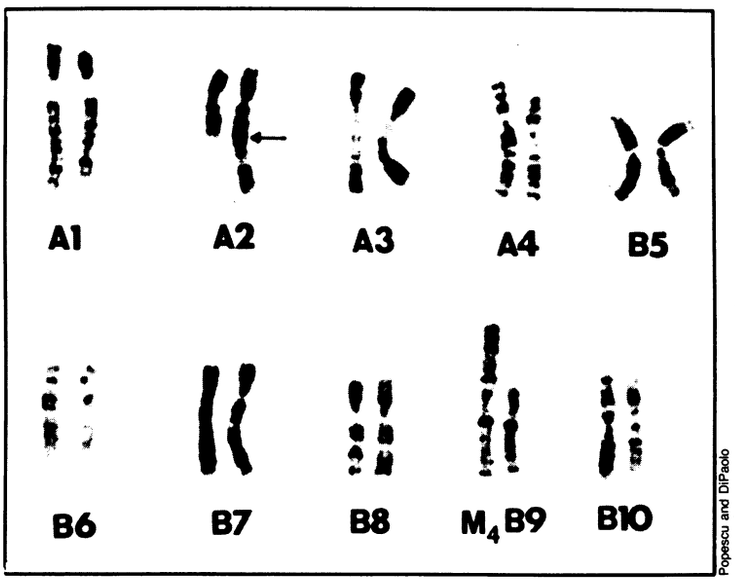
Quasars are compact bodies that give off extremely large amounts of energy. Whatever their relationship to normal galaxies may be, quasars are not part of galaxies in the view of most cosmologists but stand outside them as extragalactic objects. The spectra of quasars exhibit both bright lines that result from emission of particular wavelengths by various hot substances and dark lines that result from absorption of particular wavelengths by cool substances.

It happens in the cases of many other astronomical bodies that emission and absorption lines are produced in different parts of the same object that happen to be warmer or cooler. But in the quasar cases this does not seem to be so. The absorption lines generally show different amounts of redshift from the emission lines. This means that emitter and absorber(s) are moving at different speeds and thus cannot be simply parts of the same object. Several astrophysicists have suggested that the absorptions are done by clouds of gas emitted by the quasar that are either moving away from it or have become satellites of it. But now Williams and Weymann have found at least one instance where the dynamics do not seem to support such an interpretation.

It is one of the clouds that absorb light from the quasar PHL 1222. The redshift relation indicates that this particular cloud is traveling toward the quasar at a speed of 1,500 miles per second, extremely fast. Yet the evidence is that this cloud is also quite far from the quasar. Matter near a quasar ought to be highly ionized because of the intense radiation it receives, but this cloud, by the evidence of the wavelengths it absorbs, has quite a low degree of ionization. Williams says it must be at least a million light-years from the quasar.

It seems hardly likely that a single quasar could exert a gravitational force strong enough to produce such a speed at such a distance. It seems much more likely that the cloud is responding to the gravity of the whole cluster of galaxies in which the quasar is located. The cloud is therefore not particularly attracted to PHL 1222 nor associated with it, but a free intergalactic cloud responding to the dynamics of the whole galaxy cluster. "Since the cloud seems to be one typical of many quasars, the inference is that many other quasars' clouds can be explained in the same way," Williams concludes. Thus there would be a lot of intergalactic clouds. □

Chemical carcinogens: Cause probed



Popescu and DiPaolo

Chromosomes taken from a cell turned cancerous by a chemical carcinogen, show how chemical carcinogens can alter chromosomes. A portion of chromosome number A2 has been translocated to the short arm of chromosome number B9 to form a new chromosome, number M4.

Cancer, regardless of the tissues or organs it afflicts, consists of one or several cells gone haywire. These cells then multiply like wildfire, taking over the body and usually killing the victim. Environmental chemicals, along with viruses and radiation, have been well established as triggers of cancers in animals and tissue cultures and hence are believed to set off human cancers also. Some cancer researchers, in fact, believe that most human cancer is caused by chemicals in the environment.

Although scientists have known for 40 years that chemicals trigger cancer, at least in tissue culture, precisely how they might do so has eluded discovery. Nonetheless, investigators are learning more and more about it, as revealed at the recent annual meeting of the Federation of American Societies for Experimental Biology and by an article in the latest issue of the PROCEEDINGS OF THE NATIONAL ACADEMY OF SCIENCES.

The body's first line of defense against foreign chemicals, including carcinogens, are enzymes in the liver. In their zeal to rid the body of carcinogens, however, the enzymes may make them more carcinogenic than the parent compounds, Charles Heidelberger of the University of Wisconsin reports. Precisely how long carcinogens must remain in the body, and in what form, to do their dirty work is not known. But if they do stay long enough to cause trouble, their next stop is presumably target cells.

As far as Heidelberger can tell, carcinogens "can do their own thing without switching on RNA tumor viruses." In other words, it looks as if they can turn cells into cancer cells without an RNA tumor virus or its reverse transcriptase enzyme being present. Heidelberger admits, though, that he doesn't know whether some unknown virus might switch carcinogens on.

Once carcinogens get inside cells, they attach to chromosomes. This attachment may or may not damage the chromo-