Advances in High Energy Physics

Hindawi

Special Issue on
Nonperturbative Approaches in Field Theory

CALL FOR PAPERS

This Special Issue focusses on recent nonperturbative results in Quantum Field Theory and their (potential) applications to cosmology as well as high-energy, hadronic, and nuclear physics. While the present Standard Model (SM) of particle physics offers a long list of accomplishments and successes, it is its essentially perturbative strategy that has reached the limits to deeper and, by recent developments in cosmology, amply required insights into the structure of the quantum vacuum and its excitations in gauge theories and effective field-theory models thereof. Moreover, explaining the origin of some of the SM's eighteen or so free parameters is desirable (e.g., the infinite Coulomb self-energy contribution to the mass of a point particle). Also, clear experimental evidence for neutrino masses creates conceptual tension as to the present SM's treatment of radiative corrections with renormalizability long thought to be an essential consistency check in maintaining predictivity of this gauge-theory based model. Finally, the so-called gauge-hierarchy problem, induced by perturbative quantum fluctuations in the SM's Higgs sector, is, as of yet, open.

The present editors feel that this Special Issue is worthwhile in raising awareness on new results and ideas which have a potential to contribute to the future resolution of the points addressed above. For example, we envisage contributions discussing a departure from the point-particle description of the fundamental fermions in the SM in terms of gauge-theory solitons, protected from revealing their internal structure, the association of a nonperturbative ground state with a (gauge independent) scale of maximal resolution in computing radiative corrections, a purely gauge-sector driven, nonperturbative mechanism for electroweak symmetry breaking, which prescribes the parameters of the presently successful but not exhaustively convincing (gauge-hierarchy problem) point-particle approach of a (fundamentally charged) Higgs field, a fresh look at nucleon binding and nuclear spin in terms of a semiclassical approach to the Skyrme model, a novel SU(2) gauge-theory based approach to thermal photon gases and its implications towards high-z cosmology and the ground state of the present universe, and AdS/CFT based approaches to the low-energy regime of Quantum Chromodynamics in modelling the hadron spectrum and hadronic reactions.

Potential topics include but are not limited to the following:

- Functional methods in gauge-field theories
- Lattice gauge-theory
- Semiclassical approaches
- Resummation techniques
- Analytic insights into vacuum structure of quantum Yang-Mills theory based on exact solutions to the Euclidean field equations
- Thermal ground state in Yang-Mills thermodynamics and cosmological implications thereof
- Topological solitons in gauge-theory and other models and their interplay with gravity
- AdS/CFT based approaches to hadron physics
- Few-body systems and their field-theoretic aspects

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