Topological charges of the quantum electromagnetic field and spacelike linearity

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Abstract A general analysis of the observable structure of the quantum electromagnetic field reveal the presence of a (possibly) new topological charge. This is related to the possibility to give a covariant quantization of the electromagnetic potential, in a Hilbert space, whose the commutator on a pair of mollifying functions localized in a certain topologically non-trivial spacelike separated regions does not vanish, rather it is a central element giving rise to a topological charge.

We shall see that such a quantization is possible if the field is "spacelike linear" on mollifying functions, a weaker, but physically reasonable, form of linearity. We shall give concrete examples also in the presence of electric currents.

Finally, we briefly discuss the status of topological charges in theories with several types of electromagnetic fields, which appear in the short distance (scaling) limit of asymptotically free non-Abelian gauge theories.

The talk is based on two joint works with D. Buchholz, F. Ciolli and E. Vasselli:

- *The universal C^*-algebra of the electromagnetic field*, LMP (2016) - arXiv:[1506.06603]
- *The universal C^*-algebra of the electromagnetic field II. Topological charges and spacelike linear fields*, to appear on LMP - arXiv:[1610.03302]