The final state of a thermodynamical system

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Abstract

The maximium of the entropy S is the final state of a thermodynamical system. This is the second postulate of thermodynamics. The entropy is the measurement of the disorder of a thermodynamical system. The temprature T is becoming a minimum at the final state of a thermodynamical process.
There are existing systems which are not following the second postulate of thermodynamics, if we take closer look. For example superconductivity and ferromagnetism. In this paper we are discussing such cases and we postulate a new law of thermodynamics.

1 Introduction

The entropy is coventionally defiined as:

$$S = -k \log_2 \Omega. \tag{1}$$

Herein $k = 1.602\dot{1}0^{-19} \frac{J}{K}$ is the Boltzmann constant and Ω is representing the states of the system.
For the matter of simplyfication we consider a box with two atoms H, He which are separated by a wall into left side of the box and one in the right side are representing one state, $\Omega = 1$. Its entropy is:

$$S = -k \log_2 1 = 0. \tag{2}$$

This state is the maximum of two particles in a box. If we remove the wall the system has four different states: Both atoms in the former right side of the box; both atoms in the former left part of the box; H in the right part and He in the left part and vice versa. The entropy is:

$$S = -k(\log 1 + \log 1 + \log 1 + \log 1) = 0. \tag{3}$$

The entropy hasn't changed.
The entropy is defined with a minus sign to indicate that 0 is the maximum. For example we consider an atomic ferromagnet made of two spins and are measuring the orientation four times, since two spins combined use to have the space of four possible formations. A ferromangnet results in every measurement $\uparrow\uparrow$ where we have conventionally have been oriented 'up' conventionally:

$$S = -k \log 4 = -2k \tag{4}$$

Ω is 4 because we have four possibilitiies as a result of measurement: $\uparrow\uparrow$, $\downarrow\downarrow$, $\uparrow\downarrow$ and $\downarrow\uparrow$. Our small ferromagnet has as result four times $\uparrow\uparrow$.
The fundamental thermodynamical system of equations is:

$$dU = TdS - pdV + \mu dN \tag{5}$$

$$SdT - VdP + Nd\mu \quad = 0 \tag{6}$$

We can write the systen of equations as one equation:

$$dU = TdS - pdV + \mu dN \tag{7}$$

In order to critisize the second postulate of thermodynamics, we are interested in a system where $dV = 0$, $dN = 0$. Thus the equation to understand is:

$$dU = TdS + SdT \tag{8}$$

The entropy is defined with a minus sign because maximal disorder is the goal of a thermodynamical system and this value is $S = 0$. Our Ferrmognat has therefore the value of $-2S$ We have omitted the Boltzmann constant for simplicating the consideration.

2 Order vs. Disorder

The entropy of a two particle system each having a spin of value 1/2 above the ferromagnetic transition temperature T_c is zero. At the transition temperature we assume that a first order phase transition takes place and the entropy falling below zero and has fianlly the value $S = -2$ (we omit for the matter of simplification the Boltzmann constant.).
Since the final state has now a value of energy smaller than zero, i.e. $U_2 - U_1 < 0$. The temperature is larger than zero, since the entropy change is negative too, i.e. $dS = -2$
A change of energy towards negativity means that the final state in the scenario above is more stable than the original state. Smaller temperture

means that the resulting thermodynamical state is economically better than the original state.
The larger the change of the entropy at the transition temperature is the smaller the transition temperature.
The new postulate two of thermodynamics states: The Universe is trending towards maximal order. This means any closed thermodynamical system is tending towards the smallest possible temperature:

$$dU = TdS \tag{9}$$

$$T- > min. \tag{10}$$

$T- > min$ is equivalently means that $dU- > min$ and $dS- > max$, since

$$T = \frac{\partial U}{\partial S} \tag{11}$$

3 Discussion of the key quantity of thermodynamics, the temperature T

The temperature of a thermodynamical system is given by:

$$T(S) = \frac{\partial U}{\partial S} \equiv \frac{U_2 - U_1}{S_2 - S_1}. \tag{12}$$

What is known is that $U_2 - U_1$ is negative for our system since U_2 is the energy the Curie temperature and smaller because the ferromagnetization is more stable and is maximal ordered into the upper orientation . The change of entropy is $S_2 - S_1 = -2$ when the system has lower energy whuich is the final state.
What I proposed here is that the second postualte is not telling us that the Universe is tending to lower temperature in a thermodynamically closed system.
All physical systems are tending to minimize the inner energy U and maximize the entropy change. The final state of a thermodynamical system is maximal order like for example the small two spin ferromagnet.