Black holes not black after all

May 12 2008

International scientists have used flowing water to simulate a black hole, testing Stephen Hawking's theory that black holes are not black after all.

The researchers, led by Professor Ulf Leonhardt at the University of St Andrews and Dr Germain Rousseaux at the University of Nice, used a water channel to create analogues of black holes, simulating event horizons.

An event horizon is the place in the channel where the water begins to flow faster than the waves. The scientists sent waves against the current, varied the water speed and the wavelength, and filmed the waves with video cameras. Over several months the team painstakingly searched the videos for clues. They wanted to see whether the waves show signs of Stephen Hawking's famous prediction that the event horizon creates particles and anti-particles.

Professor Ulf Leonhardt, from the School of Physics and Astronomy, explained, "It is probably impossible to observe the Hawking radiation of black holes in space, but something like the radiation of black holes can be seen on Earth, even in something as simple as flowing water."

Black holes resemble cosmic drains where space disappears like water going down a plughole. Space seems to flow, and the closer one gets to the black hole, the faster it flows. At the event horizon space appears to reach the speed of light, so nothing, not even light, can escape beyond this point of no return.

The experiments were carried out at the Genimar laboratory near Nice which houses a 30-metre-long water channel with a powerful pump on one end and a wave machine on the other. The normal business of Genimar is testing the environmental impact of currents and waves on coasts or the hulls of French submarines, but the scientists turned the machinery to testing black holes.

The team demonstrated that something as simple and familiar as flowing water might contain clues of the mysterious and exotic physics of black holes. In a forthcoming paper in *New Journal of Physics*, the scientists report observed traces of "anti-waves" in their videos.

Professor Leonhardt continued, "Flowing water does not create anti-particles, but it may create anti-waves. Normal waves heave up and down in the direction they move, whereas anti-waves do the opposite.

"We definitely have observed these negative-frequency waves. These waves were tiny, but they were still significantly stronger than expected. However, our experiment does not completely agree with theory and so much work remains to be done to understand exactly what happens at the event horizon for water waves."

Source: University of St Andrews