Contribution ID: **11**

Type: **Regular Talk (15'+5')**

Noncommutative momentum and torsional regularization

Tuesday 1 December 2020 10:15 (20 minutes)

We show that in the presence of the torsion tensor $S^k{}_{ij}$, the quantum commutation relation for the four-momentum, traced over spinor indices, is given by $[p_i, p_j] = 2i\hbar S^k{}_{ij} p_k$.
In the Einstein–Cartan theory of gravity, in which torsion is coupled to spin of fermions, this relation in a coordinate frame reduces to a commutation relation of noncommutative momentum space, $[p_i, p_j] = i\epsilon_{ijk} U p^3 p_k$, where U is a constant on the order of the squared inverse of the Planck mass.
We propose that this relation replaces the integration in the momentum space in Feynman diagrams with the summation over the discrete momentum eigenvalues.
We derive a prescription for this summation that agrees with convergent integrals:
$\int \frac{d^4p}{(p^2+\Delta)^s} \to 4\pi U^{s-2} \sum_{l=1}^{\infty} \int_0^{\pi/2} d\phi \frac{\sin^4\phi\, n^{s-3}}{[\sin\phi + U\Delta n]^s}$,
where $n = \sqrt{l(l+1)}$ and Δ does not depend on p.
We show that this prescription regularizes ultraviolet-divergent integrals in loop diagrams.
We extend this prescription to tensor integrals.
We derive a finite, gauge-invariant vacuum polarization tensor and a finite running coupling.
Including loops from all charged fermions, we find a finite value for the bare electric charge of an electron: $\approx -1.22\, e$.
This torsional regularization may therefore provide a realistic, physical mechanism for eliminating infinities in quantum field theory and making renormalization finite.

Author: POPLAWSKI, Nikodem

Presenter: POPLAWSKI, Nikodem

Session Classification: Formal theory

Track Classification: Formal theory