

## Daily Newsletter – Thursday, July 23<sup>rd</sup>

*Welcome to Vienna and this year's EPS conference on High Energy Physics. This newsletter will guide you through the highlights of the day.*

### Astroparticle Physics, Cosmology and Gravitation

Scientists from the Pierre Auger Observatory, the largest Ultra High Energy Cosmic Rays detector in the world, will present results that cannot be described by current models. The accelerated expansion of our universe is by now a well-established fact and is believed to be due to an unknown dark energy that dominates the energy density of our current universe. There will be discussions on different theoretical approaches to describe this dark energy as well as reports on the first results from the Dark Energy Survey.

### Flavour Physics and Fundamental Symmetries

Today's program is an impressive demonstration of the capability of Flavour Physics to constrain new physics with precision measurements. The morning is devoted to the B decays which are strongly suppressed in the Standard Model. LHCb has recently found indications of large unexpected asymmetries in  $B \rightarrow K^* \mu \mu$  and hints of lepton universality violation, we will hear updated experimental results and a critical reassessment of the theoretical uncertainties.

The afternoon starts with searches for 'dark particles' which appear in models that explain dark matter or inflation. LHCb presents new results on searches for low mass dark bosons, NA48/2

searched for a dark photon in the Dalitz decays of the neutral pion. The rest of the day covers searches based on CP-violation in B and  $B_s$  mixing. New experimental results and improved theoretical predictions are shown.

### Higgs and New Physics

Two main subjects are: the impact of the properties of the Higgs boson on new physics models and the legacy of Run 1 searches for Supersymmetry, one of the most promising among these models. One contribution uses the relative rate of two Higgs boson decay channels to distinguish between the Higgs sectors in supersymmetric and other models. A talk on "compressed SUSY searches" will summarise results on models which may be missed by standard approaches. "The Standard Model as an Effective Field Theory" describes nature in a certain range of validity, beyond which a more fundamental theory must take over. Here the idea is illustrated by a definite example, embedding the SM into the MSSM.

### Top and Electroweak Physics

Given all Standard Model parameters are known, this session concentrates on what they can tell us about BSM models. Talks will be given on precision measurements and theoretical predictions of W and Z production, Drell-Yan processes and gamma-gamma reactions where forward detection capabilities of the LHC experiments play an important role. The afternoon sessions focus on the top quark: Single top production results using Tevatron and LHC data, new top pair total cross section measurements from D0, new experimental results concerning differential top production cross section,

as well as boosted tops. Simulation studies of top pair production associated with prompt photons at NLO precision are shown.

## QCD and Hadronic Physics

Quarks are some of the building blocks of matter. They were believed to only assemble in groups of two or three, but very recently, some composite particles were found containing four quarks. The LHCb Collaboration will now present its recent discovery of pentaquarks, groups of five quarks, which were only found last week.

## Neutrino Physics

Japanese T2K experiment with a baseline of 295 km will disclose first results on muon antineutrino oscillations which will allow a comparison with neutrino results and possibly give new insight into fundamental particle-antiparticle symmetries in the neutrino sector. A whole afternoon session is devoted to the controversial issue of sterile neutrinos, which have no Standard Model interactions and communicate with the standard neutrinos only via oscillations. If confirmed, sterile neutrinos would constitute physics beyond the Standard Model with far-reaching consequences in particle and astroparticle physics.

## Heavy Ion Physics

In the collisions of heavy ions, the nuclear matter can undergo a phase transition from hadrons to a state of deconfined quarks and gluons, the Quark-Gluon Plasma (QGP). Suppression of heavy quarkonia ( $J/\Psi$ ,  $\Upsilon$ ) has been predicted to be a probe of the created QGP and will be reviewed today. Another phenomenon to be discussed (related to the previous one)

is the energy loss of high-momentum partons in the Quark Gluon Plasma, leading to modified jet and hadron cross-sections and correlations, called ‘jet quenching’. For theoretical physics, to understand extremely fast thermalization of the quark-gluon plasma remains a major challenge.

## Social Events

Today the Mayor of Vienna invites all participants of the conference to a reception at a “Heuriger”, a typical Viennese cultural must!

In the courtyard of the University there are multiple exhibitions displayed. Art@CMS is an education and outreach initiative of the CMS experiment. In “Passionate about” the photographer Bree Corn explored physicists’ key motivations. A photo-essay by Kate Shaw & Jack Owen puts women in physics in the Palestinian territories in the spotlight.

The public talk “Physics meets Medicine” presents beam therapy at MedAustron, one of the leading centres for ion beam therapy and research.

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