Milky Way's Heart Gushes Antimatter

Talk about pouring your heart out.

New observations suggest that the heart of our galaxy pumps a fountain of antimatter and hot gas into the tenuous halo of material lying several thousand light-years above it. The discovery could dramatically alter astronomers' view of the Milky Way and how the hotbed of activity at the galaxy's center influences its farthest extremities.

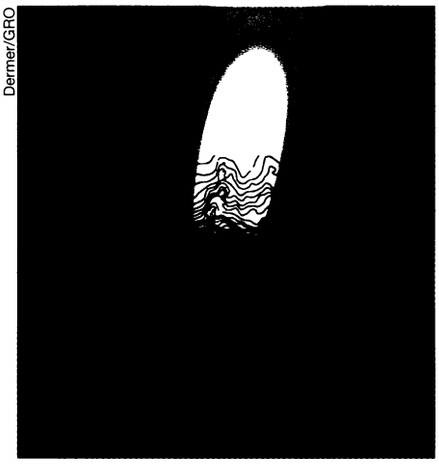
The fountain "provides a conduit between the galactic center and distant parts of the galaxy," says gamma-ray astronomer Charles D. Dermer of the Naval Research Laboratory (NRL) in Washington, D.C. "This high-altitude feature . . . reveals how the core regulates the rest of the galaxy."

James D. Kurfess of NRL and his colleagues, including William R. Purcell of Northwestern University in Evanston, Ill., reported the discovery this week at a conference on high-energy astronomy in Williamsburg, Va. The researchers base their findings on a high-energy map of the Milky Way's core compiled by an instrument aboard NASA's Compton Gamma Ray Observatory (GRO).

Blanketed in dust, the center of our galaxy remains an enigma when viewed in visible and ultraviolet light. Gamma rays, however, can escape this shroud. Since the 1970s, astronomers have detected gamma rays coming from the galactic center. The rays' wavelengths correspond to the energy generated when an electron collides with and annihilates its antimatter counterpart, a positron.

A year-long study with a GRO detector has for the first time mapped in detail the distribution of this emission along the plane of the galaxy. To the astonishment of astronomers, it also recorded a broad distribution of the same annihilation radiation in a region some 3,000 light-years out from the disk of the Milky Way. Matter in this region, part of the halo of our galaxy, is scattered very thinly, making it an unlikely place to generate a cascade of positrons that would then slow down and slam into electrons.

"We have no good idea how this radiation is being produced," says Purcell. The GRO map indicates, however, that the high-altitude radiation connects with the radiation at the galactic center. Although its resolution is limited, the map suggests that the emission is part of a stream of matter and antimatter rising from the center. Radio images hint at a similar pathway.



Radio contours overlaid on a computer simulation of annihilation radiation streaming from the Milky Way's center. The radio observations suggest that a channel leads from the center to high altitudes, in rough agreement with the location and direction of the gamma-ray geyser.

Some sort of activity "is building up and breaking open a hole in the plane of our galaxy and pouring gas into the galactic halo," Dermer asserts. Although the source of the annihilation radiation is debatable, there is no dearth of candidates in the crowded environs of the galactic center.

One likely suspect is the black hole, estimated at about 1 million times the mass of the sun, thought to reside at the core of the Milky Way. Black holes are believed to produce jets of matter and radiation that could generate the gamma-ray emission observed by GRO.

Dermer says he favors another source, the explosive death of massive stars. These explosions, known as supernovas, produce radioactive nuclei that emit a copious supply of positrons as they decay. However, Dermer's scenario would require a supernova explosion at the center of the galaxy each century for about 1 million years. That rate is higher than the rate for the rest of the galaxy and may not square with some observations.

"I don't know what the truth is," says codiscoverer Marvin Leventhal of the University of Maryland at College Park. "But this is the beginning of a new and exciting trail." — *R. Cowen*

FDA can regulate tobacco as a device

A judge in the heart of tobacco country has ruled that the Food and Drug Administration can regulate tobacco as a device for delivering nicotine, an addictive drug. However, the ruling does not allow the FDA to restrict advertising as a means of curbing tobacco experimentation—and eventual addiction—among children.

The summary judgment, handed down on April 25 by U.S. District Court Judge William J. Osteen Sr. in Greensboro, N.C., stung the tobacco industry, which had assumed that he would be sympathetic to its cause. Early in his legal career, Osteen had worked as a paid tobacco lobbyist.

Tobacco companies had petitioned the court to strike down FDA rules, issued last August, aimed at restricting young people's access to tobacco products. The rules require stores to verify with photo IDs that customers are at least 18 years old, and they ban self-service sales of tobacco in places youngsters might visit.

Osteen not only accepted FDA's claim that tobacco is a device for administering nicotine, he also countered industry charges that Congress had prohibited FDA from having any regulatory jurisdiction over tobacco products. Furthermore, he ruled that evidence of tobacco's pharmacological effects (SN: 5/14/94, p. 314) and of the industry's manipulation of nicotine to tailor those properties of tobacco (SN: 7/2/94, p. 7) indicate that these products fall squarely within FDA's purview.

At the same time, Osteen rejected FDA's right to limit certain types of advertising, such as billboards near schools. The specific law that FDA cited won't allow such measures, he says.

This leaves open the possibility that the advertising restrictions might be picked up by another agency, such as the Federal Trade Commission, notes addiction researcher Jack E. Henningfield of Johns Hopkins University in Baltimore. He says it also "kicks the door open to the research community to find other tools for reducing the powerful appeal of these products to children."

Adds John R. Hughes of the University of Vermont in Burlington, a past president of the Society for Research on Nicotine and Tobacco, the court's acceptance of nicotine as a drug may be a first step toward public recognition that tobacco control research should be coordinated by the National Institute on Drug Abuse. Currently, he notes, "no one [federal agency] really takes ownership to coordinate such research." — *J. Raloff*