Density-Mediated Propagation, Direct-Gravity, and Interactions of the Higgs-Boson

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Abstract

Coupling parameters of the Higgs-boson to other particles are proportional to their mass. It is argued that this finding originates in the scalar property of the Higgs-boson in analogy to the gravitational field, a zero-mass scalar field.

Remark

In quantum field theory the various field-types are distinguished by their behavior under Lorentz transformations, the isotropic symmetry operations of Minkowski space. The fields are classified as irreducible representations of the Lorentz group and are characterized by two half-integers (j,k), where j belongs to the left-chiral and k to the right-chiral factor of a field [1]. For instance, the lepton fields belong to j = ½, k = 0, where the different flavors are distinguished by topological differences in the representations [2]. For the electromagnetic field we have j = k = ½, and quarks are characterized by j = ½, k = 1. As an aside, there must also be a boson-quark j = 0, k = 1.

The dynamic behavior of a field is governed by a field-type specific propagation operator which determines how a field excitation propagates in space-time. As differential operators they have a j- and a k-component, acting on each factor of the (j,k) field. The Dirac operator is an example of an operator acting on a electron field. Components for j = 0 or k = 0 vanish, because the identical representation is not affected by infinitesimal rotations or boosts.

It has been proposed that interaction between fields of different types must also to be considered as propagation as far as they have a factor of common type [2]. For example, the electron field (j = ½, k = 0) also propagates to the electromagnetic field (j = k = ½) because both have the identical j-value. A less common example is the propagation between the electron- and the quark-field (again same j-value) for which the standard model has invented a special mechanism, the weak interaction. This direct propagation (for j = ½) must be distinguished from the commonly known electromagnetism which involves the electromagnetic field as a mediator between fields (with j = ½ or k = ½) at different positions. This type of 'interaction' involves two inter-field direct-propagation processes with the electromagnetic field together with it's self-propagation.

The just described type of propagation deals with differential rotations or boosts on spin-type fields (j>0 or k >0) and does not affect scalar fields (j = k = 0) at all. However, a Lorentz transformation has a additional effect on fields due to their property as densities. Densities are affected by the Lorentz contraction which gives rise to an additional propagation mechanism, Density(-Mediated) Propagation [2]. This propagation mode affects all field types alike such that it takes place between any two types of fields. Furthermore, scalar fields are exclusively affected by this type of propagation, and they propagate to (interact with) all field-types alike. This is precisely how we expect the gravitational field to behave, such that we must identify the mass-less scalar field with the gravitational field. Quite analogously to the $j = ½$ (or $k = ½$) case mentioned above, we may now distinguish on the one hand a Direct-Gravity process, namely density-propagation between any two field types (including the same), and on the other hand what is commonly understood under gravity, the interaction between bodies at different positions, mediated by the gravitational field. This latter consists of three Direct-Gravity processes, two inter-field propagation ones with the gravitational field, and self-propagation of the latter. As an aside, this direct mechanism includes interaction between electromagnetic and gravitational fields (gravitational lensing).

We can now consider the Higgs-field, which is also a scalar field. As such it propagates (interacts) exclusively via density propagation. Therefore it should be no surprise that it's interaction with other massive fields is proportional to their mass, precisely like the interaction of the gravitational scalar field with any massive field. This is what has been found in experiments at the CMS detector at the Large Hadron Collider at CERN [3]. Furthermore, as mentioned above, any two massive fields experience Direct-Gravity, which, however, is usually masked by spin propagation for two spin-carrying fields.

Conclusion

Density-mediated propagation accounts for gravity. We include it's inter-field variant in a common term of Direct-Gravity. This propagation mode includes all fields alike, but scalar fields propagate, and thus interact, exclusively by this process. Consequently, the scalar Higgs-field and the scalar zero-mass gravitational field both have interaction (Direct-Gravity) strength proportional to the partners mass. This view avoids the unsatisfactory, ether-type, concept of a omnipresent mass-providing Higgs-field. The mass of particles must follow from a solution of field equations in combination with quantization conditions, as sketched in Reference [2].

References

1. Naimark M. A., Linear Representations of the Lorentz Group, (1964), Pergamon Press
2. Gerber P. R., (2019), viXra:1911.0010
3. https://cds.cern.ch/record/2725423, last Figure