Black holes came first, astronomers conclude

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Courtesy National Radio Astronomy Observatory and World Science staff

Astronomers may have solved a cosmic chicken-and-egg problem—the question of which formed first in the early Universe, galaxies or the giant black holes found at their cores.

“It looks like the black holes came first. The evidence is piling up,” said Chris Carilli of the National Radio Astronomy Observatory in Charlottesville, Va.

Black holes are objects so compact that their gravitational pull grows strong enough to suck in everything nearby, including light. Most galaxies have at their centers enormous, or “supermassive,” black holes, whose gravity holds the stars in a galaxy together.

Carilli presented the new findings, from research done by a group studying conditions in the first billion years of the Universe’s history, at the American Astronomical Society’s meeting in Long Beach, California on Jan. 6.

Earlier studies of galaxies and their central black holes in the nearby Universe revealed an intriguing linkage between the masses of the black holes and of the central “bulges” of stars and gas in the galaxies. The black hole consistently weighs about one-thousandth of what the surrounding galactic bulge weighs.

The constancy of this relationship “indicates that the black hole and the bulge affect each others’ growth” as a galaxy forms, said Dominik Riechers of the California Institute of Technology, a member of the research team. “The big question has been whether one grows before the other or if they grow together.”

Scientists have been using the National Science Foundation’s Very Large Array radio telescope and the Plateau de Bure Interferometer in France to peer far back in the 13.7 billion-year history of the Universe, to the dawn of the first galaxies. An interferometer is an instrument that makes measurements of light waves based on patterns that arise when the waves merge, or interfere.

“We finally have been able to measure black-hole and bulge masses in several galaxies seen as they were in the first billion years after the Big Bang,” a sort of explosion believed to have given birth to our universe, said Fabian Walter of the Max-Planck Institute for Radioastronomy in Bonn. Observations of the distant universe reveal its state at some time in the past, since the light takes time to get here.

The evidence suggests that the thousand-to-one ratio seen nearby may “not hold in the early Universe. The black holes in these young galaxies are much more massive compared to the bulges than those seen in the nearby Universe,” Walter went on.

“The implication is that the black holes started growing first.”

The next challenge is to figure out how the black hole and the bulge affect each others’ growth. “We don’t know what mechanism is at work here, and why, at some point in the process, the ‘standard’ ratio between the masses is established,” Riechers said.

“To understand how the Universe got to be the way it is today, we must understand how the first stars and galaxies were formed when the Universe was young. With the new observatories we’ll have in the next few years, we’ll have the opportunity to learn important details from the era when the Universe was only a toddler compared to today’s adult,” Carilli said.

Image; An image of the galaxy M81 taken with the Hubble Space Telescope. The centers of most galaxies are dominated by giant black holes. Despite their names, the black holes appear as bright areas, be-cause of the fiery activity generated when they violently drag nearby stars and gas to ward themselves. Many galaxies also have a "bulge" of stars and gas dominating the central region. (Credit: NASA, ESA, Hubble Heritage Team (STScI AURA))