Relativity of rotational motion confirmed

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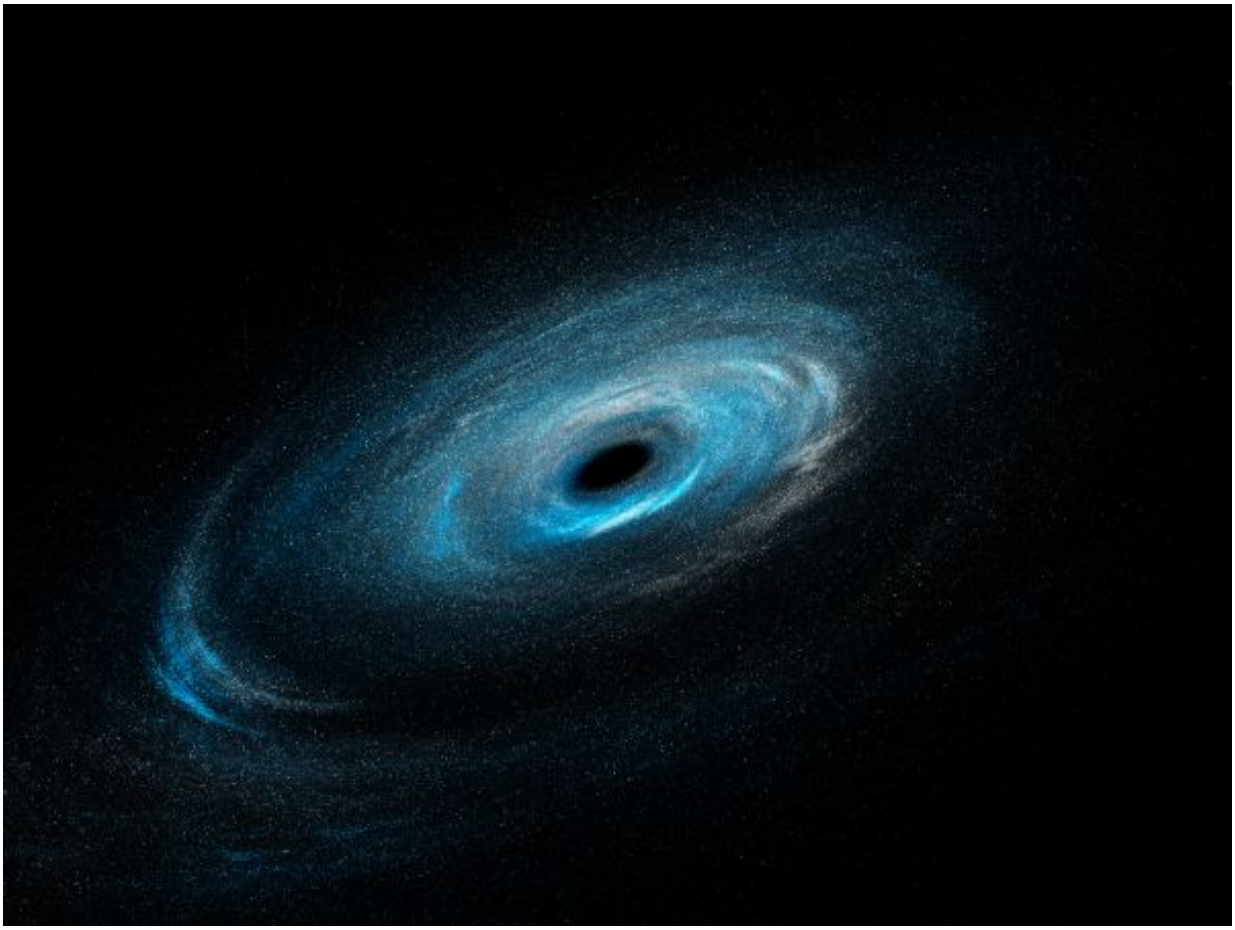

Einstein's relativity theory also applies to rotational motion. Credit: sakkmesterke / Fotolia

It has been one hundred years since the publication of Einstein's general theory of relativity in May 1916. In a paper recently published in *EPJ*

Plus, Norwegian physicist Øyvind Grøn from the Oslo and Akershus University College of Applied Sciences and his co-author Torkild Jemterud demonstrate that the rotational motion in the universe is also subject to the theory of relativity.

Imagine a person at the North pole who doesn't believe the Earth rotates. As she holds a pendulum and can observe the stars in her telescope, she remarks that the swinging plane of the pendulum and the stars rotate together. Newton, who saw the world as a classical physicist, would have pointed out that it is the Earth that rotates. However, if we assume the general principle of relativity is valid, the Earth can be considered as being at rest while the swinging plane of the pendulum and the night sky are rotating.

In fact, the rotating mass of the observable part of the universe causes the river of space—which is made up of free particles following the universe's expansion—to rotate together with the stars in the sky. And the swinging plane of the pendulum moves together with the river of space.

Until now, no-one has considered a possible connection between the general principle of relativity and the amount of dark energy in the universe, which is associated with the acceleration of the expansion of the universe, discovered in 1998. This connection can be established, Grøn argues, by using the phenomenon of inertial dragging.

When formalised in mathematical terms, the condition for inertial dragging yields an equation for calculating the amount of dark energy. The solution of that equation is that 73.7 % of the present content of the universe is in the form of dark energy. This prediction, derived from the theory of general relativity, is remarkably close to the values arrived at by different types of observations.

More information: Øyvind Grøn et al. An interesting consequence of the general principle of relativity, *The European Physical Journal Plus* (2016). DOI: 10.1140/epjp/i2016-16091-9 , dx.doi.org/10.1140/epjp/i2016-16091-9

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