Review of: "Dimensional Regularization as Mass Generating Mechanism"

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Ervin Goldfain's article Dimensional Regularization as Mass Generating Mechanism presents a brief review of regularization of relativistic quantum field theory in 4 space-time dimensions using the example of a single real scalar field with self-interaction $g\phi^4$. It displays the computation of the divergent contributions to the 1-loop 2- and 4-point functions when rendered finite by two different regularization schemes: Pauli-Villars (PV) and dimensional regularization (DR).

The paper then argues as follows: the two regularization schemes should give the same physical results, regardless of what regularization method is used. This assumption is incorrect. For any finite value of the regulator there are distinctly different observable predictions of the two regulators. For example, finite mass of the PV regulator fields implies the presence of particles with corresponding mass that, depending on how the theory is fully defined, may introduce non-causal phenomena, or violate covariance, or give a non-unitary scattering S-matrix[1]. The only way around these difficulties is to take the limit $\Lambda_{UV}^2 \to \infty$ in the PV case and $\epsilon \to 0$ in DR. The infinities that result from this limit are dealt with by using field and parameter renormalization, a by now standard procedure in defining any quantum field theory[2].

The relationship (16) in the paper, that $\epsilon \ll 1$, is content free. As one needs to take the limit $\epsilon \to 0$ as one renormalizes, it is clear that $\epsilon \ll 1$ holds. None of the claims that follow equation (16) are actually consequences of (16). There is no justification given for any of these claims. The references are all to papers by the same author, and inspection of some of them reveals both that there is no connection to the claim of the present paper, nor is there proper justification to the results in them.

Refs

[1] T. D. Lee and G. C. Wick, "Negative Metric and the Unitarity of the S Matrix," Nucl. Phys. B 9 (1969) 209.

T. D. Lee and G. C. Wick, "Finite Theory of Quantum Electrodynamics," Phys. Rev. D 2 (1970) 1033.

R. E. Cutkosky, P. V. Landshoff, D. I. Olive and J. C. Polkinghorne, Nucl. Phys. B 12, 281 (1969). N. Nakanishi, Phys. Rev. D 3, 811 (1971).

T. D. Lee and G. C. Wick, Phys. Rev. D 3 (1971) 1046.

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[2] See eg, M.E.Peskin and D.V.Schroeder, ``An Introduction to quantum field theory,"

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