No information at a distance and local mathematics affect physics and geometry

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The talk is based on an extension of local vector spaces at each space time location, used in gauge theories, to include local scalars. These are represented by local real or complex number structures at each point of space time. These structures are models that satisfy the relevant axioms for the number type. For gauge theories no information at a distance means that knowledge of which state in a vector space at one locations represents a particle, does not determine which state represents the particle in a vector space at another location. This problem is solved by use of a connection as a unitary gauge transformation. The connection gives the relation between states in vector spaces at different locations.

Extension of this to number structures at different locations is based on the discovery that two conflated concepts, number and number value are distinct. Applied to numbers, no information at a distance means that the value of a number at one location does not determine the value of the number at another location.

Here is an example. The numbers, $0, 1, 2, 3, 4 \cdots$ satisfy the axioms of arithmetic. So do the even numbers, $0, 2, 4, 6, 8 \cdots$ provided multiplication is scaled by a factor of $1/2$ The values of the numbers in both sets are determined by their positions in the well ordering. In the first set 0 has the value 0, 1 has the value 1, etc. In the set of even numbers 0 has the value 0, 2 has the value 1, 4 has the value 2, etc.

This distinction applies to rational, real and complex numbers. The value of a rational, real, or complex number in a corresponding number structure at one location does not determine the value of the same number in a number structure at another location. This is taken care of by first assuming the existence of a number scaling field, g that assigns values to numbers in structures at different locations. Connections relating values of numbers at different locations are defined from the values $g(x)$ at different locations.

The contents of local mathematics consist of structures for all types of mathematical systems that include numbers as part of their axiomatic descriptions. Connections that depend on the values of g at different locations provide the relations between structures of the same type at different space and time locations.

Local mathematics, g, and connections provide the arena for theoretical physics and properties of geometries. The presence of g affects theory descriptions and predictions of properties of physical systems and geometry. Examples of the effect of the g field and its variations in space and time on physical theory and geometry will be given. Restrictions on the values and variation of $g(x)$, required by experiments and measurements will be described.

Theory descriptions and predictions based on g are more general than the usual ones. The usual ones are a spacial case of the descriptions where $g(x) = 1$ at all space and time locations. Local mathematics becomes the usual space and time location independent global mathematics. The connection maps become the identity.