THE 2006 ERICE SCHOOL OF SUBNUCLEAR PHYSICS FOR YOUNG TALENTS

Distinguished lecturers and young physicists from countries all over the world met in Erice, Italy, from 29 August to 7 September at the Ettore Majorana Foundation and Centre for Scientific Culture for the 2006 International School of Subnuclear Physics whose director, A. Zichichi, decided that the 44th course had to be confronted with a great novelty: complexity, which could shed new light in the extension of the Standard Model which predicts the Grand Unification and the resolution of the quantum - gravity problem via the Relativistic Quantum String Theory (RQST). It is exactly the most accurate model (Bousso and Polchinski) of RQFT which has been shown to be NP complete. The consequences could be remarkable. This is how under the heading: 'The logic of Nature, Complexity and New Physics: from Quark-Gluon Plasma to Superstrings, Quantum Gravity and Beyond' the most advanced topics of physics were covered. The 2006 Erice school was devoted to the late Richard H. Dalitz and a lecture in his honour: '*Dick Dalitz: Examples of His Contributions to Particle Physics'*, was held by one of his collaborators, G.R. Goldstein from Tuft University. A particular feature of this school is to promote the 'new talents' among the young generation of physicists. The task of choosing the best talents was the responsibility of the co-director of the School - Nobel laureate Gerardus 't Hooft.

Each fellow was invited to give a presentation of the topic he is working on. The school followed once more the proven scenario consisting of morning lectures on the most up-to-date topics in subnuclear physics, followed in the afternoon by special sessions dedicated to new talents and Enrico Fermi junior grants. During these special sessions selected students at the school had the opportunity to make open presentations of their research work. Each special session was followed by a discussion on the lectures held during the morning, making a major contribution to the intellectual atmosphere of the school.

'*Complexity exists at the fundamental level*' was the theme of the opening lecture by A. Zichichi, followed by a series of lectures by L. Susskind, who addressed most advanced theories on '*Landscape and its*

physics foundations' and *'How String Theory generates the Landscape'*. These lectures confronted students with latest developments and ideas on physics beyond the Standard Model. Complementary lectures by F. Denef and M.R. Douglas on *'Complexity and landscape in String Theory'* and a survey on '*The Status of Lattice QCD*' by R.D. Kenway triggered lively discussions during afternoon '*questions and answers*' sessions. Other theory lectures included topics such as '*Complexity and Non-extensive Statistical Mechanics-Theory, Experiments, Observations'* by C. Tsallis, Brazil, '*QCD at Low Energy*' by G. Colangelo, University of Bern, '*Black Holes, Attractors and Quantum Information'* by M.J. Duff, Blackett Laboratory, Imperial College London, or '*Complexity in Stochastically Quantized Field Theories and Standard Model' by* C. Beck, University of London. Finally, I. Antoniadis, CERN, explained '*How to Detect Extradimensions'*.

More on the experimental side of physics, the students listened to an excellent overview on '*Neutrino Masses, Leptogenesis and Beyond: The Incredible Foresight of Ettore Majorana'* presented by H. Harari, Weizmann Institute. This was a very timely lecture topic, since also during the school, the director of the LNGS, E. Coccia, outlined details of the neutrino oscillation experiments at the start-up of the CERN Neutrino Beam to Gran Sasso.

Reports from running experiments covered '*Towards New Physics with Rare Processes in CP Violation',* latest results on B-physics, highlighted by M. Giorgi, Pisa/SLAC. Equally exciting was the talk on the '*FERMILAB*: *Tevatron Physics',* by N. Lockyer, University of Pennsylvania, discussing chances for major discoveries at the Tevatron prior to the start-up of LHC. Results from HERA were presented by B. Loehr, DESY in his lectures on: '*Diffraction at the Scale of Quarks and Gluons'*. The 'Top Physics Story 2005', in the view of AIP was presented by J.W. Harris, Yale, in his animated lectures: '*Evidence for a Quark-Gluon Plasma at RHIC*'. He outlined the present understanding of the 'quark gluon liquid' and highlighted the need for experiments at LHC.

An outlook to the future was given by talks on the latest plans for a

Super-Beauty project, the preparations for the future ILC and CLIC, LHC start up and upgrade scenarios and a lecture on *'The Future of Supercomputers' by* R. Petronzio, University of Rome II & INFN.

Closing lectures by G. 't Hooft and A. Zichichi concluded that particle physics looks forward to exiting times with LHC about to start. We believe to see confirmation of present theories beyond the Standard Model but we may be confronted with the totally unexpected discovery. With reference to the interpretation of RHIC data on heavy ion collisions and in view of the ALICE experiment at LHC, A. Zichichi presented one example of how to look for the totally unexpected event. Together with his collaborators he studies an experimental set-up allowing to probe quark gluon colored world (QGCW) with hard scattering probes. A beam of known particles (p, n, γ, e, μ) bombards the QGCW at the instant of its existence, during the heavy ion collision at LHC and a special set of detectors measures the properties of the outcoming particles.

Celebrating the 60th anniversary of the co-director of the school, Gerardus 't Hooft, the school ended in a festive atmosphere and the distribution of diplomas to the young talents including the 2006 prize for the best student, which went to Mrs. Yasuko Hisamatsu, University Tokyo, for her presentation of the MEG-experiment "*Search for lepton flavour violation in the decay 'μ – e γ'*", probing GUT scale physics and in preparation at the PSI, Switzerland by a collaboration of Japan, Italy, Switzerland, Russia, USA.

Report from Horst Wenninger, CERN

For further information see:
http://www.ccsem.infn.it/issp2006/index.html