Thesis Proposal for the Master's Degree in Physics

Title: Phase diagram of gauge-Higgs models on a space-time lattice

Abstract (max 10 lines): The interaction between gauge fields and the Higgs field is one of the main features of the Standard Model of particle physics and underpins the mechanism by which vector bosons acquire mass. Models of the interaction between gauge fields and the Higgs field can be formulated on a space-time lattice, where the mechanisms of symmetry breaking and mass generation can be studied in detail using numerical Monte Carlo methods, for several gauge groups and in various space-time dimensions. The main unresolved issue in this context is how to distinguish the "confined phase" from the "Higgs phase". The answer to this question may also have implications for physics beyond the Standard Model.

Supervisors: Alessandro Papa, Oleg Borisenko (INFN-Cosenza)

E-mail: alessandro.papa@fis.unical.it

Laboratory where the thesis is carried out:
Group of Theoretical Physics of Fundamental Interactions

Any participating external structures: -

Type of thesis:

- Research (theoretical)

Thesis Proposal for the Master's Degree in Physics

Title: Study of semi-hard collision processes at the LHC and future colliders

Abstract (max 10 lines): Hadronic processes characterized by a center-of-mass energy much larger than the intrinsic hard scale of the process (such as a large transverse momentum or mass) are referred to as “semi-hard” processes. Their theoretical description through standard perturbation theory misses large logarithms of the energy, which compensate the smallness of the coupling and must therefore be resummed to all orders. This resummation procedure has been known for some time and involves expressing the cross section of a given process in a factorized form, comprising a universal Green’s function and a process-specific “impact factor.” The proposal is to calculate impact factors for new processes and to numerically compute the corresponding cross sections.

Supervisors: Alessandro Papa

E-mail: alessandro.papa@fis.unical.it

Laboratory where the thesis is carried out:
Group of Theoretical Physics of Fundamental Interactions

Any participating external structures: -

Type of thesis:

- Research (theoretical)

Thesis Proposal for the Master's Degree in Physics

Title: Distribution of color fields around static quark/antiquark sources in QCD

Abstract (max 10 lines): The confinement mechanism for quarks and gluons within hadrons is not yet fully understood. Useful insights can be gained by determining the spatial distribution of chromomagnetic and chromoelectric fields (or simply, color fields) around static mesonic (quark + antiquark) and baryonic (three-quark) sources. This can be accomplished by discretizing Quantum Chromodynamics on a space-time lattice and studying its dynamics through Monte Carlo numerical simulations. The investigation can be conducted at both zero and non-zero temperatures; in the latter case, the phenomenon of deconfinement can also be explored.

Supervisor: Alessandro Papa

E-mail: alessandro.papa@fis.unical.it

Laboratory where the thesis is carried out:
Group of Theoretical Physics of Fundamental Interactions

Any participating external structures: INFN-Bari

Type of thesis:

- Research (theoretical)