

# A Supermassive Object in Galaxy M87

The galaxy in the constellation Virgo that the eighteenth century astronomer Charles Messier listed as number 87 in his catalog of "nebulae" has become a famous and much-observed object. A member of the nearest cluster of galaxies to our own, the Virgo cluster, it is also known to optical astronomers as NGC 4486. Identified as the optical counterpart of one of the earliest discovered radio sources (Virgo A) it has long been of interest to radio astronomers.

M87 is of particular interest because it is peculiar. It is an elliptical galaxy of the EO class, but it radiates more energy than galaxies of that class usually do,  $2 \times 10^{42}$  ergs per second of "anomalous" energy output. Radio evidence shows that the nucleus of M87 is energetically active, and there is also optical evidence for such activity in the form of jets that seem to be matter ejected from the nucleus.

All in all, it seemed to two slightly overlapping groups of astronomers that M87 was a good place to look for evidence to support a theoretical idea (attributed to D. Lynden-Bell of Cambridge University) that the centers of active galaxies, radio galaxies and quasars are inhabited by supermassive black holes. The gravitational collapse of matter falling into such a black hole would supply the energy for the various goings-on that are observed. The conclusion of the two parallel studies of M87, as published in the May 1 *ASTROPHYSICAL JOURNAL*, is that there is indeed a supermassive object in the nucleus of M87, which could be a black hole.

The presence of such an object was determined by studying the distribution and velocities of stars in the galaxy, particularly in the immediate neighborhood of the nucleus. The stellar distribution study, which is a study of variations in brightness over the surface of the galaxy looking for a bright central "cusp" of stars bound to the heavy object, was done by Peter J. Young, James A. Westphal, Jerome Kristian and Christopher P. Wilson of the Hale Observatories and Frederick P. Landauer of the Jet Propulsion Laboratory. They used the 60-

inch and 200-inch telescopes on Mt. Palomar.

The velocity study, which is a spectroscopic study of the velocity dispersion or the range of velocities that the galaxy's stars exhibit with respect to one another, was done by W. L. W. Sargent and Young of the Hale Observatories, Alec Boksenberg and Keith Shortridge of University College, London, C. Roger Lynds of Kitt Peak National Observatory and F. D. A. Hartwick of the University of Victoria (British Columbia). The point is to look for a velocity dispersion that is larger than usual. This testifies to the presence of an unusual amount of mass in the galactic center, because the greater the velocity distribution, the more mass has to be there to hold the stars in. This second group did their observation of M87 with the 4-meter telescope at Kitt Peak and observations of NGC 3379, which they use as a "normal" comparison galaxy, with the 200-inch at Mt. Palomar.

The velocity dispersion data for M87 show a sharp increase in passing from the outer region to the core, changing from 278 kilometers per second at the edge of the core (9.5 seconds of arc from the center) to 350 kilometers per second at 1.5 seconds of arc from the center point. No such sharp increase is evident in NGC 3379. The luminosity data show a sharp brightness "spike" in the center of M87 and excess luminosity (excess in comparison to the luminosity profile of a "normal" galaxy of this class) in the central region within 10 seconds of arc of the central point.

The velocity data inside the core of M87 can be explained by a mass concentration in the center amounting to 5 billion times the sun's mass. The luminosity data for M87, which do not fit the luminosity profile of a normal galaxy of this class, do fit a profile calculated with a black hole of 3 billion solar masses in the center and a point source of light of unspecified kind. Both groups of astronomers stress, collectively in the published papers and indi-

vidually in outside comments, that these results do not prove there is a black hole in the center of M87. Other kinds of large mass concentration could fit the data. But the black hole option is astrophysically, cosmologically and philosophically the most exciting. Since the black hole and the infalling matter surrounding it could generate a lot of radiation and could be a pump for pushing the matter that seems to be coming out in M87's optical jets and radio lobes (similar phenomena are seen in other radio galaxies and quasars), its presence would make a lot of theorists happy.

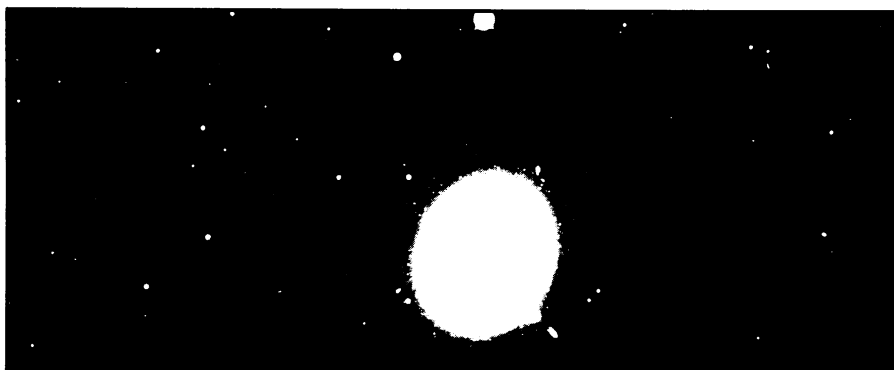
Naturally, the first question to be asked, by other astronomers as well as by the public, is whether other such examples can be looked for. They can be looked for, say these observers, but whether they will be found is a touchy question. These observations strain the capability of ground-based work. For improving the data on M87 and finding other examples, the observers recommend the Space Telescope. □

## Vitamin B6 helps autistic children

Perhaps it was inevitable that one of the most mysterious behavioral afflictions, childhood autism, should come to be treated by one of the least understood and most maligned of therapies, megavitamin therapy. The first strictly controlled studies of the effect of large doses of vitamin B6 on autistic youngsters are yielding promising results, researchers reported last week at the Academy of Orthomolecular Psychiatry symposium in Atlanta.

While the findings have obvious implications for the treatment of autism, the researchers hope they might also signal an elevation in believability and respectability for their field — one they admit is viewed by many other professionals as "hocus pocus." "This study has a great deal of significance not only in autism but in the belief held by many that the constituents of a normal diet — such as vitamins and minerals — cannot affect behavior... This is erroneous," says Bernard Rimland, director of the Institute for Child Behavior Research in San Diego.

There are already indications that the work of Rimland and others — dismissed, in effect, in a rather scathing American Psychiatric Task Force report in 1973 — may be gaining acceptance, if slowly, among psychiatrists and other professionals. The B6/autism study, for example, was published in the April 1978 *AMERICAN JOURNAL OF PSYCHIATRY* — "much to the



M87, NGC 4486, Galaxy Type EO, in Virgo: Site of black hole?

Kitt Peak National Observatory

consternation, I must say with some pleasure, of the powers within the psychiatric establishment who have been vociferously insisting that vitamins have nothing whatever to do with the functioning of the brain," Rimland says. In addition, officials of the National Society for Autistic children (NSAC) say they are "impressed with his work."

Rimland and colleagues Enoch Callaway and Pierre Dreyfus are not sure exactly what vitamin B6 does to the brain. But in their study of 16 "autistic-type" youngsters, the investigators found that 11 improved significantly while taking massive (several hundred milligrams a day) doses of the vitamin in pill or capsule form. Moreover, the majority of the subjects appeared to deteriorate when "withdrawn" from B6. Each child was placed on B6 for half the study and on a placebo for the other half, but neither they nor those who rated their behavior knew at the time which of the two was in use — that information was not revealed until the ratings were concluded.

Rimland says he "cannot account" for the four youngsters who were not helped by the megavitamin therapy (in two of the cases the behavior appeared to worsen). "Frankly, I thought we'd be right in all of them [the 16 subjects] — I'm disappointed," says Rimland. The psychologist undertook the study, he says, largely on the basis of earlier clinical observations and noncontrolled studies, both in the United States and in England.

The researcher concedes that "it is difficult to say just what the exact mechanism is" that is responsible for the apparent improvement. But those who respond positively exhibit considerably lower levels of the almost trance-like detachment and other behavioral characteristics common among autistic children. B6 has been shown to elevate serotonin levels — apparently depleted in the autistic — and Rimland suggests that this could be a sign of "an underlying allergy in the central nervous system to some substance."

He cautions, however, that "a lot of kids have been helped [several hundred are now being clinically treated with vitamins] but no kid has been made totally well... B6 may be just one of a series of things needed in treatment of the autistic." B6, even in such massive doses, does not appear to damage the system, Rimland says.

Ruth Sullivan, director of the NSAC's Information, Referral and Advocacy Office, says that Rimland "seems to be on to something that could be quite useful — how useful at this point, we don't know." "I know of no person working in the field that is more thorough in their search of the literature," she says of Rimland, whose theory of vitamin dependency could apply to "autism and other mental illness..." "We're pretty sure that autism involves some neurological disability," says Sullivan. "Conceivably, vitamin dependency may be involved with that." □

## Solar superflare is noisiest on record

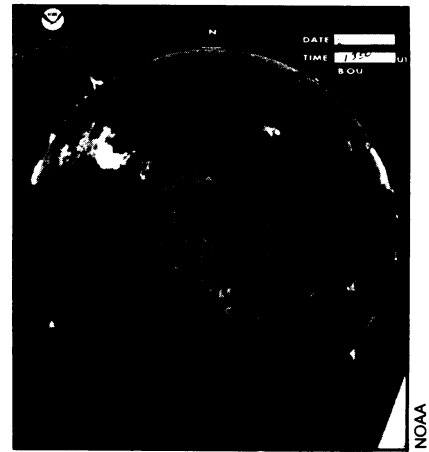
In the annals of the huge eruptions that periodically burst forth from the sun, the flare of flares took place in early August of 1972. Its X-rays, charged particles and other emissions bathed the earth in unprecedented numbers, playing havoc with communications and reaching levels that some researchers feel could have been lethal to astronauts in space. "The August '72 event," says Patrick S. McIntosh of the National Oceanic and Atmospheric Administration's Space Environment Services Center in Boulder, Colo., "is our benchmark."

Last month, however, one of the 1972 event's most important records was broken by a superflare that seems, in terms of its accompanying radio-frequency energy, to be the "noisiest" on record.

Of the sun's radio emissions, says McIntosh, the 10-centimeter wavelengths have been monitored for the longest time. During a period of minimum solar activity, the 10-cm background level is about 70 "flux units," rising to about 170 during an active period. The August 1972 event produced a level of about 22,000, an increase of more than 100-fold. The superflare of April 28, 1978, raised the number to 24,000.

A more representative indication of the flare's overall energy, however, is its X-ray output. The most common flares are small, with peak X-ray energies of about 0.001 erg per square centimeter per second reaching the earth. The August 1972 peak was about 15 ergs, with last month's event reaching about one-third that number. Because the emissions took longer to die out, however, McIntosh says, the total X-ray energy from the recent flare probably reached half the 1972 level.

It also triggered a "storm" that distorted earth's magnetic field for four days, causing communications difficulties by upsetting the ionosphere so that it could not be



April 28 flare (upper left) by H $\alpha$  light.

counted on to predictably bounce radio signals over the horizon. The U.S. Coast Guard, according to McIntosh, reported that it lost radio contact with ships from Maine to New Orleans. The distortion of the geomagnetic field lines also required the Space Environment Services Center to alert RCA Corp. and Comsat Corp., both of which operate communications satellites that depend on the field lines to maintain their proper orientation in orbit.

The superflare was part of an episode lasting more than two weeks, in which one or more "moderate-or-better" flares occurred almost every day. Ten such events were recorded on April 7 alone. If the more common, small flares are included, McIntosh says, the total during the two-week episode may have been as high as 200.

A number of the flares took the form of "loop prominences," stretching perhaps 50,000 kilometers into space and then curving back to the sun. Loops are the most energetic of prominences, McIntosh says, and the hottest, reaching temperatures as high as 2,000,000°K compared to a background temperature of about 6,000°K in the part of the solar surface surrounding the source region.

The sun's activity is expected to reach its maximum in late 1979 or early 1980. The number of sunspots, an indicator of solar activity, has already reached an average of about 100, says McIntosh, only 10 short of that during the last maximum in 1968-69. □

## Sun Day's legacy: Organization for change

On May 3, millions of people from all walks of life found common grounds for celebrating the promise of solar energy. From sunup to sundown, across the nation and in many foreign countries, fairs, rallies, tours, panels and concerts feted the sun. Many functions were just plain fun, such as dancing to solar-powered rock bands or attending races between solar-powered cars. But there were serious messages too, such as the announcement by President Carter that another \$100 million would be added to the federal solar-energy budget.

"The question is no longer whether solar energy works," said President Carter during Sun Day ceremonies at the Solar

Energy Research Institute in Golden, Colo. (SN: 4/22/78, p.255). "We know it works. The only question is how to cut costs so that solar power can be used more widely."

His speech and endorsement of solar technologies marks a turn in the President's solar stance. Less than four months ago he sent a budget proposal to the Congress calling for a reduction in solar spending. Although the additional money he described May 3 will be "reprogrammed" — which means taken from funds originally proposed for use elsewhere within the energy-department budget — solar enthusiasts see it as an important attitudinal change.

And that was the whole purpose of