Research sheds new light on black holes

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(PhysOrg.com) -- The quantum phenomenon which is thought to cause black holes to leak energy and ultimately explode is more common than first thought according to Victoria University researchers.

Physicist Stephen Hawking famously discovered in 1973 that black holes are not entirely black. Instead, a subtle quantum effect results in them losing energy and particles into space, causing them to shrink and, over trillions of years, disappear. Until Hawking's discovery, black holes were considered to have such a strong gravitational field that nothing could escape.

Research led by Matt Visser, Professor of Mathematics at Victoria, has shed new light on the theory, known as Hawking Radiation, by calculating the conditions that would be needed for radiation leaks.

"We now believe there are a number of theoretically plausible objects in the universe that emit Hawking Radiation. It's more robust and more prevalent than scientists thought."

While Hawking's discovery is widely accepted in the scientific world, no observational astronomer has yet seen a black hole exploding. The final moments are thought to involve several hundred tonnes of matter converting itself to energy in 2 or 3 seconds, causing an explosion that would dwarf any nuclear weapon ever envisaged.

Professor Visser's research team, which includes colleagues in Spain and Italy, has also provided new information about what happens just before

a black hole disappears.

"It is the last few seconds we don't understand. Our work has helped us to probe that period more closely and we have produced calculations that work down to the last few millionths of a second.

"It sounds good from the outside and it has added significantly to our understanding of what happens right at the end. However, a lot of unanswered questions remain."

Scientific papers on the research findings have recently been published in the *Journal of High Energy Physics* and in *Physical Review D* (the American Physical Society journal of particles, fields, gravitation & cosmology).

Professor Visser says discovering that Hawking Radiation is a more frequent occurrence helps unravel some of the mysteries of the Universe, but is not a cause for alarm.

"We'd have to be incredibly unlucky for a small black hole to wander into our solar system just before it was due to explode. It's very very unlikely."

Another area of Professor Visser's research is analogue spacetimes which are ways of mimicking gravity using simpler physical systems. One example is modelling acoustic black holes using sound in a moving fluid.

A former student of Professor Visser's is setting up a laboratory in Trieste, Italy, where she hopes to construct an experiment using sound in moving fluid, to observe Hawking Radiation and test the various theories about how it works.

"We would love to have a direct experience of the Hawking effect but the most likely way we will see it is by using some kind of analogue model.

"Distance is not the issue, it's that there are lots of sources of radiation in the Universe and what's being emitted by a black hole, even at the end, would be dwarfed by other sources. The last few seconds of a black hole's existence would be impressive by human standards but not by cosmological ones."

Provided by Victoria University