On Sazdović's Contribution to Finite QED

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Finite QED

- Finite QED is QED without ultraviolet divergences before renormalization procedure.
- Formulated by Johnson, Baker and Willey in 1964 and later.
- Reformulation of the perturbation approach: complete unrenormalized electron and photon propagator, and complete unrenormalized vertex function can be expanded perturbatively so that they become finite in any order of the new perturbation treatment.
- Each order of the new perturbation expansion contains an infinite number of standard Feynman diagrams.
- Necessary conditions: 1) bare electron mass $m_0 = 0$, 2) the fine-structure constant is solution a definite equation $f(\alpha_0) = 0$, and 3) suitable choice of gauge parameter.
- Possibility to investigate electromagnetic dynamical mass generation of the electron.

Finite QED

1. *Teorija skalarnog polja*,1975 Diploma work, awarded as the best diploma work in 1975 at University of Belgrade.
2. *Ispitivanje konačne spinorske elektrodinamike*, 1978 Mr.Sc. thesis.
3. *Ispitivanje konačne kvantne elektrodinamike*, 1982 PhD thesis, awarded by Institute of Physics in 1983.

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- B. Sazdović and B. Dragović, *An analysis of the Schwinger-Dyson equation for the finite electron propagator*, J. Phys. G: Nucl. Phys. **8** (1982) 1159–1171.
- B. Dragović and B. Sazdović, *On the possibility of dynamical mass generation in axial electrodynamics*, J. Phys. G: Nucl. Phys. **8** (1982) 1637–1640.

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- B. Dragović and B. Sazdović, *Some general properties of the Schwinger-Dyson equation for the finite electron propagator*, Fizika **14** (1982) 133–138.
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- B. Dragović and B. Sazdović *On the Duffin-Kemmer propagator in scalar electrodynamics*, Fizika **16** (1984) 419–430.

On finiteness of electron propagator

- The first JBW approximation of the Schwinger-Dyson equation for electron propagator

$$S^{-1}(p) = S_0^{-1}(p) - \frac{ie_0^2}{(2\pi)^4}\int d^4q\, D^0_{\mu\nu}(p-q)\,\gamma^\mu S(q)\gamma^\nu$$

- General form of the electron propagator is $S^{-1}(p) = \alpha(-p^2) - \hat{p}\beta(-p^2)$.

$$\alpha(x) = m_0 + 3g\Big(\frac{1}{x}\int_0^x \frac{y\alpha\, dy}{\alpha^2+y} + \int_x^\infty \frac{\alpha\, dy}{\alpha^2+y}\Big), \quad \beta(x) = 1$$

where after Wick rotation ($p_0 \to ip_0$), $x = p_0^2 + \vec{p}^2$, $y = q_0^2 + \vec{q}^2$ and $g = (\frac{e_0}{4\pi})^2$

- JBW finiteness if $m_0 = 0$.

On dynamical mass generation

- Integral equation for possible electron mass generation

$$\alpha(x) = \alpha(0) + 3g \int_0^x \frac{\alpha}{\alpha^2 + y}\left(\frac{y}{x} - 1\right) dy$$

- Equivalent nonlinear second-order differential boundary value problem

$$(x\,\alpha(x))'' = -3g\frac{\alpha(x)}{\alpha^2(x) + x}$$

$$x^2\,\alpha'(x) \to 0,\ x \to 0, \qquad (x\alpha(x))' \to 0,\ x \to \infty$$

- No electron mass generation in the first approximation, because there is no pole for real x.