Phases of strong interactions – Lattice studies (MI11)

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Collaborators

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1 Research

We study phases and phase transitions of strong interactions. Our work uses lattice methods and has applications to the phsyics of the Quark Gluon Plasma as well as to model building beyond the standard model based on mechanisms of strong EW breaking. Our research is articulated in several projects – some have produced results published in 2012 and are continuing, some have preliminary results, and some are new.

1. *High temperature phase transition*

Completed project: We have completed the analysis of the transition to the Quark Gluon Plasma, and of the pseudocrtical line for two light flavors using highly improved Wilson Fermions. Results have been presented at Lat2012 and are submitted to PRD.

2. *Quark Gluon Plasma and Bottomonium*

Continuing project: We have studied the thermodynamics Equation of State and the bottomonium spectrum in the LHC working region. Our results for the bottomonium are based on an improved method that we have developed and compare favorably with CMS results. Results have been presented at SEWM2012 (invited opening talk) and at other conferences, and published. We are now investigating in detail the mass systematics, analyzing the different behaviour of charm and bottom, and we are developing alternative tools for the reconstruction of the spectral functions, which are the quanitites directly amenable to a comparision with experimental results.

3. *Dense Matter*

New project: We have begun an investigation of non-homogenous phases at high density by use of QCD–like theories. We have found preliminary intriguing evidences of such phases

4. *Methods for the analysis of dense matter*

Developing project: We are developing a hybrid method for enhanced control on the results on the critical line in the temperature, chemical potential plane. Results have been presented at SEWM2012 and xQCD2012 and a paper is being written.

5. *Conformal and pre-conformal phase of strong interactions*

Continuing project: We have studied the pre-conformal dynamics and the physics of the conformal phase at strong coupling. Two papers have been published and presented as invited talks at several conferences (xQCD, ConfX, SCGT). We are continuing this study – which has received an European PRACE award – along different lines, with the ultimate goal of a complete caracterization of the phases of strong interactions.

6. *Thermmodynamics with two generations of quarks*

New project: by using the newly available high quality zero temperature results we are starting

a study of thermodynamics with the inclusion of Wilson degrees of freedom. We are preparing a new PRACE application to be submitted at the end of March.

2 Main talks and lectures

We have presented the invited plenary review on QCD Thermodynamics at the yearly Lattice Conference(Cairns), and the invited opening talk on Bottomonium physics at Strong Electrowak Matter 2012, as well as several invited topical talks at xQCD2012(Washington D.C.), confX (Munchen), SCGT2012 (Nagoya) and at the Lattice Program at the GGI. MpL has given a 30 hours graduate course on 'QCD at high temperature and density' at the Bielefeld University (ranked first by the student's senate among all the SommerSemeter offering at the Physics Department).

3 Support

We are supported by MIUR (prin09lombardo) and for computation by PRACE, the European Consortium for Computing (MpL PI), as well as under the INFN-CINECA agreement.

4 Service

MpL is a member of the Scientific Board of Ect*, she is serving in the panel for the Ken Wilson Award for excellence in Lattice Field Theory and is the appointed responsible for the agreement between INFN and CMTP. She has served in review panels /refereed for Yale University, ETH Zurich, DFG and Austrian Science Foundation, PhD defence Committee at the Humboldt University Berlin.

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