Evidence for buried quasars unites galaxies

Hidden quasars may lie at the heart of at least five radio-emitting galaxies, according to observational evidence reported this week. The new data strongly suggest that certain galaxies once categorized as different types actually represent only one type, with their seeming differences resulting from their orientations relative to Earth.

Radio galaxies belong to a group of luminous objects known for their "active galactic nuclei" (AGN). The AGN class also includes quasars and certain bright objects that don't emit much radiation at radio wavelengths – Seyfert Type I and Type II galaxies.

Since the mid-1980s, studies have suggested that members of the AGN menagerie have more in common than meets the eye. Specifically, several researchers have proposed that the active nuclei in all of these galaxies contain a quasar surrounded by a doughnut-shaped cloud of dust and gas. If viewed edge-on in visible light – and through the encircling dust – the brilliant quasars would remain shrouded from view. The parent galaxies would therefore appear to emit only the narrow bands of light characteristic of certain radio or Type II Seyfert galaxies. But if observers looked straight through the hole of the dusty doughnut, the same galaxies would instead broadcast the brilliant, wideband spectral emissions typical of a naked, radio-emitting quasar or Type I Seyfert.

Recent experiments using polarized light from Seyferts supported this unified galactic theory (SN: 6/25/88, p.404; SN: 4/27/91, p.261), but no one had ever imaged the crucial hidden quasar. To search for that missing link, Stanislav Djorgovski and his colleagues at the California Institute of Technology in Pasadena have now examined eight radio galaxies in the infrared – a wavelength band which dust cannot attenuate as completely as visible light.

The group focused special attention on Cygnus A, the brightest radio galaxy in the northern sky. Using a camera attached to the 5-meter telescope at the Palomar Observatory near Escondido, Calif., the researchers photographed Cygnus A at four successively longer near-infrared wavelengths – each penetrating the dust more deeply than the last.

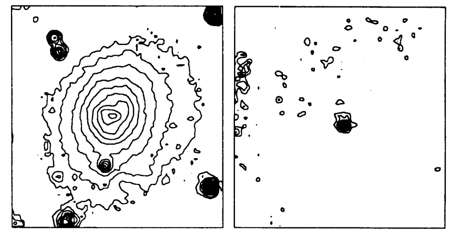
The core of the galaxy can't be discerned in visible light. But at the shortest infrared wavelength, the nucleus begins to emerge as a round, somewhat focused object, Djorgovski says. And when viewed at the longest wavelength, the core resembles a point source, as if a compact object lurked there. Moreover, the location of this compact source matches the position of the galaxy's known radio-emitting core, the researchers report.

According to Djorgovski, this all but proves that the core of Cygnus A harbors a quasar. "It's really too much to be a coincidence," he explains. "The logical interpretation is that we've found a buried quasar that we couldn't see optically."

He and his colleagues describe the Cygnus A data in the May 10 ASTROPHYSICAL JOURNAL LETTERS. And at a meeting of the American Astronomical Society in Seattle this week, Djorgovski announced that other radio galaxies studied by his team show similar evidence of a hidden quasar – M87, Perseus A, 3C236 and 3C264.

The Caltech team also estimated the apparent absorption of visible light by the dust believed to encircle Cygnus A's core. Comparing the observed intensity of the galaxy's central radio source – which emerges from the core unimpeded by the dust – with the muted emission in infrared, the team calculated that dust along the line of sight must be absorbing all but one out of every 10^{21} visible-light photons radiated by the core.

At the Seattle meeting, Andrew S. Wilson of the University of Maryland at College Park reported that he and his colleagues had independently calculated the same absorption. They made their estimate by comparing X-ray emissions from the galaxy's core with their own observations of dust-obscured, near-infrared radiation.



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Cygnus A depicted at two infrared wavelengths. Longer-wavelength image (right) reveals central point source that may indicate the galaxy harbors a quasar.

Wilson's team analyzed infrared spectra from Cygnus A using an infrared telescope on Mauna Kea in Hawaii. They detected warm molecular hydrogen, often associated with dense clouds of gas and dust, he says. Wilson notes that the hydrogen finding supports the notion that dust surrounds a hot, quasar-like object at the core of radio galaxies and perhaps other active galactic nuclei. In other words, all such nuclei may be the same at heart. *– R. Cowen*

Deep-sea denizen may tell of ocean's past

Scientists have come up with an Old Man of the Sea that makes Hemingway's character seem a youngster by comparison. This elderly creature of the deep may have its own tale to tell – not about a giant marlin, but about the ocean's past.

Preliminary carbon-14 dating suggests that the coral-like *Gerardia* specimen – retrieved from the Atlantic at a depth of 600 meters – may have lived for as long as 1,700 years, researchers reported last week at the International Radiocarbon Conference in Tucson, Ariz. While they emphasize that their radiocarbon results await confirmation, they believe *Gerardia* may provide a valuable record of environmental changes in the deep ocean over the last millennium or more.

Gerardia is not a single organism but a colony of polyps connected to each other by living tissue. Throughout their lives, the polyps slowly build up layers of proteinaceous skeleton. "We're able to get layers like a tree and date them," says Sheila Griffin of the Woods Hole (Mass.) Oceanographic Institution. Griffin and her colleagues suggest that analyses of the skeletal layers could reveal fluctuations in water temperature over time. In addition, measurements of carbon in the skeleton may offer insights into the puzzling carbon cycle of the ocean. As concern over global warming intensifies, understanding how and at what rate the ocean absorbs carbon has become an increasingly important research goal.

Scientists have sought clues to past atmospheric changes by studying the annual rings of the bristlecone pine, which can live for thousands of years. They have also analyzed million-year-old coral reefs to track variations in the shallow sea. However, the past of the ocean's deeper waters has remained closed to observation. Without an oceanic equivalent to the bristlecone, Griffith says, "we've never been able to record things like temperature changes at these depths."

Gerardia's secret to long life is the constant replacement of old polyps with new ones. "The [colonies] are potentially immortal; they can go on forever," says zoologist Malcolm Shick of the University of Maine, Orono. However, he adds, previous specimens have not exceeded a life span of 250 years.

Griffin says it's possible that her group's preliminary radiocarbon date represents the age of seafloor sediment within the skeleton rather than the age of the skeleton itself. Before publishing their results, the researchers plan to use other isotope tests, and possibly a chemical dating method called amino acid racemization, to confirm the specimen's venerable age. *– J. Travis*