Black hole entropy leads to a quantized space-time

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Abstract

Based on Prof. Bekenstein and Prof. Hawking, the black hole maximal entropy[1], the maximum amount of information that a black hole can conceal, beyond its event horizon, is proportional to the area of its event horizon surface divided by quantized area units, in the scale of Planck area (the square of Planck length). This is a surprising result since it limits the amount of information bits in a volume of space to the amount of Planck area units that can fit into its surrounding surface area. Taking this information limit from the event horizon of a black hole to the event horizon of a sphere in the size of Planck length in each of its three dimensions, will open up a new approach to our space -time structure.

Introduction

The Hawking Bekenstein equation of black hole entropy, limits the amount of the entropy in the volume of space within the event horizon to be proportional to the area of the event horizon divided by Planck's area (the square of Planck's length). Since any volume of space will contain less information than a black hole, the information in a sphere is limited by its surrounding surface divided by Planck area units. This means that a three-dimensional sphere of space is the radius size of Planck length can contain only one bit of information since its surface area is in the size of one Planck area.

Equation 1: $S \approx \frac{A}{{l_p}^2}$

S – The amount of information bits in a sphere of space, A – the area of its surrounding surface, ${l_p}^2$ – Planck area (information unit area).

Equation 2: $S_P \approx \frac{A_P}{{l_P}^2} \approx \frac{{l_P}^2}{{l_P}^2} = 1$

S_P – The amount of information bits in a sphere of space with a radius of Planck length, A_P – the area of its surrounding surface which is equivalent to one Planck area, ${l_p}^2$ – Planck area (the Hawking Bekenstein information unit area).

This means that a volume of space in the radius of Planck length can contain only one bit of information. As can be seen in figures 1 and 2 there are endless combinations of energy (information) setups in a Planck sized volume of space. This contradicts equation 2.

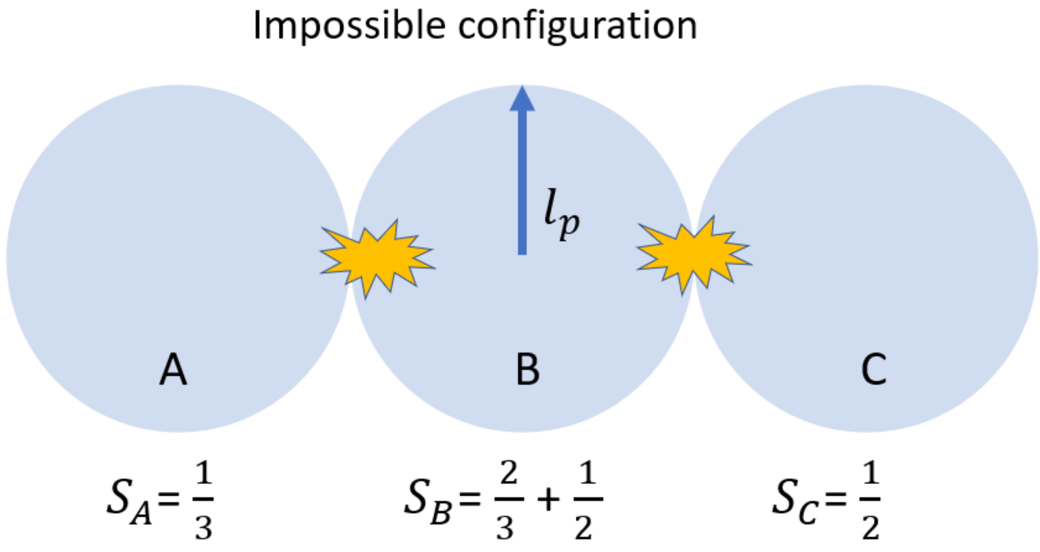

Figure 1: An example of space units in the size of Planck length, illustrated as circles A, B, C that the information about their contained energy units (S_A ,S_B , S_C), cannot be described just by '0' and '1'. This is a contradiction to the Hawking Bekenstein information formula. The yellow star shape illustrates an energy / information unit. The two-dimensional circles illustrate a three-dimensional symmetric shape like a round bubble while the grid dimension is the three-dimensional space between them.

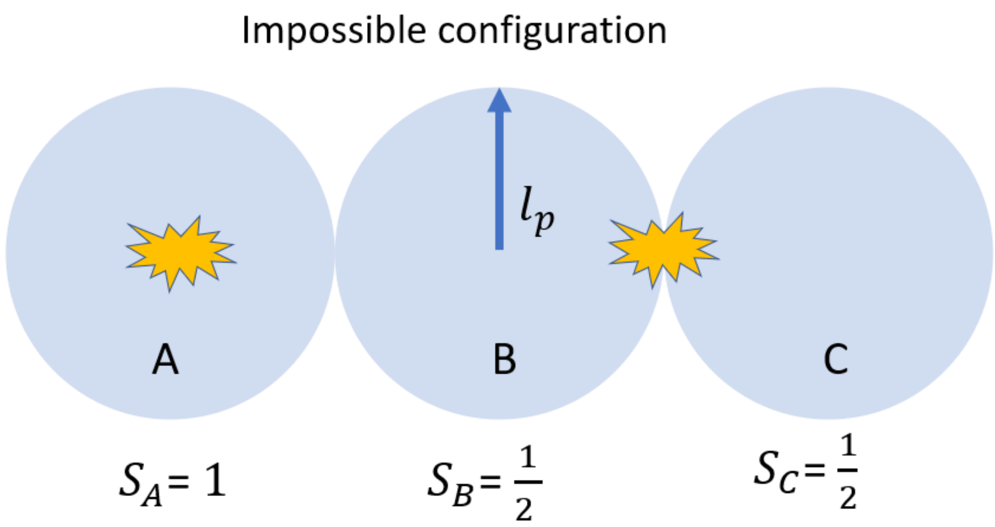

Figure 2: An example of space units in the size of Planck length, illustrated as circles A, B, C that the information about their contained energy units (S_A ,S_B , S_C), cannot be described just by '0' and '1'. This is a contradiction to the Hawking Bekenstein information formula. The yellow star shape illustrates an energy / information unit.

Conclusion

Based on the Hawking Bekenstein formula, a volume of space in the radius of Planck length can contain only one bit of information. This restriction can be achieved only by quantifying space into unit cells in the size of Planck length in each dimension where each unit cell can either occupy an energy unit ('1') or not ('0') as illustrated in figure 3. The bordering between the space unit cells is illustrated in figure 3 by the red contour lines. These bordering lines represent an extra three-dimensional non-local grid shaped dimension (the grid dimension) defining and connecting the Planck sized local space units to one another. The non-locality of the grid dimension can explain the non-locality of quantum mechanics (e.g. quantum entanglement). The grid dimension will influence the movement of energy from one-unit space cell to the next and influence the mass of element particles. Since this is the role of the Higgs field, the non-local grid dimension and the Higgs field might be the same thing.

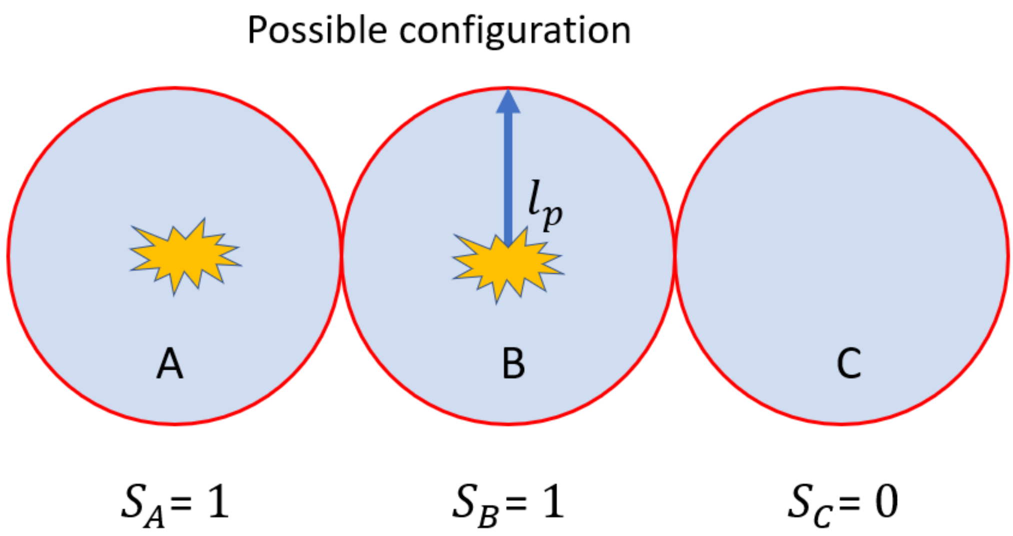

Figure 3: Two-dimensional illustration of quantized space units with a restriction that each space unit can have either '1' or '0' energy (information) units as illustrated in the figure above. With this configuration, there will be no contradiction with the Hawking Bekenstein information formula. The red borders for each circle illustrate the grid dimension. The grid dimension (its name comes from its grid formation), is both the border line between the quantized three-dimensional space units and the non-local connectivity between them as required by quantum mechanics (e.g. quantum entanglement).

REFERENCES:

[1] https://journals.aps.org/prd/abstract/10.1103/PhysRevD.7.2333