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Preface

The present issue of the *European Physical Journal - Web of Conferences* contains the notes of lectures and selected contributions presented at the Helmholtz International Summer School (HISS) on *Dense Matter in Heavy-Ion Collisions and Astrophysics* (DM2008). This event was held in the period from 14.-26. July 2008 at the Bogoliubov Laboratory for Theoretical Physics of JINR Dubna, organized in close collaboration with the Helmholtz Centre for Heavy Ion Research (GSI mbH) Darmstadt. The main goal of the HISS program is to foster the contacts between the German Helmholtz centres such as GSI and DESY on the one side and research centres in Russia and the former Eastern Bloc countries on the other and to attract the young generation of scientists to the future programs for exploring the *Structure of Matter*.

The scientific program was based the three pillars: Physics of Dense Matter, Heavy-Ion Physics and Astrophysics of Compact Stars. The lectures were delivered by 18 top experts in these fields coming from 9 countries: Russia (4), Germany (4), USA (3), Italy (2), China, Netherlands, Poland, South Africa and CERN. The 48 participants (Diploma, Ph.D. students and young postdocs) came from 11 countries, the majority from Germany, Russia and JINR member countries, but also from Italy, South Korea, the UK and the USA. This summer school was supported by the President of the Helmholtz Association within the Initiative and Networking Fund, by the Helmholtz Centres GSI and DESY, by the Russian Foundation for Basic Research and by the European Science Foundation (ESF) research networking programme *The Physics of Compact Stars* (http://compstar-esf.org), devoted to the education of young scientists and interdisciplinary contacts between the communities of Gravitational Physics, Astrophysics and Dense Matter Physics.

As in Dubna the process of developing the Nuclotron-based Ion Collider fAcility (NICA) makes progress in close collaboration with the CBM experiment at the upcoming FAIR facility in Darmstadt, this summer school was characterized by a focus on heavy-ion collision experiments. Excellent overviews of the exciting results from the experiments at RHIC Brookhaven (Hallman) and NA60 at CERN-SPS (Arnaldi) were given. Simulations of results to be expected at the just started CERN-LHC facility were given by Ana Marin from the ALICE experiment, Peter Senger introduced the scientific program of the CBM experiment and Alexander Sorin presented the status of planning for the NICA-MPD complex in Dubna. The lecture program offered introductory courses to modern aspects of dense matter theory such as: *Condensates in Nuclear Matter* (Röpke), *BEC-BCS Crossover in Quark Matter* (Zhuang), *Color Glass Condensate* (Gelis), *Lattice QCD at Finite Density and Temperature* (Lombardo), *Hadron Production in the Thermal Statistical Model* (Cleymans), *Quarkonia in the Quark-Gluon Plasma* (Wong), *Nonperturbative QCD Matter Models* (Blaschke) and the *Quark-Hadron Mixed Phase* (Toneev), guiding fastly from the basics to the forefront of research.

While the exploration of the phase transition from nuclear matter to quark matter in heavy-ion collisions meets the problems of nonequilibrium evolution in shortest time scales and extremely small volumina, complementary insights into the physics of this transition might be gained from studies of compact stars (radio pulsars, x-ray dim neutron stars, accreting stars in low-mass X-ray binaries, etc.) or during the core collapse of supernovae. The education in this emerging field of Astro-Hadron Physics is very attractive for young scientists and gives additional support to theoretical and experimental studies of superdense nuclear matter to be created in the planned CBM as well as NICA-MPD experiments.

We are proud to mention that one of the very experts in the field of *Dense Matter in Astrophysics*, James Lattimer from Stony Brook (USA), was a key lecturer at the school and gave a comprehensive series of 4 lectures and a number of exercises. Further Astrophysics lectures were devoted, e.g., to the topics of *Neutron Star Observations* (Popov), *Accreting Neutron Stars* (Patruno), *Neutrino Processes in Neutron Stars* (Kolomeitsev) and *Compact Star Cooling* (Grigorian). In addition to the canon of lectures, we present in these Proceedings also a selection of research contributions from the participants.

The particpants of DM2008 highly appreciated that they were offered the Lecture Notes of the first HISS Dubna held in August 2004 on *Hot Points in Astrophysics and Cosmology*, published by the JINR Dubna. The present edition of the lectures and selected contributions at DM2008 will serve the purpose to replace and update the former material as a basis for future summer school programmes on the *Physics of Dense Matter*.

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