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## Shedding light on black holes

By Jim Erickson, Rocky Mountain News  
February 1, 2006

Now you can journey to the core of a voracious black hole without leaving Denver.

A new planetarium show produced by the Denver Museum of Nature & Science leads viewers into the immense black hole astronomers say is lurking at the center of our Milky Way galaxy.

The 23-minute production features the first scientifically accurate visualizations of black holes - images based on Albert Einstein's equations and hard observational data, researchers involved with the project said Tuesday.

"This is the closest I've ever gotten to a black hole or would ever want to get," said Sonoma State University astronomer Lynn Cominsky, who has been studying black holes for more than 30 years.

Cominsky and University of Colorado astrophysicist Andrew J.S. Hamilton are the program's science directors.

"This does represent the absolute best of our knowledge," Cominsky said after the show, narrated by actor Liam Neeson, was previewed for reporters. *Black Holes: The Other Side of Infinity* opens Feb. 10 at the museum's Gates Planetarium.

Perhaps the most arresting sequence of images in the new program shows a black hole forming after a red supergiant star explodes.

The scene begins with the fiery-orange sphere of the supergiant hovering above a blue gridwork meant to represent the fabric of space-time. Einstein predicted that a massive object's gravitational force can warp space-time and that the formation of a black hole can puncture it.

In *Black Holes*, the supergiant explosion creates a tornado-like vortex in the blue gridwork's surface.

As the viewer is drawn ever closer, the whirlpool becomes a raging river with hard-paddling kayakers. They struggle to avoid plunging over the edge of a Niagara-size waterfall.

But resistance proves futile, and the kayakers are swept into the black hole.

"How do we know it's right?" Hamilton said of the show's visualizations. "You follow the laws of physics, and in this case it's the laws of general relativity laid down by Einstein."

To create images for the digital planetarium's dome, the production team relied on the Black Hole Flight Simulator, a computer program devised by Hamilton during a yearlong sabbatical at the museum in 2001 and 2002.

The simulator was a follow-up to black hole visualizations Hamilton began in the 1990s.

Armed with Hamilton's software, computer graphics experts at the National Center for Supercomputing Applications in Illinois developed the show's eye-popping images.

The program takes viewers on a fast-paced search for black holes across deep space. Along the way, they glimpse the creation of the universe, the formation of the first stars, a collision between two galaxies, and a stellar explosion called a supernova.

The supernova visuals required 5,400 hours of supercomputer time, said Donna Cox, the show's producer and art director. The Illinois supercomputer center generated 750 gigabytes of digital imagery for *Black Holes*, said Cox, director of visualization there.



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Scientists believe black holes lie at the center of the Milky Way galaxy. A show, *Black Holes: The Other Side of Infinity*, leads viewers into the dark region of space. The show, produced by the Denver Museum of Nature & Science, opens Feb. 10 at the museum's Gates Planetarium.

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A black hole is an unimaginably dense object, with a gravitational field so strong that nothing - not even light - can escape its pull.

Because they can't be observed directly, black holes must be inferred from their effects on nearby matter. A recent flurry of black hole discoveries has nearly all astronomers convinced that the long-theorized objects truly exist, Cominsky said.

There are two types of black hole.

Stellar black holes form when a large, dying star explodes. The star's outer layers are blasted away, but its inner core can collapse into a black hole holding a few times the mass of the sun.

Our Milky Way galaxy probably holds millions of stellar black holes.

Supermassive black holes lurk in the center of galaxies. They can be millions - even billions - of times more massive than the sun and can shred neighboring stars that get too close.

## If you go

- **Where:** Denver Museum of Nature & Science, 2001 Colorado Blvd.
- **When:** Opens Feb. 10.
- **Tickets:** Adults, \$15 (all tickets include admission to museum); 18 and under, \$10; 65 and older, \$10. For museum members, planetarium show is \$5, \$4 for 18 and under and 65 and over.
- **For specific show times and to watch a trailer of the film, go to:** [www.dmns.org](http://www.dmns.org)



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