Workshop on Non Perturbative Aspects of Field Theories Morelia '07

November 5-6

PROGRAM

TALKS

A Calculation of Parton Distribution Functions

Profr. Craig D. Roberts, Phys. Div. ANL

Abstract: Parton distributions are key to an understanding of QCD's role in modern nuclear physics. However, they are essentially nonperturbative and cannot be calculated in perturbation theory. Thus, absent a truly accurate quantitative and predictive nonperturbative tool, the QCD calculation of parton distribution functions remains an alluring but distant prospect. I will provide some background and describe the application of Dyson-Schwinger equations to this problem.

Dynamical Mass Generation in QED with Magnetic Fields of Arbitrary Strength

Dr. Alejandro Ayala, ICN-UNAM

Abstract: We study the dynamical generation of masses for fundamental fermions in quenched quantum electrodynamics, in the presence of magnetic fields, by solving the Schwinger-Dyson equation for the fermion self-energy in the rainbow approximation. We employ the Ritus eigenfunction formalism which provides a neat solution to the technical problem of summing over all Landau levels. It is well known that magnetic fields catalyze the generation of fermion mass m for arbitrarily small values of the electromagnetic coupling α and that $m \propto \sqrt{eB}$. On the other hand, when α exceeds the critical value α_c which marks the onslaught of dynamical fermion mass in vacuum, $m \propto \Lambda$, the cut-off required to regularize the ultraviolet divergences. Our approach confirms such behavior and reproduces results known in literature for limiting cases of eB and α. We also point out the relevance of our work for possible physical applications.

Hamiltonian Approach to Bound States in Quantum Field Theory

Dr. Axel Weber, IFM-UMSNH

Abstract: I present a generalization of the Gell-Mann-Low theorem that allows to describe bound states in quantum field theory, in addition to the usual scattering states. The corresponding effective Schroedinger equation for the bound states energies and constituent wave functions is analytically derived to lowest order and numerically solved for the Wick-Cutskosky model, Yukawa theory and Coulomb gauge QED. I discuss various properties of the solutions and compare to other bound state equations.

The Two-Sided Story of the QGV: Searching for Complementarity in P/Non-P QCD

Dra. María Elena Tejeda-Yeomans, USON

Abstract: The program of calculating multi-loop dimensionally regulated QCD amplitudes is a step toward Standard Model hard-scattering cross-sections beyond leading order. In this context it is useful to note that the factorization for amplitudes is shared by cross sections in the limit of partonic threshold. Therefore the exponentiated structure of analytic singularities of the amplitudes is reflected in the cross-sections with radiation. This observation is the basis for many resummation programs, which are useful guides that help us push the boundaries of PQCD into non-PQCD regimes.

On the other hand, efforts made with both lattice and continuum studies in QCD such as DSE, shed light on the non-perturbative dynamics of the theory through the analysis of the infrared behavior of n-point functions and their connection to propagators as means to provide a better understanding on confinement and and dynamical breakdown of chiral symmetry. In particular, a better knowledge of the QGV in PT, could help narrow down its non-P structure.

The career towards having high precision results for perturbative calculations has generated a plethora of tools that can now allow us to explore some multi-loop n-point functions using different regularization and renormalization schemes, together with different off-shelness configurations for internal and external states. In this talk I present P/non-P QCD aspects of the QGV and highlight their complementarity in the aforementioned situations.

Lattice Calculations on the Spectrum of Dirac and Dirac-Kahler Operators

Dr. Rafael G. Campos, FCFM-UMSNH

Abstract: We use a lattice formulation to study the spectra of the Dirac and the Dirac-Kahler operators on the 2-sphere. This lattice formulation uses differentiation matrices which yield exact values for the derivative of trigonometric polynomials preserving the Leibniz rule and therefore, this formulation can be used to study the fermion-boson symmetry on the lattice. In this context, we find that the free Dirac and Dirac-Kahler operators on the 2-sphere exhibit fermionic as well as bosonic-like eigensolutions for which the corresponding eigenvalues and the number of states are computed. In the Dirac case these solutions appears in doublets, except for the bosonic mode with zero eigenvalue, indicating the possible existence of a symmetry of the square of the Dirac operator.

Off-Shell Green Functions: One loop with Growing Legs

Yajaira Concha Sánchez, IFM-UMSNH

Abstract: We study the evaluation of 2-, 3- and 4-point off-shell Green functions in scalar QED at the one-loop level. On one hand, these calculations can point towards their possible non perturbative structures and on the other, we are likely to get a clearer analytical insight into the singularity structure of these functions.

The Worldline Formalism in Curved Space

Profr. Christian Schubert, IFM-UMSNH

Abstract: As is well-known from nonrelativistic quantum mechanics, the construction of path integrals in curved spaces leads to certain mathematical subtleties which are not present in flat space. Similarly, attempts to extend the relativistic worldline path integral formalism to curved space have met with formidable difficulties which have been resolved only quite recently. I this talk I discuss the various subtleties which can appear in this formalism, and present some sample calculations of curved space effective actions as well as graviton amplitudes.

Dynamical Chiral Symmetry Breaking and Confinement in QED3
Dr. Alfredo Raya Montaño, IFM-UMSNH

Abstract: Dynamical Chiral Symmetry Breaking (DCSB) and Confinement are two crucial features of QCD which are responsible for the nature of the hadronic spectrum. A simpler model which exhibits both is quantum electrodynamics in (2+1) space-time dimensions, QED3. A long standing debate in this model is the existence of a critical number of fermion families, Nc, above which DCSB ceases to take place. This was established almost two decades ago from the solutions of the Schwinger-Dyson equations (SDEs), in the leading order in the 1/N expansion in the Landau gauge. Confinement has also been found to be absent in this scenario. In this work, we study the stability of the solutions to the said SDEs under a variation of gauge. We find that the Landau gauge is an isolated covariant gauge in the sense that it is the only one which exhibits the above mentioned results. Away from this gauge, DCSB takes place for arbitrary large N and confinement is reinstated.

Masses, Condensates, Confinement and Gauge Invariance
Adnan Bashir, IFM-UMSNH

Abstract: We study the gauge invariance of dynamically generated masses, condensates, and confinement in the light of Landau-Khalatnikov-Fradkin transformations.

POSTERS

Feynman Propagator in Quantum Mechanics through Schwinger's Method

José Manuel González Valdés, FCFM-UMSNH

Abstract: We employ Schwinger's method to derive the Feynman propagator for two time independent Quantum Mechanical systems: the harmonic oscillator and a non-relativistic charged particle in a uniform magnetic field.

Numerical Study of Schwinger-Dyson Equations in QED3 in the $1/N$ Approximation

Saúl Sánchez Madrigal, IFM-UMSNH

Abstract: We study the Schwinger-Dyson equation for the fermion propagator in QED3 including vacuum polarization effects in the leading order of the $1/N$ approximation in a numerical fashion. We check the stability of the solutions under a variation of gauge and conclude that the Landau gauge is an isolated gauge in the sense that it is the only one in which a non-trivial solution ceases to exist if N exceeds a critical value $N_c = 32/\pi^2$.

Dynamical Symmetry Breaking in Presence of Magnetic Fields of Arbitrary Strength

Eduardo Rojas Peña, ICN-UNAM

Abstract: We study the dynamical generation of masses for fundamental fermions in quenched quantum electrodynamics in the presence of magnetic fields of arbitrary strength, using Schwinger-Dyson equations (SDEs). We use the Ritus eigenfunction formalism and go beyond the lowest Landau Level (LLL). We give a solution to the technical problem of the summing over Landau levels. The numerical solution reproduces the very well known result in the strong field limit, as well as some features of the result in the weak field limit. This treatment allows us to explore a more realistic region of parameter space otherwise forbidden when using other methods.

Fermions in Magnetic Fields and $\bar{q}q$-Condensates

Ma. de Jesús Anguiano Galicia, IFM-UMSNH

Abstract: In this work we study the dynamics fermions in presence of a uniform magnetic field by solving the corresponding Dirac equation. We center our attention to the (3+1)- and (2 +1)-dimensional cases. Upon second quantization of the solutions, we obtain expressions for the different $\bar{q}q$-condensates and do connection with known results when possible.

QCD Vertex in the Infra-Red

Laura Xiomara Gutiérrez Guerrero, IFM-UMSNH

Abstract: A detailed knowledge of the quark-gluon vertex is essential for an understanding of the dynamics of quark confinement and chiral symmetry breaking. We carry out numerical study of one-loop QCD vertex and compare it with recent lattice calculations to see at what point on the momentum scale, non-perturbative effects set in. We may expect that the QCD running coupling thus defined will perhaps not be as singular as hinted from Schwinger-Dyson equation studies. Moreover, as the QCD vertex is tied to the quark propagator through Slavnov-Taylor identity, phenomenological knowledge of this propagator derived from hadronic observables may suggest an enhancement in the dominant terms in the QCD vertex in the infra-red.

Time Table:

Monday:

Craig **Roberts**: 9:00 - 10:00
Alejandro **Ayala**: 10:00 - 11:00

Axel **Weber**: 11:30 - 12:30
Maria Elena **Tejeda-Yeomans**: 12:30 - 13:30

Rafael G. **Campos**: 16:00 - 17:00
Poster Session 17:00 - 18:00

Tuesday:

Yajaira **Concha**: 9:00 - 10:00
Christian **Schubert**: 10:00 - 11:00

Alfredo **Raya**: 11:30 - 12:30
Adnan **Bashir**: 12:30 - 13:30