ASTROPHYSICIST HELPS CRACK A BLACK HOLE MYSTERY: ENERGY JETS

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With almost limitless gravitational power, black holes are supposed to gulp everything that comes near them, even weightless light photons.

So astronomers have long sought explanations for observations that black holes emit high-energy particles, often through visually impressive jets that unfurl from the black holes' poles in thick, tornado-like coils. Now, in a paper published in this month's edition of the Astrophysical Journal, a University of Florida researcher has bolstered and expanded a longtime theory about how and why these photons and electrons escape powerful gape of black holes, caused by the collapse of stars.

"My calculations may solve the mystery as to where the large number of high-energy observed electrons originate from," said Reva Kay Williams, a UF courtesy postdoctoral associate. "My calculations also help explain some of our observations, such as why many (black hole) jets are observed to be uneven, or one-sided."

Williams' research is the first to prove the Penrose mechanism, a 35-year-old theory named for its author, Oxford University mathematics and physics professor Roger Penrose. It also provides a new, physical explanation for the odd appearance of many of the jets, which some astronomers believe was merely the result of an optical illusion.

Fernando de Felice, a physicist at the University of Padova in Italy, said Williams' findings represent an important contribution to the field.

“Until recently, it was believed that the Penrose mechanism was not very efficient for generating energetic particles, but Dr. Williams’ detailed and perseverant work showed that this may not be true and, to the contrary, that it may be relevant to high-energy astrophysics,” he said.

Penrose’s theory says the rotational energy of a spinning black hole powers and lifts particles large distances away. Williams’ research, based in part on computer modeling, shows these particles appear to be created at the part of the hole where gravity is so powerful it bends light into a circle around the hole.

Her calculations also suggest the one-sided appearance of the jets is the result of the black holes’ gravitational dragging of space and time near their cores - not just, as some suggested, a consequence of the observer’s position relative to the jets. “The interest in Dr. Williams’ work is that it has enriched the possibilities of having energy output in active cosmic sources,” de Felice said.

Source: University of Florida