Membranes, Strings and Loops

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ABSTRACT: There has presented the arguments that the loops are the most fundamental objects and the Cartesian products of the Witten (super)string and the Duff supermembranes are the most important objects. In the end the relations between strings, membranes and loops have been discovered.

I argue M. J. Duff's point that the supermembrane is the most fundamental object [1]. I think, however, that the loops are the most fundamental. As the arguments I use the facts discovered by M. J. Duff himself that there is the mixing of loops and strings with the loops of membranes [2] and there is the integration of the fields of membranes along the closed curves [3].
I hope that M. J. Duff will forgive me it.
The loop is the fundamental object with the loop-particle dualism and with the particle as a black-hole being the tunnel to a parallel Universe or to the MEGAVERSE.
However, the Cartesian product of the Witten (super)string and Duff (super)membrane is the most important object [4].
We have:

$$S \times M = \iint L \, dr \, dz \qquad (1)$$

S – the Witten string or superstring
M – the Duff membrane or supermembrane
L – the Ashtekar loop

This equation units the Witten (super)string, the Duff (super)membrane and the Ashtekar loop.
But:

$$\iint L \, dr \, dz = I \qquad (2)$$

and at the additional conditions:

$$I = W \quad \text{or} \quad J = H$$

where:
W – the Hawking wormhole
H – hair

This way the equations (1) and (2) plus the equation of objects [5] give the whole description of relations between the fundamental objects.
We can generalize an equation (1) to all possible (super)strings and (super)membranes together with the spaces containing them with the dimensions respectively P_s and D_m .
The equation (1) obtains the shape:

$$S \times M = \sum_{i=2}^{N} \underbrace{\int \ldots \int}_{i} L \underbrace{dx_2 \ldots dx_n}_{i} \qquad (3)$$

because

$$N = D_S \cdot D_M$$

$$D_s \neq 1 \quad \text{and} \quad D_M \neq 1$$

I = instanton or wormhole or hair or black hole. The terms at the right member of the equation (3) describe warmholes, hairs, black holes.
(l - j) integrals in the i–integral describe (i – j) dimensional loops, which weave these objects.
The terms at the right member of the equation (3) are the generalization of the equation (2) for a bigger number of dimensions.

The idea of this description is such that at the beginning we analyze the easiest case and next we generalize it.
The integrals describe strings, membranes, superstrings, supermembranes and any-dimensional p-branes. The integration proceeds over all possible orientations of loops in the space, so L is a function generally.

These relatively easy equations describe the fundamental relations between the fundamental objects. This is possible to include it into the black holes if we treat it as a tunnel to another Universe or to the MEGAVERSE.
More precisely: the Cartesian product of two sets is the set (here string and membrane) whose "volume" is expressed by an integral of the loops over the space, whose loops weave this set.
The coordinates x_1 may be curvilinear. We can treat x_1 as the time coordinate and this way we can get rid of the difficulties connected with this coordinate. In the opinion of certain authors there are more time coordinates than one [6-12].
The symbol $\times$ means the Cartesian product.
Next we have:

$$\underbrace{\int \dots \int}_{i} L\, dx_2 \dots dx_l = \underbrace{\int \dots \int}_{h} \left(\underbrace{\int \dots \int}_{j} L \underbrace{dx_2 \dots dx_{j+1}}_{j} \right) \underbrace{dx_{j+1} \dots dx_i}_{h}$$

So we take under consideration the j-dimensional loops (j < i).
In the equation (1) L is a loop, but mathematically it is a periodic function with the period 2π.
The equations (1) and (3) are different formulas but both are intuitively guessed as all the most important equations of the physics. The formula (3) is a generalization of the equation (1).
In the equation (3) we put together all possible orientations of the string and the membrane (towards one another, mutually) and we sum over all possible orientations of loops and their distributions in the space.
The string can be two-dimensional and the membrane four-dimensional [7].
The necessity of an addition at the right member of the equation (3) results from the consideration of all possible orientations of the string towards the membrane. Some of these integrals can be equal zero because of the symmetry.
In the formula (3) the Cartesian product of two string or two membranes can appear at the left member instead of the Cartesian product $S \times M$.
However, then this formula loses its general character.
The Cartesian product of any finite number of objects of the type of string or membrane has the same character, but in the case of the upper limit of the addition N is a product of dimensions of these strings or membranes.

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