



Modern Functional Quantum Field Theory: Summing Feynman Graphs

Herbert M Fried

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These pages offer a simple, analytic, functional approach to non-perturbative QFT, using a frequently overlooked functional representation of Fradkin to explicitly calculate relevant portions of the Schwinger Generating Functional (GF). In QED, this corresponds to summing all Feynman graphs representing virtual photon exchange between charged particles. It is then possible to see, analytically, the cancellation of an infinite number of perturbative, UV logarithmic divergences, leading to an approximate but most reasonable statement of finite charge renormalization.

A similar treatment of QCD, with the addition of a long-overlooked but simple rearrangement of the Schwinger GF which displays Manifest Gauge Invariance, is then able to produce a simple, analytic derivation of quark-binding potentials without any approximation of infinite quark masses. A crucial improvement of previous QCD theory takes into account the experimental fact that asymptotic quarks are always found in bound states; and therefore that their transverse coordinates can never be measured, nor specified, exactly. And this change of formalism permits a clear and simple realization of true quark binding, into mesons and nucleons. An extension into the QCD binding of two nucleons into an effective deuteron presents a simple, analytic derivation of nuclear forces.

Finally, a new QED-based solution of Vacuum Energy is displayed as a possible candidate for Dark Energy. An obvious generalization to include Inflation, which automatically suggests a model for Dark Matter, is immediately possible; and one more obvious generalization produces an understanding of the origin of the Big Bang, and of the Birth (and Death) of a Universe. If nothing else, this illustrates the Power and the Reach of Quantum Field Theory.

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