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ORIGINAL ARTICLE

Seeable universe and its accelerated expansion: an observational test

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Abstract From the equivalence principle, one gets the strength of the gravitational effect of a mass M on the metric at position r from it. It is proportional to the dimensionless parameter $\beta^2 = 2GM/rc^2$, which normally is $\ll 1$. Here G is the gravitational constant, M the mass of the gravitating body, r the position of the metric from the gravitating body and c the speed of light. The seeable universe is the sphere, with center at the observer, having a size such that it shall contain all light emitted within it. For this to occur one can impose that the gravitational effect on the velocity of light at r is zero for the radial component, and non zero for the tangential one. Light is then trapped. The condition is given by the equality $R_g = 2GM/c^2$, where R_g represents the radius of the *seeable* universe. It is the gravitational radius of the mass M. The result has been presented elsewhere as the condition for the universe to be treated as a black hole. According to present observations, for the case of our universe taken as flat ($k = 0$), and the equation of state as $p = -\rho c^2$, we prove here from the Einstein's cosmological equations that the universe is expanding in an accelerated way as t^2, a constant acceleration as has been observed. This implies that the gravitational radius of the universe (at the event horizon) expands as t^2. Taking c as constant, observing the galaxies deep in space this means deep in time as ct, linear. Then, far away galaxies from the observer that we see today will disappear in time as they get out of the distance ct that is $< R_g$. The accelerated expanding vacuum will drag them out of sight. This may be a valid test for the present ideas in cosmology. Previous calculations are here halved by our results.

Keywords Cosmology · Gravitation · Black holes · Universe · Gravitational radius

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1 Introduction

In 1962 Ney asked himself *How large must a universe be in order that it shall contain light emitted within it?* If we change the wording *how large* by *how strong the gravity field must be* and the word *universe* by the word *object*, then we have the history of *black holes* as follows: first known consideration of light not being able to escape from such an object (not a universe) was given by Michell in 1784. Eleven years later Laplace (1795) addressed the same question. After the publication of Einstein's general relativity Schwarzschild published in 1916 a solution to general relativity advancing his well known radius (later referred as the gravitational radius of a mass M, $R_g = 2GM/c^2$). About 50 years later it was recognized that black holes were predicted by general relativity. Was Wheeler the known author of the name *black hole* in 1967, referring to the *continuous gravitational collapse* of an over-compact mass. It is evident that the first author to treat our universe as a black hole, five years before this name was used, was Ney (1962). It is not necessary to think of a black hole as an over-compact mass. One can have a black hole with any mass, as long as it also has the right size. The biggest mass that one can consider is the mass of the *seeable* universe: a universe that contains all light emitted within it. Usually the word *visible* universe