The collapse of the event horizon in the de sitter universe

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In this article reviews the evolution of the future of the Universe with a cosmological constant. When restricting the event horizon of the Universe, there exists a nonzero temperature of the Hawking. This effect leads to the reduction of the cosmological event horizon after a stage of expansion of the Universe with constant density of dark energy. Time compression in this Universe is determined only cosmological constant.

1.The cosmological event horizon standard ΛCDM model.

Given the fact that our real universe is expanding with accelerated motion in the plane Euclidean geometry arises end of the cosmological horizon. This is due to the fact that the visible universe is limited to the event horizon, which is extended over time according to the law:

$$\rho_c = \frac{3H^2}{8\pi G} \ ,$$

$$1 = \Omega_m + \Omega_k + \Omega_\Lambda,$$

$\Omega_m=8\pi G\rho/3H^2$, $\Omega_k = -(kc^2)/(a^2H^2)$, $\Omega_\Lambda=(\Lambda c^2)/(3H^2)$ – the sum of the density of baryonic matter, dark matter and dark energy provide critical density at flat Universe.

The event horizon define through the coefficient of Hubble:

$$r_g = \frac{c}{H}$$

As you can see from this relation, the event horizon of the Universe will increase over time, the reduction of critical density. If the current density of dark energy in the future will not change, the evolution of the Universe gradually begin more and more to match the de sitter model. In this case, the radius of the event horizon, over time, will tend to limit the constant value. All that is beyond the horizon, not available for monitoring, because the speed of light is the limit for any interactions. The object is located in the centre of the observable universe, does not interact with anything beyond the horizon.
In the very distant future all light sources located outside the gravitational related Local group of galaxies (which includes our milky Way), will be beyond this horizon and will become invisible.

2. Hawking radiation at cosmological event horizon.

In the quantum field theory of physical vacuum is filled with constantly emerging and disappearing fluctuations of different fields (you can also say «virtual particles»). In the field of external forces, the dynamics of these fluctuations is changing, and if the forces are large enough, right out of the vacuum can give birth to a pair of particle-antiparticle. Such processes are taking place near but outside the event horizon of a black hole. It is possible case, when the total energy of antiparticles is negative, and the total energy of the particle - positive. Falling into a black hole, the antiparticle reduces its full rest energy, and hence the mass, while the particle is able to fly away into infinity. For remote observer it looks like radiation of a black hole. Radiation near the event horizon of a black hole, you can map a certain temperature.

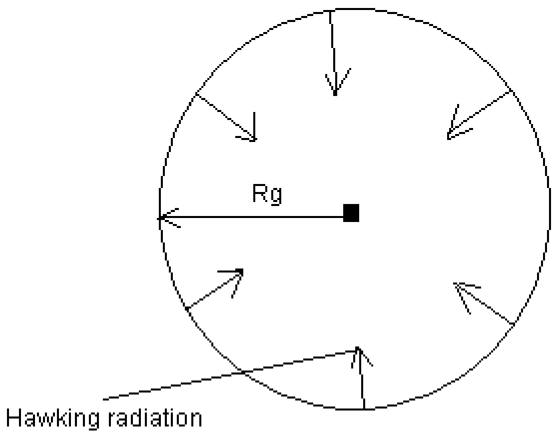
$$T_{BH} = \frac{\hbar c^3}{8\pi k GM},$$

Thus not only the spectrum of radiation, but the more subtle, its characteristics are the same as blackbody radiation. Developing the theory, you can build and complete the thermodynamics of black holes.

The presence of an event horizon for the Universe implies the temperature Hawking, which is defined through the gravitational radius of the horizon or the ratio of Hubble:

$$\mathrm{T} = \frac{c\ \hbar}{4\pi k\ r_g} = \frac{\hbar\ H}{4\pi k}$$

H – коэффициент Хаббла.



For an observer located in the center of the sphere of the event horizon of the Universe, too, will have the final temperature, i.e. Hawking radiation will go with the boundaries of the visible Universe. If the ratio of the Hubble will reach to the value of the cosmological constant wavelengths do i.e. the density of the visible and dark matter many times decrease, the temperature of the Hawking at cosmological horizon reaches finite nonzero values. This means that over time , within the scope of the event horizon of the Universe will accumulate energy in the form of Hawking radiation by the formula:

$$J = \sigma T^4$$

$$\frac{dE}{dt} = \frac{\hbar\, c^2}{3840\pi r_g^2} = \frac{\hbar\, H^2}{3840\pi}$$

From the point of view of an observer in the center of the sphere of the event horizon of the Universe with constant dark energy, the average density of Hawking radiation will grow. The universe will begin to shrink back

$$\frac{d(\rho V)}{dt} = \frac{d\rho}{dt}V + \rho\frac{dV}{dt} = \frac{3d(H^2)}{8\pi G\ dt}\left(\frac{4\pi}{3}r_g^3\right) + \frac{3H^2}{8\pi G}\frac{d}{dt}\left(\frac{4\pi}{3}r_g^3\right)$$

$$r_g = \frac{c}{H} \qquad\qquad \frac{dM}{dt} = \frac{d(\rho V)}{dt} = \frac{c^2}{2G}\frac{dr_g}{dt}$$

$\frac{dE}{dt} + c^2\frac{dM}{dt} = 0 -$ the balance of energy in the Universe (lone observer with dark energy) at the Hawking radiation with energy

Then the speed of the compression of the event horizon for the future of the Universe is:

$$\frac{dr_g}{dt} = -\frac{G\hbar}{960\pi c^2 r_g^2}$$

Compression of the Universe since the disappearance of visible and dark matter in the existence of a cosmological constant and unchanging lone observer will occur due to Hawking radiation from the cosmological event horizon. This radiation energy will be accumulated on further reduction of event horizon that will lead to the fact that the universe will again be compressed and heated to the super-dense state for some time

$$\tau = \frac{2880\pi c^2}{G\hbar\left(\frac{\Lambda}{3}\right)^{\frac{3}{2}}} \cong 10^{159}\ sec$$

As you can see, the calculations have given great importance of the time by which the universe will begin their compression up reverse dense state in the centre of which was almost eternal observer.
If you notice, that according to the final formula of the Universe compressed stop when the size of the event horizon is comparable to the Planck length, when the speed of the compression of the event horizon is equal to or slightly exceeded the speed of light, in this case, the event horizon of the Universe as a region of space-time defined by the finite speed of light disappears.

$$\frac{G\hbar}{960\pi c^2 r_g^2} \geq \mathrm{c}$$

This means you get a super-dense state compressed Universe to Planck size than not constrained by the disappearance of the event horizon. Pressure and temperature are doing a tremendous job with the expansion of the Universe, which basically gives the Big Bang.