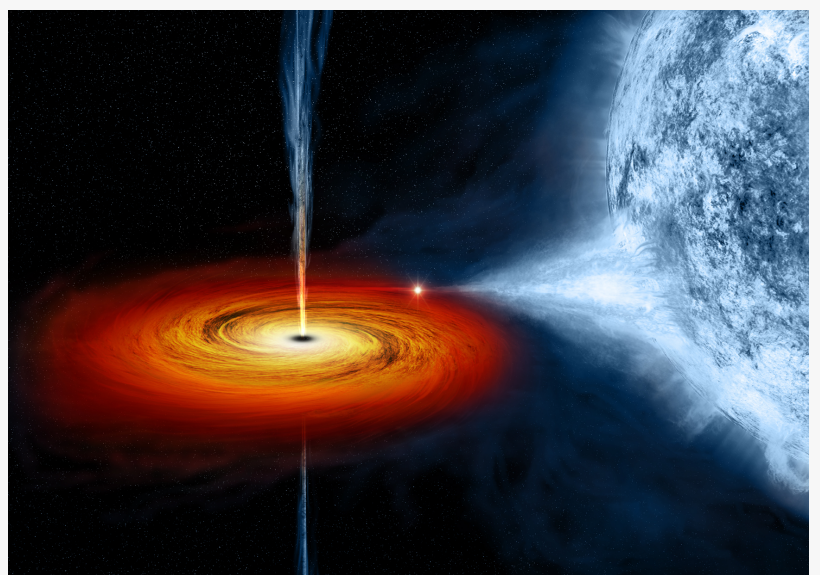


First Proof that “Plunging Regions” exist around Black Holes in Space

Einstein's theory of gravity in space proved for the first time by scientists at Oxford University Physics

OXFORD, UNITED KINGDOM, May 16, 2024 /EINPresswire.com/ -- Einstein has been proved correct with a key prediction about black holes, an international team led by researchers at [Oxford University Physics](#) has found. Using X-ray data to test a key prediction of Einstein's theory of gravity, their study, published today in the [Monthly Notices of the Royal Astronomical Society](#), gives the first observational proof that a “plunging-region” around black holes not only exists, but exerts some of the strongest gravitational forces yet identified in the galaxy.



Credit NASA/CXC/M.Weiss. The black hole pulls material from a companion star towards it, forming a disc that rotates around the black hole before falling into it

The new findings are part of wide-ranging investigations into outstanding mysteries around black holes by astrophysicists at Oxford University Physics. This study, “Continuum emission from within the plunging region of black hole discs”, focuses on smaller black holes relatively close to Earth, using X-ray data gathered from NASA's space-based NuSTAR and NICER telescopes. Later this year, a second Oxford team hopes to move closer to filming first movies of larger, more distant black holes as part of multi-million European initiative.

Unlike in Newton's theory in gravity, Einstein's theory states that sufficiently close to a black hole it is impossible for particles to safely follow circular orbits, instead they rapidly “plunge” toward the black hole at close to the speed of light – giving the plunging region its name. The Oxford study focused on this region in depth for the first-time, using X-ray data to gain better understanding of the force generated by black holes.

“This is the first look at how plasma, peeled from the outer edge of a star, undergoes its final fall into the centre of a black hole, a process happening in a system around ten thousand light years

“

Einstein predicted this final plunge, but for the first time we've demonstrated it. Think of a river turning into a waterfall. Hitherto, we've seen the river - this is first sight of the waterfall.”

Dr Andrew Mummery, Oxford University Physics

away,” said [Dr Andrew Mummery](#), of Oxford University Physics, who led the study*. “What’s really exciting is that there are many black holes in the galaxy, and we now have a powerful new technique for using them to study the strongest known gravitational fields.”

“Einstein’s theory predicted that this final plunge would exist, but this is the first time we’ve been able to demonstrate it happening,” Dr Mummery continued.

“Think of it like a river turning into a waterfall – hitherto, we have been looking at the river. This is our first sight of the waterfall.”

“We believe this represents an exciting new development in the study of black holes, allowing us to investigate this final area around them. Only then can we fully understand the gravitational force,” Mummery added. “This final plunge of plasma happens at the very edge of a black hole and shows matter responding to gravity in its strongest possible form.”

Astrophysicists have for some time been trying to understand what happens close to the black hole’s surface and do this by studying discs of material orbiting around them. There is a final region of spacetime, known as the plunging region, where it is impossible to stop a final descent into the black hole and the surrounding fluid is effectively doomed.

Debate between astrophysicists has been underway for many decades as to whether the so-called plunging region would be detectable. The Oxford team has spent the last couple of years developing models for it and, in the study just published, demonstrate its first confirmed detection found using X-ray telescopes and data from the international space station.

Whilst this study focuses on small black holes closer to Earth, a second study team from Oxford University Physics is part of a European initiative to build a new telescope, The Africa Millimetre Telescope, which would be hugely enhance our ability to make direct images of black holes. Over Euro 10 million funding has already been secured, part of which will support several first PhDs in astrophysics for The University of Namibia, working closely with the Oxford Physics University team.

The new telescope is expected to enable observation, and filming, for the first time of large black holes at the centre of our own galaxy, as well as far beyond. As with the small black holes, large black holes are expected to have a so-called “event horizon”, dragging material from space toward their centre in a spiral as the black hole rotates. These represent almost unimaginable sources of energy and the team hope to observe – and film - them rotating for the first time.

About Oxford University Physics

Oxford University Physics is one of the largest physics departments in the world, top-ranked in the UK and among the lead research universities globally in all key areas of physics. Its mission is to apply the transformative power of physics to the foremost scientific problems and educate the next generation of physicists as well as to promote innovation and public engagement with physics.

Oxford University Physics leads ground-breaking scientific research across a wide spectrum of challenges: from quantum computing, quantum materials and quantum matter to space missions and observation; from climate science to the development of next-generation technologies for renewable energy; and from designing experiments to understand the nature of existence to revolutionising medicine and healthcare through biophysics.

Oxford University Physics has spun out 18 companies since launching the University's first commercial venture in 1959 and works with enterprise across most areas of its leading scientific research.

About Oxford University

Oxford University has been placed number 1 in the Times Higher Education World University Rankings for the eighth year running, and number 3 in the QS World Rankings 2024. At the heart of this success are the twin-pillars of our ground-breaking research and innovation and our distinctive educational offer.

Oxford is world-famous for research and teaching excellence and home to some of the most talented people from across the globe. Our work helps the lives of millions, solving real-world problems through a huge network of partnerships and collaborations. The breadth and interdisciplinary nature of our research alongside our personalised approach to teaching sparks imaginative and inventive insights and solutions.

Through its research commercialisation arm, Oxford University Innovation, Oxford is the highest university patent filer in the UK and is ranked first in the UK for university spinouts.

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