Our not-so-quiet galaxy: Sans black hole?

In recent years astrophysicists have tended to attribute any situation in which a large amount of energy is generated in a small space to the activity of a black hole. It seems to many that the most convenient way of explaining such large amounts of energy production is by the conversion of the energy gained by matter from the surroundings of the black hole as it falls into the black hole. As it falls, the infalling matter gains a great deal of kinetic energy. Friction that occurs as this infalling matter bunches together may convert some of that kinetic energy into heat that is then radiated. If the collisions that make the friction also ionize some of the infalling matter, this matter, which is now electrically charged, can itneract with nearby magnetic and electric fields and radiate some of its energy in a variety of nonthermal ways. The exact balance between thermal and nonthermal emissions and the exact geometry of the infalling matter around the black hole can vary according to the specific observational circumstances that the astrophysicists wish to explain.

Among the things that are explained in this way are quasars and the so-called active centers of galaxies, that is, the nuclei of certain galaxies that appear to be radiating far too much energy to be explained by a simple conglomeration of stars. It used to be thought that there was a division between active galaxies and quiet galaxies. Our own galaxy, the Milky Way, was thought for a long time to belong to the quiet class for which no exotic explanations or models were necessary. Observations of recent years, however, seem to show that a great deal of energy is produced in the center of our galaxy and many astrophysicists are coming to think there is some kind of exotic black hole mechanism at work there. But the distinction between active and inactive galaxies seems to be fading, to be replaced by a continuum running from less energetic to more energetic with basically the same mechanism operating in all of them (SN: 5/1/82, p. 293).

There are dissenting voices to this view of the continuum between active and inactive galaxies. Among them is that of George Rieke of the University of Arizona's Steward Observatory, who spoke at last week's meeting of The Astronomical Society of the Pacific in San Diego. Rieke believes that our galaxy does not need to have a black hole mechanism in its center.

Rieke believes that the goings on in the center of our galaxy can be explained by a large burst of star formation, and he believes that such an explanation may also apply to other galaxies as well.

One of the difficulties in our own galaxy, and in others, is that the center is obscured by clouds and dust. This is what makes infrared observation an ideal means of assessing galactic centers. The dust does not permit much visible light to get through. It absorbs a great deal, which it reradiates as infrared, and it permits the passage of some of the infrared from bodies inside the cloud. Rieke says that infrared spectra of individual stars within one parsec of the galactic center permit them to be classified. There are a sizable number of red supergiants from spectral class M1 to spectral class M6. If these stars exist in the center of the galaxy in the numbers suggested by infrared observation, there should also be a large number of blue supergiants in the center. In fact, for every seven red supergiants, astrophysicists would expect to find 80 blue supergiants in the same area. In this way blue supergiants in the center of the galaxy could be the source of an amount of luminosity equal to 30 million times the luminosity of the sun. This provides plenty of blue and ultraviolet light, which is capable of ionizing gas in the clouds surrounding the center.

The presence of a large amount of ionized gas there, which is betrayed by its radio emanations, is one of the pieces of data that is often cited in support of models that propose the activity of a black hole. Rieke says that starlight on this scale is sufficient to produce the amount of ionization that is seen in the center; the action of friction of matter falling into a black hole is not necessary. Thus we have a model for the center of our galaxy that involves a great deal of concentrated star formation. This is what is known in astrophysical circles as a star burst mode. Such a model is also possible for a lot of other galaxies, and Rieke suggests that systematic infrared studies may show whether they are galaxies with active nuclei — that is, with something very exotic going on in their centers — or ones with centers that just have lots of star formation. *—D. E. Thomsen*

Detection of fetal sickle cell anemia

Scientists have developed a faster, cheaper way to diagnose fetal sickle cell anemia, a painful, sometimes fatal hereditary disease that is estimated to affect from 40,000 to 50,000 black persons in the United States.

The test, blot hybridization, uses an efficient enzyme called Mst II. The matching results of two separate studies were reported in the July 1 New England Journal of Medicine by Stuart H. Orkin of Children's Hospital and Medical Center in Boston and researchers at Johns Hopkins University in Baltimore and Judy C. Chang and Yuet Wai Kan of the University of California at San Francisco. The findings of both groups suggest that the method will shorten diagnosis time from five weeks to two weeks and cut costs by at least $200 per person.

People with sickle cell anemia have defective molecules of hemoglobin, the oxygen-carrying protein in red blood cells. This defective hemoglobin stiffens into rods when deprived of oxygen, causing the red blood cells to distort into a sickle shape. These cells block tiny blood vessels in the body, cutting off oxygen to tissues and causing intense pain.

Ten years ago sickle cell anemia could be detected *in utero* by drawing a sample of fetal blood from the placenta, but the method was dangerous and caused fetal death 5 out of 100 times.

With blot hybridization, doctors obtain fetal cells from the amniotic fluid surrounding the fetus. They withdraw a small amount, isolate the DNA and place it in a test tube with an enzyme.

Blot hybridization works because certain enzymes recognize patterns of linked amino acids and break DNA strands in specific spots; strands of sickle cell DNA broken by the enzyme are characteristically longer than normal.

The enzyme used in the past was not as specific as Mst II and required a large amount of DNA to work properly, according to Corinne D. Boehm, a geneticist at Johns Hopkins University, who worked on the study along with Johns Hopkins colleagues Peter F. R. Little and Haig H. Kazazian. The disadvantage to the old enzyme, according to Boehm, was that doctors had to wait as long as five weeks in order to obtain enough DNA from growing fetal cell cultures.

Referring to the old enzyme test, Boehm said, "Ninety-five percent of pregnancies were diagnosable but you had to get started early and you had to do a lot of complicated family studies. So it could be done, but it was a lot more complicated and it took a lot longer."

Normal hemoglobin consists of long strands of amino acids in regular patterns. The sickle defect occurs on a particular chain of the hemoglobin molecule called the beta chain; the normal amino acid sequence of CCTGAGG is changed to CCTGTGG in which glutamic acid, or A, is replaced by valine, or T. Mst II works by breaking the chain every time it sees or recognizes the sequence CCTGAGG to give DNA fragments of a certain length. Because sickle cell DNA doesn't have this same, normal pattern of amino acids, the fragments are longer.

Once scientists have obtained the DNA, they need a way to visualize the fragments. They do this by combining the DNA in question with radioactive DNA to form a radioactive hybrid that is placed on X-ray film. The radioactive DNA exposes the film, leaving a white mark that can be measured. *— K. A. Fackelmann*