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The Physics of the Quark-Gluon Plasma

Introductory Lectures

Springer

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Preface

The study of strongly interacting matter has over the past 30 years become one of the major areas of high-energy physics. Pioneering theoretical work in statistical quantum chromodynamics leads to the advent of a vigorous experimental program, using heavy-ion collisions to create small droplets of a medium whose energy density surpasses all previously investigated ranges. This in turn triggered new approaches in theory, addressing innovative aspects from hydrodynamics to parton saturation and gravity models. Never before have creative theoretical ideas and ingenious experiments worked so well in a complimentary and tandem mode. The exciting perspectives of all these developments have brought numerous young research workers into the game. The future of the field clearly depends on the competence and the enthusiasm of these young experimentalists and theorists beginning their research on high-energy nuclear collisions.

This was the justification for organizing in February of 2008 a large-scale school on the topic in Jaipur, India, a charming Rajasthan city filled with cultural heritage. The fact that the Quark Matter conference was going to be held here soon afterward provided good opportunity to convene a school introducing to young physicists in particular the more recent developments in the field, those not yet covered by excellent textbooks available on this topic. The lectures at the school were to be held by leading international experts on the different topics, and as can be seen, we indeed succeeded in attracting scientists who combine expertise with pedagogical capabilities.

The essential aspects and concepts of high-energy heavy-ion collisions to be addressed at the school were

- QCD Thermodynamics
- Global Features
- Hydrodynamics and Flow
- Electromagnetic Probes
- Jet Production
- Quarkonium Production
- Saturation and Color Glass Condensate
- Gravity–QCD Relations

For each of these topics, general survey lectures introduced the main ideas, presented the current state of the theoretical understanding, and summarized the basic experimental results obtained so far.

The planning of the school met with excellent resonance among young physicists worldwide. Almost 100 students from many countries attended, listened, and, as these lecture notes bear witness of, participated. We had decided the written version of the lectures would be prepared by each lecturer together with two to three students, who volunteered for this task. Furthermore, this idea fell on fruitful ground, and both students and lecturers profited from the collaboration in preparing the different chapters.

It is a particular pleasure to one of us (B.S.) that these lectures are published by Springer Verlag, who had already published the lectures at the first school on the QGP in India. That was held many years ago, 1989 in Puri, and it was to a large extent responsible for creating the great and active present community of research workers in India.

We have received generous funding from the Variable Energy Cyclotron Centre, Kolkata, the Centre for Advanced Research and Education of the Saha Institute of Nuclear Physics, Kolkata, the Board of Research in Nuclear Science, the Department of Atomic Energy, Government of India, and the Institute of Physics, Bhubaneswar. For all this support, we are very grateful.

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