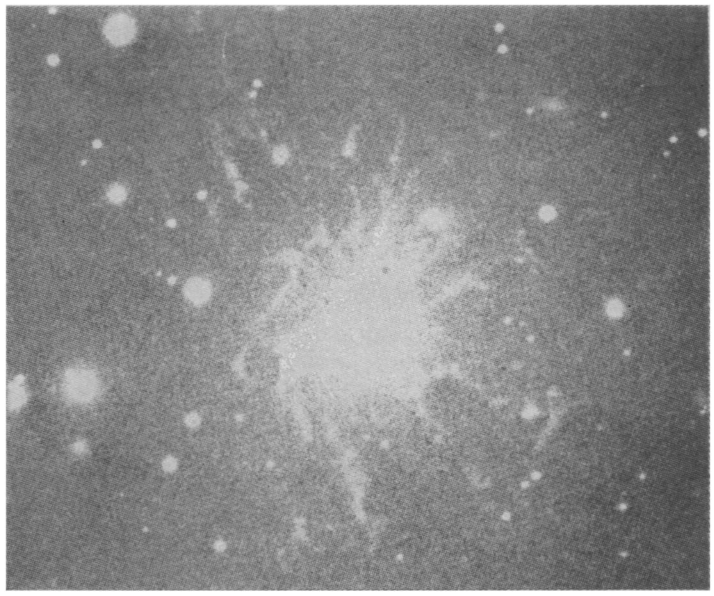
science news
OF THE WEEK



Kitt Peak Nat'l Obs.

NGC 1275: Seyfert galaxy is a strong emitter of X-rays.

Brighter than 10 trillion suns

First X-ray observation of a Seyfert galaxy may help elucidate their relationship to quasars

Seyfert galaxies are characterized by compact, extremely bright nuclei. They were first identified as a group by Dr. Carl Seyfert in 1943.

The compactness of the Seyfert galaxies led some astronomers to suggest that they are somehow a link, evolutionary or otherwise, between ordinary galaxies and quasars, extragalactic objects that look like stars but radiate energy in amounts greater than galaxies do (SN: 3/20/71, p. 193). In visible light Seyfert galaxies are rather dim, and their energy output did not seem consistent with such a suggestion until radio and infrared studies showed that they radiate in unseen wavelengths many times the energy they do in visible ones. Their infrared output is so strong that it earned them the nickname "invisible quasars."

The first Seyfert galaxy to show up in the X-ray range of the spectrum is reported in the March 15 ASTROPHYSICAL JOURNAL LETTERS by Drs. Gilbert Fritz, Arthur Davidsen, John F. Meekins and Herbert Friedman of the Naval Research Laboratory. It is located in the constellation Perseus and is catalogued as NGC 1275. In catalogues of radio sources it is known as Perseus A or 3C 84. It is about 200 million light-years away.

The NRL group obtained a partial X-ray spectrum for NGC 1275 and by extrapolating this into ranges they could not observe, they estimate an energy output of 2×10^{46} ergs per second in the wavelength range between 1 and 100 angstroms. This is equivalent to the radiation at all wavelengths of 10^{13} stars like the sun. (The total energy output of the Milky Way galaxy is about 10^{43} ergs per second.)

The X-ray identification of NGC 1275 was a surprise, says Dr. Fritz. The detectors, which were flown on an Aerobee rocket from White Sands, N.M., on Feb. 28, 1970, were set to scan the sky for X-ray sources in general. A Seyfert galaxy was not expected to show up since most theoretical estimates of their probable X-ray output were below the threshold of sensitivity of the equipment.

The Uhuru satellite, which was launched from the pad in the Indian Ocean off the coast of Kenya last December, has also observed NGC 1275, says Dr. Fritz.

Now that one Seyfert galaxy has been found, Dr. Fritz expects X-ray astronomers to go looking for more. He believes they will be found more easily by directed observations that look at particular Seyfert galaxies for long times. The experiment that detected NGC 1275 was a sky scan that stayed on the object for only one second. The NRL group would like to do rocket experiments that could look at a particular Seyfert galaxy from 20 seconds to a minute. They have a project for an observation aboard an Orbiting Solar Observatory satellite that could look at a given Seyfert galaxy for days.

If more X-ray Seyferts and more X-ray quasars can be found, comparisons may help elucidate the nature of any relationship that exists between them. There is a long way to go before statistically significant evidence is in: At present only four X-ray sources outside the Milky Way galaxy have been found. In addition to NGC 1275 they are the quasar 3C 273, the giant elliptical galaxy M87 (known to radio astronomers as Virgo A) and the radio galaxy known as Centaurus A or NGC 5128. There are about 50 known X-ray sources within the Milky Way galaxy.

The NRL group warns against drawing too many conclusions from the example of NGC 1275; as Seyfert galaxies go, it is a peculiar one. NGC 1275's radio output is much stronger than other Seyferts', so its X-ray output is likely to be stronger too. Furthermore NGC 1275 is a highly variable radio source; its radio emission can change by as much as 10^{41} or 10^{43} ergs per second in the course of a year.

Nevertheless, radio astronomy studies have shown similarities in structure between NGC 1275 and the quasar 3C 273. Both have dense cores surrounded by halos. In NGC 1275 the core is about one light-year in diameter; in 3C 273, less than three light-years. Both cores suffer repeated energetic outbursts on scales of months or years.

What produces the energies radiated by these bodies is a major mystery for astrophysicists to solve. The thermonuclear fusion processes that produce stellar energies are definitely not efficient enough.

Gravitational collapse, in which a body grows smaller and denser under the influence of its own gravity, is one suggestion. In the process of collapse a large part of the mass is converted to radiated energy in a way much more efficient than thermonuclear fusion.

Another source now in favor is the rotational kinetic energy of a spinning body. When a spinning object collapses (say a star collapsing into a pulsar) it gains a store of rotational kinetic energy greater than could have been produced by thermonuclear conversion of all its mass. Current theories of explosive galaxies like NGC 1275 envision compact nuclear regions composed of millions of pulsar-like objects, or else a giant spinar containing a mass equivalent to 100 million stars and rotating with a period as short as days or months. By comparison, the Milky Way, which has a diffuse nucleus, rotates once in 200 million years. □