The heat death of the universe

Life, Death

The hypothesis about heat death of the universe Our knowledge of the universe is still negligible, and we can not confidently assert that the universe is not under the influence of external forces, or may be considered as a thermodynamic system. However, it is the concept of heat death was the first step to realize the possible finiteness of the Universe, although we do not know when and on what scenario will happen of its destruction. At the present stage of existence (13. 72 billion years), the universe radiates as a black body with a temperature of 2, 725 K. Its maximum to the frequency 160. GHz (microwave radiation), which corresponds to a wavelength of 1. 9 mm. It is isotropic up to 0, 001% - the standard deviation of temperature is approximately 18 IWC. The heat death is a possible final thermodynamic state of the universe, in which it has " run down" to a state of no thermodynamic free energy to sustain motion or life. In physical terms, it has reached maximum entropy. The hypothesis of a universal heat death stems from the 1850s ideas of William Thomson, 1st Baron Kelvin who extrapolated the theory of heat views of mechanical energy loss in nature, as embodied in the first two laws of thermodynamics, to universal operation.

The idea of heat death of the universe derives from discussion of the application of the first two laws of thermodynamics to universal processes. Specifically, in 1851 William Thomson outlined the view, as based on recent experiments on the dynamical theory of heat, that " heat is not a substance, but a dynamical form of mechanical effect, we perceive that there must be an equivalence between mechanical work and heat, as between cause and effect. [1] In 1852, Thomson published his " On a Universal Tendency in Nature to the Dissipation of Mechanical Energy" in which he outlined the rudiments of the second law of thermodynamics summarized by the view that mechanical motion and the energy used to create that motion will tend to dissipate or run down, naturally. [2] The ideas in this paper, in relation to their application to the age of the sun and the dynamics of the universal operation, attracted the likes of William Rankine and Hermann von Helmholtz.

The three of them were said to have exchanged ideas on this subject. [3] In 1862, Thomson published " On the age of the sun’s heat", an article in which he reiterated his fundamental beliefs in the indestructibility of energy (the first law) and the universal dissipation of energy (the second law), leading to diffusion of heat, cessation of motion, and exhaustion of potential energy through the material universe while clarifying his view of the consequences for the universe as a whole.

In a key paragraph, Thomson wrote: The result would inevitably be a state of universal rest and death, if the universe were finite and left to obey existing laws. But it is impossible to conceive a limit to the extent of matter in the universe; and thereforesciencepoints rather to an endless progress, through an endless space, of action involving the transformation of potential energy into palpable motion and hence into heat, than to a single finite mechanism, running down like a clock, and stopping forever. 4] Boltzmann, open the connection of entropy S and the statistical weight of P, considered that the current state of the universe is homogeneous grand fluctuation *, although its appearance has a negligible probability. [5] In a " heat death", the temperature of the entire universe would be very close to absolute zero. Heat death is, however, not quite the same as " cold death", or the " Big

Freeze", in which the universe simply becomes too cold to sustain life due to continued expansion; though, from the point of view of anything that might be alive, the result is quite similar. 6]. Inflationary cosmology suggests that in the early universe, before cosmic expansion, energy was uniformly distributed,[7] and thus the universe was in a state superficially similar to heat death. However, the two states are in fact very different: in the early universe, gravity was a very important force, and in a gravitational system, if energy is uniformly distributed, entropy is quite low, compared to a state in which most matter has collapsed into black holes.

Thus, such a state is not in thermal equilibrium, and in fact there is no thermal equilibrium for such a system, as it is thermodynamically unstable.[8][9] However, in the heat death scenario, the energy density is so low that the system can be thought of as non-gravitational, such that a state in which energy is uniformly distributed is a thermal equilibrium state, i. e. , the state of maximal entropy. The final state of the universe depends on the assumptions made about its ultimate fate, and these assumptions have varied considerably over the late 20th century and early 21st century.

In a " closed" universe that undergoes recollapse, a heat death is expected to occur, with the universe approaching arbitrarily high temperature and maximal entropy as the end of the collapse approaches. [citation needed] In an " open" or " flat" universe that continues expanding indefinitely, a heat death is also expected to occur[citation needed], with the universe cooling to approach absolute zero temperature and approaching a state of maximal entropy over a very long time period.

There is dispute over whether or not an expanding universe can approach maximal entropy; it has been proposed that in an expanding universe, the value of maximum entropy increases faster than the universe gains entropy, causing the universe to move progressively further away from heat death. However, current analysis of entropy suggests that the visible universe has more entropy than previously thought. This is because the research concludes that supermassive black holes are the largest contributor. 10] From the Big Bang through the present day and well into the future, matter and dark matter in the universe is concentrated in stars, galaxies, and galaxy clusters. Therefore, the universe is not in thermodynamic equilibrium and objects can do physical work. [11]. The decay time of a roughly galaxy-mass (1011 solar masses) supermassive black hole due to Hawking radiation is on the order of 10100 years,[12], so entropy can be produced until at least that time. After that time, the universe enters the so-called dark era, and is expected to consist chiefly of a dilute gas of photons and leptons. [11].

With only very diffuse matter remaining, activity in the universe will have tailed off dramatically, with very low energy levels and very large time scales. Speculatively, it is possible that the Universe may enter a second inflationary epoch, or, assuming that the current vacuum state is a false vacuum, the vacuum may decay into a lower-energy state. [11]. It is also possible that entropy production will cease and the universe will achieve heat death. [11].