

## Editorial

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This edition of the Proceedings of Science contains papers presented at the 12<sup>th</sup> International Conference on *B*-Physics at Hadron Machines (Beauty 2009) which took place between 7 – 11<sup>th</sup> September 2009 at the 100 year-old building of the Physics Institute, Heidelberg University, Germany. This was the latest in a series of meetings dating back to the 1993 conference held at Liblice Castle in the Czech Republic. The aim of the Beauty series of conferences is to review results in the field of *B*-physics and CP-violation, as well as to explore the physics potential of current and upcoming *B* physics experiments, especially those at hadron machines.

More than 70 participants attended the conference. The programme covered all new results in the field of beauty and charm physics, plans for physics analyses at currently running machines, and the future potential for new facilities. The excellent talks all generated lively discussion.

The previous Beauty conference, held in 2006 in Oxford (UK), was marked by the impressive successes of the two Tevatron experiments CDF and D0, and the superb performance of the two *B* factory experiments, BaBar and Belle. At that time, it was expected that the Heidelberg conference would review the first data and provide the first *B*-physics measurements from the LHC. Unfortunately the LHC accident of September 2008 dashed these hopes, nevertheless the conference still had many exciting results and developments to present. There were several exciting sessions devoted entirely to the status of the LHC detectors ALICE, ATLAS, CMS and LHCb, their commissioning achievements, their physics perspectives and possible upgrade scenarios. It was impressive to see the progress of the four collaborations in their analysis of millions of cosmic ray and proton beam (“splash”) events, recorded in September 2008. The detectors were demonstrated to be in excellent readiness and very well prepared to record the first proton-proton collisions scheduled for the end of 2009. The speakers presented detailed planning of the experiments to record and to analyze the very first LHC data, and their perspectives for future *B*-physics measurements at this exciting new machine.

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The Nobel-Prize awarded to Kobayashi and Maskawa in 2008 for the relationship between the mixing of three quark generations and the violation of CP symmetry in the Standard Model marked a resounding success for flavour physics. However, the focus of today's and future precision heavy-flavour experiments is no longer the confirmation of the CKM mechanism in the Standard Model, but the search for new phenomena, and to challenge theory with high-precision measurements. At Beauty 2009, the wide-ranging possibilities to search for new physics in the decays of heavy-quark flavours was therefore a common theme.

The conference first reviewed in detail the status of the unitarity triangle. A remarkable achievement of the  $B$ -factories is that the angle  $\beta(\phi_1)$  is now known to a precision of less than  $1^\circ$ , the angle  $\alpha(\phi_2)$  has an error of less than  $5^\circ$ , and for the angle  $\gamma(\phi_3)$  there are first pioneering measurements but still with large errors. Significant improvements by the LHCb experiment, in particular for the angle  $\gamma$  down to  $2^\circ$ , are expected in the next few years. The knowledge of the triangle sides is currently limited by theory, with an error of the most precise side of 3% (measured through  $B$  mixing and limited by lattice QCD uncertainties). Overall the  $B$  meson measurements show excellent agreement with Standard Model predictions, despite a slight "tension" observed for the result of  $|V_{ub}|$  and the direct measurement of the angle  $\beta$ .

Tantalising hints of possible new physics were also presented at the conference. One of the highlights was the determination of the CP violating  $B_s$  mixing phase  $\phi_s$  in  $B_s \rightarrow J/\psi\phi$  decays, where the combined Tevatron results for the phase  $\phi_s$  differs by about 2 sigma from the Standard Model prediction. A small deviation from theory has also been reported by Babar and Belle for the muon forward-backward asymmetry measured in the  $\mu\mu$  rest frame of  $B \rightarrow K^*\mu\mu$  decays, an asymmetry that is very sensitive to new physics scenarios. Whether these deviations are confirmed as the first sign of new physics will be answered soon by the LHCb experiment. For both measurements the LHCb collaboration expects significant results with a data-set of less than  $500\text{pb}^{-1}$ .

The continuation of flavour physics beyond the current LHCb experiments was also an important topic of the conference. According to current plans, LHCb will collect data corresponding to a total of  $10\text{fb}^{-1}$ , or  $10^{13}$   $B$  mesons produced inside the acceptance of the detector. Nevertheless this data sample will still not fully exploit the enormous potential of flavour physics. Detailed and ambitious plans of the LHCb collaboration to operate the detector at a factor 10 higher luminosities were presented. There are complimentary proposals to further exploit flavour physics by next-generation asymmetric  $e^+e^- B$  factories. KEK has taken the initiative to work on an upgrade of the existing KEK-B machine and the Belle detector. A second proposal to build a *Super Flavor Factory* in Italy is also at a very advanced level and was also presented at the conference. Both "Super-B" projects aim to collect the first  $50\text{ab}^{-1}$  of data by 2020.

The Beauty 2009 conference was the first meeting without Prof. Peter Schlein, the founder of the conference series and the conference chair up to 2006, who sadly passed away in February 2008. The Heidelberg conference was dedicated to the memory of this exceptional physicist. It was Peter who, at a very early time, had the vision to exploit the large  $b$  quark production in forward proton-proton collisions for the precision measurements of  $B$  hadron decays. Peter was remembered in a very moving speech by Dr. Samim Erhan and after in a concert at which the *Sonata Hebraica for Viola and Piano* composed by Peter Schlein's father Irving was performed. It was the focus of

Peter Schlein's later years to bring the beauty and originality of his father's musical works to the attention of a wider audience.

The Beauty 2009 conference had a rich programme of social activities which enabled additional discussion outside of the conference room. The Monday session concluded with a barbecue in the garden of the institute. On Tuesday evening there was the concert in memory of Peter Schlein in the *Alte Aula* of the University followed by a reception. The conference excursion on Wednesday afternoon visited the Romanesque cathedral of Speyer and the Castle of Heidelberg. The Conference banquet took place on Thursday night in the *Palais Prinz Carl* and was concluded with an after-dinner speech by Prof. Neville Harnew. The conference closed on the afternoon of Friday, 11<sup>th</sup> September with an excellent summary talk by Prof. Kevin Pitts who sketched the developments and achievements, and the hopes and aspirations in the field of *B* physics.

In conclusion, the conference was extremely lively and highly successful. *B*-physics continues to flourish and has an exciting future ahead. We wait in great anticipation to the long-awaited heavy flavour results from the LHC, which we expect to provide a window on new physics beyond the Standard Model. We look forward to the next (13<sup>th</sup>) International Conference on *B*-Physics at Hadron Machines (Beauty 2011) which will be held between 4 – 8<sup>th</sup> April 2011 in Amsterdam, the Netherlands.

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