Redefining ‘system’ and ‘entropy’ in physical terms

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Abstract:

In this paper, I propose that any independent physical system is closed and isolated, and that the system as well as its subsystems has entropy. An increase in entropy of the system causes a decrease in entropy of its subsystems. So ‘normal entropy’ is the preferred state of a static system. A dynamic system, however, oscillates between high and low entropy states. The proposed concept limits ‘the role of second law of thermodynamics’, and predicts ‘a pulsating model’ for the universe, and ‘a reversible low-entropy state’ for black holes.

Key words: Independent system, Entropy, Second law of thermodynamics, pulsating universe, black holes

1. Introduction:

The terms ‘system’ and ‘entropy’ are frequently used in physics. But both lack clear physical meaning. As pointed out in my previous paper [1], definitions derived from mathematical laws often have no physical meanings, and hence should be restated. The redefining is based on the classical concepts that bodies made up of matter move in absolute space, and interact with each other using forces; so the explanations based on quantum mechanics and relativity theories of Einstein are completely ignored.

2. Physical systems:

A physical system can be defined as a collection of bodies held together by interactions. The absence of either ‘more than one body’ or ‘interaction’ will make it a non-system. For interaction, the bodies should have energy and force. Energy keeps them as separate bodies and force holds them together as a system. A physical system occupies a finite region in space, contains a finite number of bodies and can be either open or closed.

An independent physical system will not interact with other systems. Non-interaction means the system has no external energy or field. The energy and field remains with the bodies in it. Such a system should be stable and so should be in a state of equilibrium. So an independent system can be defined as follows:

> “*An independent physical system is a ‘collection of interacting bodies’ remaining in equilibrium; it is closed, isolated, and stable; it occupies a finite region of space, contains a finite number of bodies and has no external energy or field.*”

For static equilibrium, a minimum of two independent forces are required in addition to energy. However, with a single force and energy, dynamic equilibrium can be attained, if each body in the system is invariably a subsystem containing smaller bodies. The internal and external energies of these subsystems can interchange alternately keeping the system in equilibrium. An open system can exist only as a part of some independent system, and will be affected by what happens in the parent system.

3. Entropy:

Entropy is at present defined as a state function of a system. Being a mathematical function, entropy has no clear physical meaning, and the term 'measure of disorder' is used as an approximate statement for entropy. The most disordered state of a system will be when the individual units of it have maximum external energy, and the most ordered state, when these have minimum external energy. Based on this, entropy can be redefined as follows:

"*Entropy of a system is the measure of the external energies of bodies in it.*"

The above definition gives a clear physical meaning to entropy. A system as well as its subsystems has entropy. The entropy of a static isolated system remains constant. However, the entropy of a dynamic system remains changing. The only possible way the entropy of an independent system increases with time is that initially much of the energy remains as internal energy of the subsystems, and gradually this energy changes into their speeds. So, when the entropy of an independent system increases, the entropies of its subsystems decrease. But at present, the relation between these two entropies is ignored.

When the internal and external energies of the subsystems remain balanced, the system is in a state of normal entropy. However, it is impossible to remain in such a static state, if there is only one force. In such cases, the system oscillates between high and low entropy states. This creates two distinct phases in an independent dynamic system: one of increasing entropy and the other, of decreasing entropy. In the former phase, the entropies of the subsystems at all sub-levels decrease, and in the latter, their entropies increase.

4. Second law of thermodynamics:

The new concept limits the role of the second law. The increase in entropy of a system is due to the increase in speed of the constituents. For example, if the internal energy of the reactants is released in a chemical reaction, it is acquired by the products as kinetic energy, thus increasing the entropy of that system. A similar process can be expected of stars: the energy released in stars leads to an increase in its speed, increasing the entropy of the galaxy. The emission of radiations in these cases is just a side effect indicating that the existing phase is one of increasing entropy. In an isolated system, these radiations cannot escape, and will be reabsorbed in the phase of decreasing entropy. Thus, the second law of thermodynamics cannot say anything about entropy or the dispersed energy. So it gets reduced to a simple statement: Cooling of a hot body is spontaneous, whereas getting heated is a forced action.

5. **Pulsating universe:**

The new concept predicts a pulsating universe. The universe contains moving bodies held together by gravity. So it is a system, and hence finite. The galaxy-clusters themselves are systems, and so a system having galaxy-clusters as the individual units can be an independent system. If a system of galaxy-clusters is still an open system, it will be part of a larger closed system, or that larger system will be the universe for us. Thus, logically the universe should be an isolated system having no external energy or field, and with only a single force (gravity), it will be in a state of dynamic equilibrium.

A dynamic equilibrium creates two phases, a phase of increasing entropy and a phase of decreasing entropy. The observed dispersal of energy suggests that the entropy of the universe is now increasing. That means the speeds of the principal subsystems in it is increasing, and naturally this causes expansion. So the other phase will be a contracting phase, where the internal energies of the subsystems increase.

Thus the universe remains pulsating, the principal subsystems moving away and returning back alternately. However, to validate this, a proper theoretical model [2] of the universe is required. In that model, the universe should have no external field and the principal subsystems should have the energy required to move at very high speeds.

6. **Black holes:**

The new concept predicts that black holes have low-entropy potential states. The dynamic equilibrium of the universe causes changes in the bodies; in one phase, this forces the bodies into potential states having low entropy, and in the other phase, forces them into potential states having high entropy. We are familiar with the high entropy state of bodies – hot stars having high internal energy and emitting radiations. So the low entropy state will be one having low internal energy and absorbing all radiations – naturally, black holes.

The low internal energy of a black hole suggests that its external energy or speed will be high. So the masses at the centers of galaxies will be the first to become black holes, as these would be moving faster than stars. The low entropy state is a reversible potential state, the intensity of which can decrease spontaneously. Or, the formation of black holes is not an irreversible process, and does not lead to any singularity. However, to validate this, a clear theoretical model [3] is required.

7. Conclusion:

I have shown that ‘system’ and ‘entropy’ can be redefined physically so as to give these terms clear physical meanings. The new definitions limit the role of second law of thermodynamics, thus removing the suspicion that the law may be violated sometimes. The new definitions resolve the problem of non-predictability of what happens to the universe in future by predicting a pulsating model, and eliminate the dilemma of singularity by predicting reversible low-entropy potential states for black holes. However, as mentioned in the paper, the predicted structures require further theoretical validation.

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[1]. Jose P Koshy, *Physical reality and the mathematical laws – a new philosophical approach,* **viXra: 1311.0118** (history and philosophy of physics)

[2]. A paper proposing a ‘*three dimensional structure*’ of the ‘*pulsating universe*’ having ‘*no external field*’, and where the ‘*speed and limit of expansion*’ are decided by ‘*speed of light*’ will be posted subsequently in viXra.org

[3]. A paper titled “*Black holes have cold energy*” will soon be posted in viXra.org as the next paper in this series.