

Preface to
Lectures by Prof. Jean-Paul BLAIZOT
on
Quantum Fields at Finite Temperature
“from tera to nano Kelvin”

We are pleased to present the lectures given by Prof. Jean-Paul Blaizot, our distinguished guest from Institute de Physique Théorique, CEA-Saclay, during his one month stay in Komaba as a Visiting Professor of the Graduate School of Arts and Sciences of the University of Tokyo in the fall of 2009.

These lectures cover some fundamentals of quantum field theories at finite temperature and their applications to physics of the quark-gluon plasma at very high temperatures exceeding tera kelvins, and to physics of cold atoms at very low temperatures below nano kelvins. The quark-gluon plasma is a primeval form of matter which is believed to have pervaded very early universe until few micro seconds from its birth, and great efforts have been directed to recreate it and to study its properties by collisions of heavy nuclei at very high energies with RHIC, a dedicated relativistic heavy-ion collider at Brookhaven, and now with LHC, presently highest energy hadron collider at CERN. Physics of the cold atoms have been also a focus of intense theoretical as well as experimental researches, since they had been successfully manufactured in 1995 by ingenious methods using modern laser beam technology. It is amusing that the same theoretical method can be applied to these apparently very different physical systems. There are many common theoretical problems with the same origin due to infrared divergences arising in most naive perturbation theory as coherently discussed in these lecture notes.

The lectures were well attended by graduate students both of Komaba campus, where the lectures were delivered, and of Hongo campus, and by some more senior scientists in the area. They were taped, transcribed by some of the participants of the lectures, mostly by students, and then edited later by the author. With these notes we wish to convey the real-time live atmosphere of the lectures in the class which consisted of very well organized and illuminating oral presentations of the lecturer, occasionally followed by lively and heated discussions on certain subtle points treated in these lectures.

These notes would never become materialized without the enthusiastic efforts of many

students who participated in the transcription from the digital tapes. They are Yukinao Akamatsu, Koichi Hattori, Daigo Honda, Yoshiaki Onishi, Takashi Sano, Naoto Tanji, Shun Uchino and Kazuhiro Watanabe. In particular, the high quality works of Onishi and Tanji set the models for the later works. My colleague, Hirotsugu Fujii and Yusuke Kato also kindly helped and supervised the works of the students. I thank them all for their excellent works.

On behalf of all the participants, I wish to thank Prof. Blaizot once again for his very elegant and inspiring lectures accessible to us all and for his efforts in bringing transcribed notes to the present final form, keeping the style of original oral presentation intact.

Tetsuo Matsui

Komaba, Tokyo

May, 2011

with Prof. J.-P. Blaizot

