

## The Problem of Universal Recurrence with respect to the 2. Law of Thermodynamics

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The most serious objection to any physical model promoting universal recurrence of space-time events, is that which follows from the 2. Law of thermodynamics.

### **Definition**

The entropy of a system can be defined as a measure of its order or randomness. The higher it's randomness, the higher is its entropy. For a given set of external conditions (energy, volume etc.), the entropy of the system will be confined between a lower and an upper limit. At the upper limit the system cannot become more random.

The entropy is a so called state function. This means that it depends only on the state of the system, and not on the way it has reached this state.

### **2. Law of thermodynamics**

The entropy of any closed system, i.e. a system that doesn't exchange energy with it's surroundings, is either constant or increasing in time. If irreversible processes take place in the system, the entropy is increasing, and this increase will continue until the system has reached a state of equilibrium.

### **Consequence**

If the universe is closed, it's ultimate faith will be a state of equilibrium at which all dynamics including Life will have ceased (The heat death).

For universal recurrence to be possible, there thus has to be (negentropic) processes which reduce the entropy so as to bring it back to it's original value. Notice that the critical issue is to bring the system (Universe) back just once. If it can be brought back once, then obviously it can be brought back indefinitely. Another important point is, that with respect to the 2nd law, the impossibility is that of universal recurrence, because the Universe is taken to be closed. The 2nd law does not in principle rule out recurrence of the history of an open system as the Earth. In other words, the problem lies in that of universal recurrence, not eternal recurrence.

The earth is an open system which receives high frequency radiation from the sun and emits low frequency radiation to its surroundings. The earth acts like a heat engine receiving heat from a high temperature reservoir and delivering heat to a cold temperature reservoir. The work done by this engine includes winds and currents (mechanical energy) and a part of the solar radiation is converted into chemical energy in the process of photosynthesis. The net result of these irreversible processes is an entropy increase of the surroundings. We are continuously heating up the universe. Looking at the universe as a whole, the stars, including the sun, can be seen as driving all the dynamics around us.

According to present day theories, the sun like any other star is an extremely hot (million degrees) plasma performing a thermonuclear burn, the energy of which is converted into e.m. radiation, not unlike that of any glowing body (hot iron). This burn can only go on for a finite time, as there is only a finite amount of fusible matter in the sun. In an eternal universe with universal recurrence in 5000 years, we must require an eternal sun with a fairly constant entropy, which again means that negentropic processes of replenishing the sun have to take place, which the 2nd law prohibits. Thus the the whole problem about the 2nd law is basically that of explaining how the sun can be eternal.