

Symposium - Symmetries and Phases in the Universe

Monday, 23 June 2008 - Wednesday, 25 June 2008

Kloster Irsee

Scientific Programme

TALKS

(ordered by speaker's last name)

speaker: Lars **Bergström**

affiliation: University of Stockholm, Sweden

title: *Dark matter: candidates and detection methods*

abstract:

With the LHC soon starting, and many new methods of detecting dark matter are reaching into theoretically interesting parameter regions, the hunt for finding the identity of dark matter is entering a crucial stage. A review of some of the more frequently discussed candidates and detection methods will be given.

speaker: Pierre **Binétruy**

affiliation: APC Paris, France

title: *Brane inflation*

abstract:

I discuss how inflation scenarios are constructed in the context of string and brane models. The most relevant difficulties encountered along the road as well as the solutions envisaged to solve them will be reviewed. Open questions as well as predictions for observables will be discussed.

speaker: Peter **Braun-Munzinger**

affiliation: GSI, Germany

title: *Ultra-relativistic nuclear collisions and the QCD phase diagram*

abstract:

We discuss recent experimental results on the collisions of atomic nuclei at ultra-relativistic energies. In such collisions a very hot and dense fireball is formed which equilibrizes rapidly and expands collectively much like an ideal fluid. At least initially the fireball is dense enough to strongly degrade the energy of high momentum partons. We will demonstrate that hadron production takes place at the phase boundary between QGP and the hadronic phase and discuss the implications of this finding. Finally, we will discuss how various probes such as heavy quarks and quarkonia can be used to diagnose the QGP and discuss the prospects of QGP research at the LHC accelerator which will start operations in summer 2008.

speaker: Wilfried **Buchmüller**

affiliation: DESY, Germany

title: *Baryogenesis and dark matter*

abstract:

The classical picture of GUT baryogenesis has been strongly modified by theoretical progress concerning two nonperturbative features of the standard model: the phase diagram of the electroweak theory, and baryon and lepton number changing sphaleron processes in the high-temperature symmetric phase. We review three viable models, electroweak baryogenesis, the Affleck-Dine mechanism and leptogenesis and discuss the prospects to falsify them. All models are closely tied to the nature of dark matter, especially in supersymmetric theories. In the near future results from LHC and gamma-ray astronomy will shed new light on the origin of the matter-antimatter asymmetry of the universe.

speaker: Daniel **Denegri**

affiliation: CERN Switzerland

title: *Mass generation in the universe*

abstract

The present status of the LHC project will be described, i.e. the progress on the commissioning of the LHC and the expected start-up scenario for mid-2008. In particular, the status and commissioning of the Compact Muon Solenoid (CMS) detector will be discussed. In the science part of the talk, some physics expectations concerning top studies, Higgs searches, supersymmetry and extra dimensions studies will be presented.

speaker: Alvaro **de Rujula**

affiliation: CERN Switzerland

title: *The threat of dark science*

abstract:

Much of this symposium will be devoted to the "science of the dark": dark mass and energy, black holes, the universe when it was not transparent to visible light, etc. My talk, contrariwise, will be dedicated to the brightest objects sometimes visible by eye from cosmological distances: gamma-ray bursts (GRBs). There has been considerable progress in the understanding of GRBs

during the recent "Swift era". This satellite has filled a gap in the observations of GRBs and their afterglows, mainly in the X-ray domain, wherein previous information was scarce. I contend that GRBs are very well understood, since the predictions for them are fulfilled in detail, in spite of the elementary simplicity of the underlying physics. I shall concentrate on the science of the subject, but my title refers to its dark sociological aspects, which may be threatening in other domains as well.

speaker: Gino **Isidori**

affiliation: LNF Frascati, Italy

title: *The breaking of CP and flavor symmetries*

abstract:

Within the Standard Model flavor and CP symmetries are broken only by the Yukawa interaction. Recent experimental results on the decays of "beauty" and "strange" quarks confirm this mechanism, and put stringent constraints on possible new flavor and CP symmetry-breaking terms. We discuss the consequences of these results for extensions of the Standard Model with new degrees of freedom around the TeV scale. We also outline the importance of future low-energy experiments, both in the quark and in the lepton sector, in shedding light on this problem.

speaker: Manfred **Lindner**

affiliation: MPIK Heidelberg, Germany

title: *Neutrinos as probe of new physics*

abstract:

Neutrinos are very special particles which give unique insights into various fundamental issues in particle and astroparticle physics. On the other side, neutrinos are also very special probes into the different sources. This leads to interesting connections to astrophysics, cosmology, nuclear physics and geophysics. A selection of recent results and an outlook on future developments will be given.

speaker: Angela **Olinto**

affiliation: University of Chicago, USA

title: *The origin of the highest energy particles*

abstract:

After almost a century of observations, the ultra-high energy sky has finally displayed an anisotropic distribution. A significant correlation between the arrival directions of ultra-high cosmic rays measured by the Pierre Auger Observatory and the distribution of nearby active galactic nuclei signals the dawn of particle astronomy. These historic results have important implications to both astrophysics and particle physics.

speaker: Keith **Olive**

affiliation: University of Minnesota, USA

title: *Big Bang Nucleosynthesis: status of concordance*

abstract:

An overview of the standard model of big bang nucleosynthesis (BBN) in the post-WMAP era is presented. With the value of the baryon-to-photon ratio determined to relatively high precision by WMAP, standard BBN no longer has any free parameters. In this context, the theoretical prediction for the abundances of D, He-3, He-4, Li-6, and Li-7 is discussed. The observational determination of the light nuclides is also discussed. Emphasis is placed on systematic uncertainties in He-4 observations and the present Li-7 discrepancy. Possible explanations for the latter are reviewed.

speaker: Thanu **Padmanabhan**

affiliation: IUCAA Pune, India

title: *Gravity: The inside story*

abstract:

I will describe an alternative perspective on gravity which describes it as an emergent phenomenon (like e.g., elasticity). This approach provides a deeper understanding of several inexplicable features of conventional gravity related to the thermodynamic properties of horizons. The field equations arise from an entropy maximization principle and reduce to standard Einstein's equations at the lowest order. The new perspective also has important implications for the cosmological constant problem which I will discuss.

speaker: Bernard **Schutz**

affiliation: AEI Potsdam, Germany

title: *Gravitational wave cosmology*

abstract:

The gravitational wave detectors LIGO and VIRGO will begin regular observations of merging binary neutron stars and black holes at modest redshifts by 2014 and perhaps even sooner. LISA, whose launch is presently scheduled for 2018, will observe the inspiral and merger of massive black holes out to any redshift at which they occur in LISA's frequency band. These systems are 'standard sirens' whose signal contains enough information to determine their luminosity distances. This is a calibration-free distance measure, independent of the usual cosmic distance ladder. Neutron-star coalescences may be associated with short gamma-ray bursts, whose redshifts can be obtained from their afterglows. The resulting measurement of the Hubble constant by LIGO and VIRGO could reach the 1% accuracy level. In the case of LISA, recent work on its ability to locate

binary signals suggests that, at redshifts of order 1, positions should be accurate to tens of arcminutes. If black-hole coalescences mark their host galaxies in an observable way, then LISA could measure dark energy and its evolution with an accuracy competitive with that expected from many survey techniques, and it would have the chance of directly measuring the luminosity-distance relation out to redshifts of 5 or greater.

speaker: Joe **Silk**

affiliation: University of Oxford, UK

title: *The evolution of structure in the universe*

abstract:

The origin of the galaxies represents an important focus of current cosmological research, both observational and theoretical. Its resolution involves a comprehensive understanding of star formation, galaxy dynamics, dark matter and the cosmology of the very early universe. It is a field that is largely driven by a phenomenology that depends on our accumulating data taken with the largest available telescopes. I will review our current understanding of galaxy formation and assess the challenges that lie ahead.

speaker: George **Smoot**

affiliation: LBL Berkeley, USA

title: *The Cosmic Microwave Background*

abstract:

This talk reviews the current status of observations of the cosmic microwave background and prospects for the next few years with emphasis on polarization observations.

speaker: Wolfram **Weise**

affiliation: TU Munich, Germany

title: *Phases of QCD*

abstract:

A survey is given of present views concerning the phase diagram of Quantum Chromodynamics, with emphasis on quark-gluon matter under extreme conditions of temperature and density. Recent results from lattices QCD are reviewed. Approaches for modeling QCD thermodynamics, its symmetry breaking patterns and phases are outlined. Current physics issues related to the phases of QCD, from the early universe to high-energy nuclear collisions and properties of neutron stars, are discussed.

