Non-commutative Gauge Theories: Bounds and Extra-dimensional Possibilities

Carl E. Carlson

Nuclear and Particle Theory Group, College of William and Mary, Williamsburg, VA, USA

We shall look at the canonical version of non-commutative field theory, which is Lorentz violating, and first expalin the bounds on the noncommutativity parameter and then consider some strategies for making the theory Lorentz invariant. After stating the Feynman rules for noncommutative QCD, we compute one dangerous Lorentz-violating operator generated through radiative corrections. Interesting effects appear at the one-loop level, in contrast to noncommutative U(N) gauge theories, leading to a stringent bound. Our results, as well as others appearing recently in the literature, suggest collider limits are not competitive with low-energy tests of Lorentz violation for bounding the scale of spacetime noncommutativity. Noncommutativity among extra, compactified spatial dimensions is far less constrained and may have discernable signatures in accelerator based experiments. As an example, we study the experimental consequences of noncommutative QED in six dimensions, with noncommutativity restricted to the extra dimnsions. Vertices involving the Kaluza-Klein (KK) excitations of the photon can yield order 100of the lighter modes. These effects are likely within the reach of a future Very Large Hadron Collider (VLHC).

References

[1] C. E. Carlson, C. D. Carone and R. F. Lebed, Phys. Lett. B **518**, 201 (2001) [arXiv:hep-ph/0107291].
[2] C. E. Carlson and C. D. Carone, Phys. Rev. D **65**, 075007 (2002) [arXiv:hep-ph/0112143].