

# **DESY PRC 73 Recommendations**

**(Final and updated Version – 04 June 2012)**

## **ATLAS**

The DESY ATLAS group is making very strong contributions to the collaboration and is highly visible in physics analyses, on the tracker upgrade project, and on software and detector operations. The PRC is pleased to note that the manpower situation on the PETAL project now seems to be adequate. The group has formally joined the operation team of the Silicon Tracker and is making a very good start with well-defined commitments. We strongly recommend that a computing-oriented position to be opened for the ATLAS group in order to strengthen their connection with IT and the NAF.

The PRC congratulates the DESY ATLAS group for their considerable achievements.

## **CMS**

The DESY CMS group continues to make very strong physics contribution to the CMS collaboration. There are conference results and papers in all areas of involvement. The PRC is pleased to note the continued increase in the number on PhD students. The group is also making strong contributions to detector operations, upgrades in computing. Members of the group hold leadership roles in CMS management, operations as well as in physics coordination. The upgrade work proceeds on track with the new LHC schedule. The PRC is pleased to note the first public physics results using CASTOR. The communication and joint planning with IT on NAF is beginning. The first quarterly meeting between IT and NAF has taken place. The PRC encourages this communication and cooperation.

The PRC congratulates the DESY CMS group on their considerable achievements.

## **Computing/NAF/TIER 2**

DESY has set up a very efficient high-performance infrastructure for LHC data processing, simulation and analysis. The LHC Tier2 at DESY provides 5% of the total Tier2 capacity for each of the two experiments, ATLAS and CMS, and is among the most reliable resources in the LHC computing Grid. The remaining grid resources in Germany, 7.5% of the total Tier2 resources in ATLAS and 2.5% in CMS, are installed mostly at German universities with hardware funds provided by Helmholtz Alliance "Physics at the Terascale". This funding ends in 2012, and presently no solution has been found to further support this very successful distributed Tier2 infrastructure in Germany. The PRC strongly encourages DESY to take an active role in securing both the amount of resources needed and the very fruitful collaboration between DESY IT and the Tier2 sites at universities.

With the National Analysis Facility (NAF) DESY hosts an infrastructure for LHC data analysis on which many German institutes rely. The PRC is pleased to see that the increase in available resources is about in line with the recommendations in the NAF review made available in autumn 2011. The usage of the NAF is well distributed among experiments, DESY and external users. The PRC is happy to see that quarterly meetings between the experiments and IT have started, and we encourage such communication to continue and increase.

Filling a computing position for DESY ATLAS that is equivalent to that in DESY CMS is very important in maintaining a good connection to IT for the DESY ATLAS group. Compared to the analysis presented in the NAF report, DESY IT still lacks manpower ( $\sim 2$  FTE) for NAF support; this severely limits the ability of IT to respond to some of the recommendations of the report, like improved monitoring or provisioning of interactive tools. Special concerns of ATLAS, like the split of their data set between Zeuthen and Hamburg, should be addressed at the quarterly meeting and involve the directorate(s) if necessary.

## OLYMPUS

The PRC congratulates the collaboration to the enormous progress since the last meeting.

For the data taking in January/February, the problems with noise in the chambers and with the target cell heating have been solved. The beam parameters of DORIS have been very well understood and the machine operation has been well optimized, i.e. it was found that running in top-up mode is less efficient than refilling the machine. All detectors apart from the GEM tracker have been operated stable together with the common DAQ and the slow control. During the data taking it was discovered that there is a mismatch by a factor of 4 between the calculated luminosity from the beam current and the target slow control information and the values obtained from the three different luminosity detectors.

The PRC recognized that 1) to understand this luminosity discrepancy with the finalized offline software and 2) to install the well-tested GEM tracker are the most critical items to be completed before the final data taking period, October-December in 2012.

To reach the integrated luminosity needed to separate the difference in the electron-proton and positron-proton elastic cross section due to the two photon exchange, the DAQ dead-time has to be decreased from the current 25% to 5% level. A factor of  $\sim 10$  of the trigger reduction is expected to be achieved by implementing a 2nd-level trigger requiring hits in the different wire chamber planes.

The collaboration is encouraged to set up, in addition to the DESY test beam, a cosmic test stand for the GEM tracker. It is of high importance that the correct gas mixture, HV setting and other operational parameters are well determined and understood before the tracker is installed in the detector.

The PRC recommends a readiness "review" in September (scheduled for 24<sup>th</sup> of September 2012) with members of the PRC and the DESY management. This review should clarify if the critical topics for the final data taking period listed above have been resolved.

At the next PRC meeting the collaboration should present the well analyzed results from the data already taken. This should include results showing the left and right detector asymmetries are under control by changing electron and positron beams, and reversing the magnetic field direction. The collaboration showed an intention to run also at higher beam energy, i.e. 4 GeV. For such an extension a concrete run plan must be presented at the next PRC meeting with verified experimental feasibilities.

Further we recommend continuing the support from DESY on the current level, as it is critical for the success of the experiment. The impact of running PETRA in parallel to OLYMPUS should be kept at the absolute minimum. It would be good if a plan could be devolved how Olympus could get beam time beyond December 2012 in case of a technical emergency would occur during the data taking in autumn.

The PRC is looking forward to hear about a successful autumn data taking period.

## **ZEUS**

The ZEUS collaboration has once more shown significant progress on the finalization of important analyses. The conversion to the future-proof data format ("common n-tuples") is complete, and the ZEUS efforts on long-term data preservation are also progressing very well. The PRC is very pleased with the outline of the future structure of the collaboration, which will keep the collaboration functioning beyond 2014; the requested moderate organizational support by DESY is strongly recommended. Many young students are still interested to pursue physics studies using ZEUS data, and the ZEUS collaboration is organizing sufficient supervision for these projects. Altogether, there still is a rich physics potential in the ZEUS data, and the PRC recommends providing all possible support to enable future publications based on ZEUS data. As DESY will not be able to fund students for ZEUS beyond 2014, the PRC suggest to explore new ways, either by more intensively pursuing combined PhD theses on HERA and LHC data, or by identifying new external funding sources (e.g. DAAD fellowships).

In conclusion, the PRC is very satisfied with the progress and future planning of the ZEUS collaboration, and most strongly recommends the requested support by DESY as the host laboratory.

## **H1**

We congratulate H1 to its very visible and unabatedly ongoing publication output, proving increasing efficiency in analysis organization in times of linearly decreasing person power. We expect that recent analysis results surpassing theory precision encourage corresponding work on theory side. Rewarding analysis contributions are made possible by continuous support for scientists visiting DESY. We recommend sustaining this support still after 2014 especially if the related HERA analyses are combined with or create input for LHC analyses. We explicitly acknowledge the central contributions and the strong push from H1 both to HERAfitter and to the HERA data preservation efforts.

H1 has set up a very promising and elaborate long term organization plan, which is clearly very well suited for securing long-lasting effective and active contributions from the remaining authors. The

implementation of the plan has already begun and is well on schedule. We encourage DESY to support this organizational effort with secretarial support on appropriate level, which should not stop after 2014 but level out at 0.1 FTE on long term.

## **HERMES**

The PRC congratulates the HERMES collaboration for their continuous progress producing high impact results and papers. This scientific output is well recognized by the community receiving still a high number of talks at conferences, although a decline is visible. The extraction of the full set of TMD amplitudes together with an impressive set of DVCS amplitudes is a formidable accomplishment to be acclaimed by the PRC. The physics publication on DVCS utilizing the recoil detector will soon be submitted for publication. However, the PRC raised some concern about the slow progress to finish the technical recoil detector paper. The PRC notes that the activities on the HERMES data preservation have made very good progress.

For the next PRC the collaboration is requested to show a plan on the finally decided new collaboration structure and on its implementation. Moreover, the PRC would like to see a prioritized publication plan/roadmap how the high impact papers are finished.

We recommend that DESY continues the highly appreciated support of the collaboration to extend the terms for Postdocs and PhD student. The PRC raises some concern that soon there is no DESY person anymore involved in the HERMES experiment.

## **HERAFITTER/PDFs**

The PRC notes that the acceptance by the LHC and PDF theory communities of the HERAFitter project has made rapid progress in the last six months. The proposal to foster the growth of this development appears to us to be well justified. The proposed organization of a steering committee is adequate for the near future. We feel it is important to have a theory representative in the steering committee. The PRC encourages the DESY laboratory to support the HERAFitter project with manpower, where appropriate.

We congratulate the HERAFitter team on achievements so far.

## **Data Preservation Project**

The PRC is very satisfied with the enormous progress in the data preservation project driven by DESY IT and the HERA collaborations H1, HERMES and ZEUS. In particular, the extensive validation procedures to guarantee the long-term integrity of the data and the functioning of the software components are important and very much appreciated ingredients. In addition, the efforts to archive non-digital data and internal documentation are essential to enable future understanding of the physics results achieved and

enable new analysis using the frame works set up within the data preservation project. Naturally, preservation aims at securing long-term access, and needs corresponding support concerning both the IT-related and the experimental expertise. The PRC most strongly recommends to provide the necessary long-term support of 1/2 FTE per supported experiment, in addition to the efforts of the DESY IT division.

## Astroparticle Physics

The PRC acknowledges the thorough and informative presentations given in the open and closed sessions, showing the high quality of research and presenting clear views on the future.

**Astroparticle Theory:** The astroparticle theory group was created about three years ago by the installation of the joint faculty position of Martin Pohl at the University of Potsdam and at Zeuthen, profiting both from astronomy at Potsdam University and AIP, as well as from the experimental groups actively pursuing astroparticle experiments at Zeuthen. The topical research is very close to experimentalist's interests and the number of yearly publications is high.

The PRC welcomes efforts to apply for increased third party funding to further increase the size of the group, to install collaborative structures and to improve the supervision of an increasing number of students by the conversion of a postdoc position to a permanent position at Zeuthen. The PRC also supports the wish for access to adequate shared mid-size computing resources of approximately 1000 cores.

**Gamma Ray astronomy:** DESY is participating in three active ground-based gamma ray Cherenkov telescopes (H.E.S.S., Magic and VERITAS), as well as in the analysis of data from the Fermi satellite. The common goal of all participants is the preparation and exploitation of the Cherenkov Telescope Array (CTA) observatory, where important technical contributions by DESY, for example the construction of a mid-size telescope prototype, are well on track. In the discussion, the question was raised whether a concentration on fewer groups and a stronger focus on CTA would be advisable. It was pointed out that there is enough critical impact in all areas (e.g. DESY is the largest single group in VERITAS and among the largest groups in CTA) and that it is very important to be actively engaged in physics analyses well before the start of CTA. Efforts to exploit synergies among the running experiments, by e.g. using the CTA framework and other tools, by combined fitting of spectra from different instrument and by a common seminar are being undertaken. The camera electronics upgrade for H.E.S.S. should be ready within 2-2.5 years, when the focus of all participating scientists will turn to CTA construction. Zeuthen sees itself as a leading institute in astroparticle physics and wishes to go further in this direction.

The PRC appreciates the efforts and encourages DESY to keep exploiting synergies among gamma ray experiments, e.g. by initiating joint publications combining complementary studies from different groups.

## Theory/Lattice Gauge Theory

In this report the PRC was specifically asked to review the lattice activities of the DESY Theory Group. The DESY Lattice group is part of the ETM and ALPHA international lattice collaborations doing interesting physics calculations and has also substantial expertise in hardware and software issues.

The lattice group is very active and is producing relevant results for the field. The ETM collaboration is using a lattice fermion formulation called twisted mass, which has several good features, including having discretization errors that start as the second power of the lattice spacing. This improved action compares well with improved actions used by other groups. It is useful for the community to have QCD lattice results based on different improved lattice actions.

ETM is currently running simulations with 2+1+1 fermions in the sea. They showed preliminary results for light and charm decay constants that are very promising and point towards improving the agreement with experiment. It will be very interesting to see the more definite results in the future.

The Lattice group has recently done a refined calculation for the hadronic contribution to the muon anomalous magnetic moment.

They have also performed a calculation of triviality bounds on the Higgs mass as a function of the scale of new physics that may be particularly interesting in the light of the recently observed excess in LHC data that seems compatible with a 125 GeV SM-like Higgs boson.

The DESY lattice group has a longstanding interest in flavor physics. Within the ALPHA collaboration they have used a nonperturbative scheme to calculate the running of the strong gauge coupling non-perturbatively.

They are also working on lattice HQET calculations of B meson quantities. They use a nonperturbative renormalization scheme and their results to date are based on quenched ( $nf=0$ ) and  $nf=2$  simulations.

The PRC values the diverse physics programme of the DESY lattice gauge theory group. The PRC encourages them to continue developing their techniques to meet the challenges of the next generation simulations.

The PRC strongly supports the lattice program at DESY site Zeuthen and its close collaboration with Humboldt University Berlin, as well as the partnership with other German Universities. The PRC encourages the DESY directorate to sustain support for the DESY based lattice gauge theory program and the simulation lab in Zeuthen.

## ALPS II

The DESY PRC has considered the Summary of the ALPS II physics case and the material submitted by the ALPS collaboration. The PRC also consulted with external referees in this domain.

The PRC considers that the ALPS II experiment has a projected reach that will allow it to explore axion like particles in new regions of parameter space beyond those that have been explored by other experiments such as CAST at CERN. This will demand an improvement of more than 3 orders of magnitude with respect to ALPS I, mainly relying on a revolutionary idea of resonant axion-photon regeneration, and hence it is important to clearly show the capability of the ALPS II technology to achieve such a goal. They will also be sensitive to hidden photons and mini-charged particles.

Many of the ideas for these types of new particles come from string theory and imply the existence of hidden sector states that coupled very weakly to the Standard Model particles. In the case of axions one can argue that their existence may provide an explanation for Dark Matter and, depending on the region of parameter space, for the strong CP problem. The latter is not at the expected reach of ALPS II.

Other hidden sector particles are not compelling in the sense that they are not needed to solve any particular problem of the Standard model of high energy physics, and hence their properties are not well constrained. On the other hand, there are some tantalizing hints that an axion-like particle may provide a solution to the observed transparency of the universe to high energy gamma rays and to the apparent non-standard cooling of white dwarfs. Here the strength of the proposed ALPS II experiment is that It is not predicated on any astrophysical assumptions and could explore interesting regions of parameter space connected with these astrophysical explanations.

In summary, in the last few years the axion physics community has seen strong growth. There are axion dark matter searches, solar axion searches and searches for axion-like particles by shining light through walls. In the latter category, the obvious next step is in the direction of the ALPS-II experiment or experiments of similar sensitivity such as the one planned by the GammeV collaboration at Fermilab.

The physics case for ALPS II is promising. Its success will depend on the ALPS II capability to achieve the claimed sensitivity and will involve a high but reasonable element of risk, in the sense that it will be exploring uncharted territory were there might be no new particles.

The PRC would like to request the ALPS II TDR by Aug. 31st, 2012, and will like to determine external experimental referees, including experts on laser physics, who will be informed by DESY well before the submission date. Experts on the experimental issues should be agreed upon with the ALPS II collaboration.

The PRC as well as the external referees will further consider the physics case in the light of the TDR. The PRC recommends a one-day special workshop on ALPS II, to be organised the day before the next PRC meeting in Zeuthen, i.e. on November 7th, 2012, in close consultation with the PRC.

## **BELLE II**

The PRC is pleased to see this promising new addition to the DESY HEP program.

BELLE II offers excellent technical and physics potential for DESY participation. The PRC notes that several areas of involvement have already been proposed, including a challenging vertex detector project. The DESY effort, so far, mainly consists of part-time people. This will need to evolve quickly to more full-time participation in view of the aggressive schedule for construction of the detector.

The PRC endorses the plan to join BELLE I as part of the plan to ramp up physics analysis towards BELLE II, and supports the plan to recruit students for analysis work.

The PRC congratulates the BELLE II team for starting an interesting new initiative for DESY HEP.

#### **DESY TEST BEAM**

The PRC recognizes the DESY test beam as an important, and extensively used, facility for the HEP community. The three areas into which beam is delivered saw record availability over 99% in 2012 for a wide variety of experiments and detector types.

The DESY test beam will be very important to the community again in 2013, especially as there are projected to be no test beams available at CERN or Fermilab during this period.

The PRC notes that the test beams are supported by a dedicated, but part-time, team and suggests that a more efficient and systematic management would be achieved by the support of a full time person.

Some investment to increase availability, for instance by enabling parallel installations and the use of both beam polarities, should be considered.

A possible fruitful extension of the present test beam facilities could be their integration into the proposed Detector Laboratory.

The PRC congratulates the DESY test beam team for providing a valuable and vital service to the community