

## Milky Way's black hole seen as particle smasher

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Scientists were startled to find in 2004 that the center of our galaxy is emitting gamma rays, the highest-energy form of light. Now astronomers say they've discovered what might produce these.

A black hole believed to lurk in that place, they propose, could be a cosmic form of particle accelerator—a machine built to smash subatomic particles together in order to understand their components. The black hole, according to this view, would rev up particles known as protons, parts of the cores of ordinary atoms, and smash them at near-light speeds into lower-energy protons. The collisions would produce gamma rays. It's similar to the same kind of particle physics experiments that the Large Hadron Collider, a next-generation accelerator in Switzerland, will perform, said David Balaban of the University of Arizona in Tucson, Ariz. That machine is due to start operating this year. A graphic illustrating the idea that the black hole at the center of the Milky Way is like an extremely powerful particle accelerator, revving up protons in the surrounding magnetic plasma and sling-ing them into lower-energy protons with such energy that high-energy gamma rays result from the collision. The yellow line depicts a high-energy proton flung into a lower-energy proton in a cloud of hydrogen gas. The green arrow represents the high-energy gamma ray that results from the collision. (Credit: Sarah Balaban) Balaban and colleagues wrote a paper on the findings published in the March issue of *Astronomical Journal*, a research publication. The Large Hadron Collider is expected to be able to accelerate protons to seven trillion electron-volts, a measure of energy. Our galaxy's black hole whips protons to up to 100 trillion electron-volts, according to the new study. That's all the more impressive because "Our black hole is pretty inactive compared to massive black holes sitting in other galaxies," Balaban said. A black hole is an object so tightly compressed that its own weight creates gravity that sucks in anything within a certain range, including light. Most galaxies are thought to harbor central, huge black holes dubbed supermassive black holes. Powerful, chaotic magnetic fields accelerate protons and other particles near our black hole to extremely high energies, Balaban's team argued. "Our galaxy's central supermassive object has been a constant source of surprise ever since its discovery some 30 years ago," said the University of Arizona's Fulvio Melia, a collaborator in the study. "Slightly but surely it has become the best studied and most compelling black hole in the universe. Now we're even finding that its apparent quietness over much of the [light] spectrum belies the real power it generates a mere breath above its event horizon—the point of no return—past which nothing can escape its grip. The Milky Way black hole is one of the most energetic particle accelerators in the galaxy, but it does this by proxy," Melia said. It catches a magnetized plasma, or electrically charged gas that's haplessly trapped within its clutches, into sling-ing protons to un-earthly speeds.

Courtesy University of Arizona and World Science staff

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