# Undergraduate thesis project
# “Phase transitions in QED through the Schwinger - Dyson formalism”

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## Summary

In this work we treat the problem of the non-perturbative formulation of Quantum Electrodynamics with the use of the Schwinger - Dyson formalism.
After a brief introduction to quantum field theory and the renormalization group methods, we formulate the Schwinger - Dyson equations and derive a closed system of integral equations relating the dynamical fermion mass to the renormalization functions of the photon and fermion fields (M,F,G - system). Using the rainbow approximation, we show that this system can be cast in the form of a non-linear integral equation of the Hammerstein type. We prove that QED4 undergoes a phase transition signaling the (dynamical) breakdown of chiral symmetry and with the aid of bifurcation theory we calculate analytically the critical point and the scaling law.
We also discuss the concepts of vacuum stabilization through dynamical mass generation and dimensional transmutation in strong coupling regimes. Finally, we give an overview of numerical results obtained in QED4 in the unquenched approximation and discuss the phase diagram of the theory in both the quenched and unquenched approximations.