Black Holes May Fill the Universe with Seeds of Life

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The black hole at the center of the NGC 4051 galaxy emits a hot wind of chemical elements, including elements like carbon and oxygen that are critical for life. The hot wind originates very close to the black hole, at a distance about five times the size of Neptune's orbit. Although speedy, the wind is weaker than expected and ejects only 2 to 5 percent of accreting material. Credit: George Seitz/Adam Block/NOAO/AURA/NSF

New research shows that black holes are not the ultimate destroyers that are often portrayed in popular culture. Instead, warm gas escaping from the clutches of enormous black holes could be one source of the chemical elements that make life possible.

Immediately after the Big Bang, the universe contained only hydrogen and helium. Heavier chemical elements had to be cooked up inside the first stars, then scattered throughout space to be incorporated in next-generation stars and their planets. Black holes may have helped to distribute those elements across the cosmos.

Black holes are not all-consuming monsters. Until gas crosses the boundary known as the event horizon, it can still escape if it is heated sufficiently.

“One of the big questions in cosmology is how much influence massive black holes exert on their surroundings,” said co-author Martin Elvis of the Harvard-Smithsonian Center for Astrophysics (CfA). “This research helps answer that question.”

An international team of astronomers has found that hot winds from giant black holes in galactic centers may blow heavy elements like carbon and oxygen into the vast tracts of space between galaxies.

The team, led by Yair Krongold of the Universidad Nacional Autonoma de Mexico, studied the supermassive black hole at the center of the galaxy NGC 4051. They found that gas was escaping from much closer to the black hole than previously thought. The outflow source is located about 2,000 Schwarzschild radii from the black hole, or about five times the size of Neptune’s orbit. (The Schwarzschild radius is the black hole’s “point of no return” – about 4 million miles for the black hole in NGC 4051.)

The team could also determine the fraction of gas that was avoiding being swallowed. That fraction ended up being smaller than earlier studies suggested.

“We calculate that between 2 to 5 percent of the accreting material is flowing back out,” says team member Fabrizio Nicastro of the CfA.

Winds from black holes have been clocked at speeds of up to 4 million miles per hour. Over thousands of years, the chemical elements such as carbon and oxygen in those winds can travel immense distances, eventually becoming incorporated into the cosmic clouds of gas and dust, called nebulae, that will form new stars and planets.

This research, which used data from the European Space Agency’s XMM-Newton satellite, is being

reported in the April 20 issue of *The Astrophysical Journal*.

Source: Harvard-Smithsonian Center for Astrophysics