

# Recommendations of the 77.PRC

Final Version – 16 May 2014

## LHC Experiments:

### **ATLAS**

The DESY ATLAS group continues to make strong contributions to the experiment. The group pursues a strong portfolio covering Standard Model and top physics analyses, a search for electroweak SUSY production and makes a strong impact in Higgs physics. The PRC takes note with pleasure that 6 new papers mainly on 7 TeV analyses have been published with several 8 TeV analyses in the pipeline. The PRC congratulates the group for their healthy physics analysis program where YIGs play a crucial role. The continued involvement of senior staff in physics analysis complementing the core involvements in Higgs, Standard Model and top physics is encouraged. In view of the discovery potential of the impending 13 TeV run, physics beyond the Standard Model searches (exotics, SUSY) should be further expanded.

The DESY ATLAS group also makes important contributions to SCT and ALFA operations and shoulders a large responsibility in generator validation and MC production as well as simulations for phase 2. As a recent addition, an involvement in the ATLAS conditions database has been started. The group is also heavily involved in the ATLAS phase-0, phase-1 and phase-2 upgrades. In particular, the PETAL 2014 project could reach a major milestone with the fabrication of the first modules and their integration in the petalet. The PRC notes that the group is well poised to play a leading role in the ATLAS phase-2 upgrades and that funding needs to be secured in the coming year. The PRC congratulates the DESY ATLAS group on their many accomplishments.

### **CMS**

The DESY CMS group consists currently of 21 staff, 20 postdoc and 25 PhD Students, and technical staff in addition. The PRC notes that both, CMS and LHC are proceeding well for their preparation for Run II. DESY CMS group members are taking many important coordinating responsibilities within the CMS collaboration, including the position of the deputy spokesperson. The group is engaged in many physics analyses including those on Higgs, Top, SUSY and QCD. Planning for the 13 TeV analyses is also in a good state.

For the Phase 0 upgrades, the new BCM has now been tested in the DESY test beam and the installation is planned for later in the year. The installation of SiPMs in the outer hadron (OH) calorimeter is now complete and commissioning is underway. For Phase 1, a full-sized barrel pixel module has now been successfully bonded in house. They are on track for starting the module production later in this year. The DESY CMS group continues to make strong contributions to the experiment and plans for Run II both for physics and detector are in a good state. A new YIG group has joined recently, strengthening top analysis

efforts. The group holds leadership roles in management as well as physics. The role of DESY in endcap production for phase II is now clear. The PRC notes that it is crucial that the funding is secured in the coming year. We also note, as we did last time, that the continuation of effort on the BCM beyond 2014 is unclear and that CMS, DESY-CMS and DESY needs to clarify this issue. Finally, the PRC congratulates the DESY CMS group for their many accomplishments.

## **Computing/IT**

The DESY Tier2 continues to be one of the best performing Tier 2s in the world. The evolution of dCache that has taken place recently adds much very useful functionality for users. The migration to NAF 2.0 has been made successfully and is now a more efficient and maintainable system. The usage of the new facility by various groups looks strong. Nevertheless, the PRC notes that there are indications of shortage of manpower in the IT in view of the increasing demands from many areas of DESY.

## **HERA Experiments**

### **H1, ZEUS and HERMES**

The PRC congratulates all three collaborations for their still impressive number of high impact publications, results and the large number of highly visible presentations at several conferences. It is recognized that this becomes more and more challenging due to the declining person power in the collaborations and the end of HERA funding at DESY at the end of 2014. All three collaborations have implemented means of preserving their data for future use. We encourage all three collaborations to seek third party funding for continuing invitations of Ph.D. students from other countries to DESY to foster finalizing publications. The collaborations are encouraged to finalize the remaining high profile publications. It would be extremely helpful for all three collaborations if DESY could find some resources, which would help the collaborations to continue to give talks on the remaining high impact publications and results.

## **HERAFitter**

The PRC congratulates the proponents of the HERAFitter project of successfully establishing HERAFitter in the HEP community. HERAFitter is a unique Open-Source QCD and PDF framework that is complementary to global fits emphasizing experimental uncertainties. There is a sizeable community contributing to HERAFitter, including members of the ALICE, ATLAS, CMS, H1, LHCb, ZEUS and the theory community. Due to its open source nature, it flexibly allows the testing of phenomenological models as has been recently demonstrated. A first stable release has been achieved in December 2013 and efforts are ongoing to interface with HepData activities. Since its inception, it has been used in 19 public results out of which 10 are in peer-reviewed journals, with one physics analysis publication submitted by the HERAFitter developer team and one technical publication on HERAFitter in the pipeline. The PRC finds

the “opt-in” authorship of HERAFitter papers as particularly well suited to the open character of the project. The PRC encourages the HERAFitter group to continue to publish its own phenomenological studies.

The PRC suggests that DESY should continue to play a leading role in supporting the HERAFitter project intellectually and technically since its use could be two-fold: In addition to its clear role in precision Standard Model measurements (at LHC as well as HERA legacy measurements) it could prove a crucial asset for searches for beyond the Standard Model physics at the LHC@13-14 TeV should nature have decided to hide new physics close to Standard Model processes, requiring a superior determination of SM backgrounds at the few percent level. In order to keep HERAFitter alive, dedicated IT support and access to standard NAF facilities are vital. In addition, continued intellectual and managerial leadership by DESY personnel is highly desirable and should be recognized and encouraged. Due to its potential link to the LHC program, the PRC suggests that HERAFitter proponents and LHC stakeholders discuss the potential synergies and possibilities of long-term support for HERAFitter and report during the next PRC meeting.

### **PROSA**

The PRC acknowledges the important contributions of individual PROSA members to high impact papers from different collaborations, i.e. ATLAS, CMS, and of course in theory and phenomenology. The PRC notes that there has not yet been any publication as a whole and that the PROSA collaboration is not very visible in the HEP community.

It was difficult to discern what the added value of the PROSA collaboration to the scientific community is in addition to the individual accomplishments of the collaborations and theory authors. Therefore the PRC suggests that the PROSA collaboration presents what the goals of the collaboration are and how they will benefit the wider HEP community at the next PRC meeting.

The PRC would like to recommend considering a reorganization of PROSA in line with other groups, i.e. LEP & TEVATRON EW and New Phenomena and Higgs WG and HERA combination groups. This might also ease the possibility to obtain funding.

### **OLYMPUS**

The PRC congratulates the OLYMPUS collaboration for their steady progress since the last PRC meeting. The PRC appreciates the effort of the collaboration to keep the PRC informed also outside of the regular PRC meetings about the progress on the analysis. The PRC also appreciates the effort to publish NIM papers on the different detector components and recognizes that the one on the Olympus experiment and target have already been published. The PRC recognizes that the Monte Carlo will be absolutely critical to achieve a final high precision result. There has been significant progress in finalizing the MC,

especially on the sector of implementing radiative corrections for the different modeled processes. But there remains still significant work before a full analysis of all data can be attempted.

The PRC remains concerned about the manpower situation in the analysis. Unfortunately several collaborating institutes are still not involved in the analysis, which leads to the fact that key software and analysis tasks are currently only covered by single experts in non-permanent positions. The collaboration is asked again to make any effort possible to increase the number of people involved in the analysis and distribute tasks more widely through the collaborating institutions. It is unfortunate that despite the large effort of the collaboration to analyze the data it remains not possible to judge whether OLYMPUS is able to achieve its advertised high precision results.

The PRC request for the next meeting in October 2014 concrete numbers on the different systematic contributions to the final result.

It is recognized that DESY funding for OLYMPUS is coming to an end in 2014 – therefore, it would be preferable to have a preliminary result on the same time scale.

### **ILC@DESY**

The PRC is happy to see the DESY ILC group keeping active momentum after the submission of the Detailed Baseline Design (DBD) for the detectors. The group is congratulated for continued valuable detector development and work specific to the selected site in Japan. DESY's leadership role in the European ILC community is appreciated and also acknowledged in supporting the negotiations towards the realization of the ILC.

The committee encourages the group to explore the potential application of new technologies beyond those discussed in the DBD. More generic R&D should be useful in various fields later and enhance the basic strength of DESY in future. The committee takes notes that there is a concern regarding the activity in Zeuthen site where a core person is going to retire.

### **Belle/Belle2@DESY**

The committee was impressed that the DESY Belle group is working actively on the physics analyses in Belle covering,  $e^+e^- \rightarrow \mu^+\mu^-$  in terms of FB asymmetry, QCD vacuum structure using the  $e^+e^- \rightarrow 2(h^+h^-)$  reaction around  $E_{cm} \sim 10$  GeV and the penguin reaction of  $b \rightarrow s l^+ l^-$ . Further involvement in Belle physics is encouraged to attract more fresh students to DESY. The contribution of DESY to the Belle computing resources is significant. It is noted that the Belle II MC production carried out in DESY is the 2<sup>nd</sup> biggest after KEK.

The committee congratulates to the fantastic success of the VXD beam test performed in January at DESY, where all the components of the system including, the DEPFET PXD, the four layers of silicon strip SVD, the real DAQ framework and the CO2 cooling. The ROI algorithm of SVD in HLT is proven to work successfully. The performance of the alignment algorithm developed by the DESY group is also demonstrated. The committee is very happy to see the first important demonstration of the Belle II detector system towards completion in the coming years.

The committee expects the group to keep a leading position in the Belle II collaboration in the coming construction period.

## **Theory**

This time, there was no special PRC review on theory. In a brief discussion with DESY theory colleagues in the closed session, the PRC concluded:

- In future there will be two theory talks at one PRC meeting per year with rotating theory topics.
- At the next PRC meeting in fall 2014 (in Zeuthen) the PRC requests to hear open session presentations from Lattice Gauge Theory and Strings.
- Every third PRC there will be a talk on theoretical Astroparticle Physics.

## **ALPS II**

The ALPSII science remains compelling, in my opinion. There are hints of astrophysical signals, but these signals are controversial in their interpretation as new light particles. Overall, I feel the science is speculative, but as I said compelling. The group has a high profile. They are always mentioned as key players in the worldwide effort to discover axions and ALPS. The group also has good theory support, including that from A. Ringwald, who as well has a high worldwide profile in astroparticle theory. As yet I don't feel the CERN competition is serious. Also, the FNAL competition is not yet serious. The issue of additional on-site manpower for optics seems resolved by having brought in a new postdoc.

The experiment is challenging, as the ALPSII experimenters are well aware. Mostly their project development is proceeding well and is more or less on schedule. I note the following as risks:

1. IR leaks. As far as I know, the ALPS IIc specification for IR light rejection is unprecedented. I especially worry about non-linear processes in mirrors or filters that upconvert IR into the green. I believe ALPSII will certainly be able to identify this if it's happening. I believe there may be a way to use a completely opaque wall if the filters should be the source of these photons.

2. Metrology. I think the ALPSII mirror & table design is sensible in that it is simple and robust. The current mirrors do not achieve alignment specification, and the vendor is still developing fabrication. The current mirrors seem fully satisfactory to commission ALPSIIa, so the new mirrors are not delaying the project. However, should another vendor be selected, this decision would need to be made by the next PRC to not impact the current project schedule. If the spec cannot be met, there are technical solutions by adding positional degrees of freedom to the optics system. This should therefore be a line item on the next PRC/ALPSII report.

3. Magnet bending. I would have guessed unbending the dipoles would be high risk. However, there is the one example of an Italian-built dipole surviving the procedure at full specification. I understand this bending procedure is actually an “unbending” procedure, but I am nervous nonetheless. It seems very sensible therefore to apply the bending procedure to a magnet of the German fabrication. The magnets are crucial to the experiment and, unlike the other risks, I don’t know of a straightforward way to proceed if the bending results in poor yield.

4. Program risk. The XFEL project is using manpower that would otherwise be applied to prepping the tunnel and magnets. This delay is by itself probably not an ALPSII program crisis. However, I imagine the ALPSII partners are less than 100% pleased with this delay. Further delays would make the situation worse and potentially disrupt the ALPSII collaboration. I therefore reiterate my recommendation from PRC 76 that ALPSII and DESY management have clear understandings on key magnet and infrastructure dates. This would send a reassuring message to the ALPSII collaborators and let everyone know when the project is slipping.

Regarding key upcoming milestones, I am aware of the following:

1. Lock. The collaboration has already achieved short-term lock of the single FP cavity. They plan on co-locking the two FP’s for a long time this summer.

2. Mirror/table. The result of the mirror & table metrology study should be ready by PRC 78.

3. The mirror/table metrology issue is scheduled to be settled by the end of summer.

4. Vibrations. The collaboration said their analysis of archival seismic tunnel data suggests high-frequency vibrations are low enough amplitude. The collaboration plans on instrumenting the tunnel with accelerometers to further refine these estimates. A preliminary result of this should be ready by PRC 78. The collaboration is also studying long-term ground motions. Initial studies on existing data suggest this movement is acceptably small. This, too, will be part of long-term monitoring in the tunnel.

5. TES noise. This is lower-risk as the experiment sensitivity does not strongly depend on the TES noise rate. That said, the collaboration timetable calls for new TES results for sometime in the autumn; this may be after the PRC 78.

6. ALPSIIb de-scope. The collaboration intends to present their report on the repercussions of eliminating ALPSIIb from the program at PRC 78. This will include key milestones from ALPSIIb that are needed for IIc.

Summarizing, the science case remains good. The collaboration’s progress has been good and the project is more-or-less on track. I recommend that a second magnet be bent and tested. I also recommend there be a schedule and agreement between ALPS and DESY management about technical support for the tunnel infrastructure and magnets.

## **Astroparticle Physics**

The PRC was impressed at the level of accomplishment in the area of astroparticle physics. Both main areas of research, neutrinos and gamma rays, are producing excellent scientific results and are making steady progress towards future, more capable detectors. No significant difficulties in the astroparticle physics program were identified.

### **Neutrinos:**

The IceCube observatory continues to work well and to steadily increase its accumulated lifetime. As discussed in the previous PRC report, IceCube has made a major breakthrough in the observation of high-energy astrophysical neutrinos. The evidence for excess contained and semi-contained events, first reported in 2013, has become stronger with some additional data; now a total of 37 events are detected over a background of approximately 15, corresponding to statistical significance of around 5.7 standard deviations. Considering cascade events at the very high energies above 1 PeV, an additional event has been added to bring the total number to three. The statistical significance is now sufficient to allow for first estimates of the spectrum of the signal – i.e. to try to constrain the spectral index or the possibility of a spectral cutoff. So far, the data marginally prefer a somewhat softer spectrum than the simplest  $E^{-2.0}$  differential shape. Studies have also been carried out to search for possible event clustering that would provide evidence for source locations on the sky. No significant clustering is yet detected.

Another topic of great scientific interest is that of neutrino oscillations. IceCube has reported the first significant measurement of the mixing parameters  $\theta_{23}$  and  $\Delta m^2$  made by a high-energy neutrino telescope. With the data available this year, a very competitive measurement can be completed. The DESY group made key contributions to this work.

The future of IceCube beyond the current instrumentation is a matter of extensive discussion. A workshop entitled “Neutrinos Beyond IceCube” was held in the US near Washington D.C. in the same week as this PRC meeting. The workshop examined possible upgrades to IceCube and the relevant scientific issues. Three principal upgrades are being considered: 1) the PINGU low-energy extension to carry out neutrino oscillation studies, 2) a multi -km<sup>2</sup> surface detector that would serve as an atmospheric neutrino veto, and 3) a high-energy extension of IceCube with up to an order of magnitude larger effective area. Each of these ideas have merits and what will be carried out will be constrained by time and money. It is clear that DESY will play a significant role in the future of IceCube and the recent filling of the Humboldt/DESY professorship position by M. Kowalski will strengthen this role.

*The PRC agrees that there are still many uncertainties that make it difficult to concretely specify the upgrade path for IceCube. However, we recommend that the group start development of an internal plan that describes the timeline for upgrades and DESY's role in them. The initial version of this plan can be presented at the next PRC meeting (Fall 2014).*

### **Gamma Rays**

The breadth of research carried out by DESY in the area of high-energy gamma-ray astronomy is very impressive. DESY has expertise in Fermi and in all three major operating Cherenkov telescope arrays

(HESS, MAGIC and VERITAS). Looking towards the future, of the 32 DESY astroparticle scientists, 20 are involved in the Cherenkov Telescope Array (CTA) project. Within CTA, DESY plays a leading role in the development of the Medium Size Telescope (MST) and Array Control (ACTL) systems. A number of recent scientific results were presented that highlighted DESY's involvement. The Crab, arguably the most-studied astronomical source, continues to provide surprises in the high energy and very high energy (VHE) bands. Intense flaring from the Crab Nebula has been detected and characterized by Fermi at GeV energies, but recent observations made by VERITAS and HESS that are simultaneous with the flaring fail to detect any variation in the VHE flux. On the other hand, the Crab Pulsar has now been unambiguously seen at energies up to 400 GeV requiring modifications of the theories of high-energy emission from pulsars. A recent spectacular gamma ray burst (GRB) studied by Fermi and other instruments offered a unique opportunity for follow-up by the ground-based instruments; in spite of unfavorable observing conditions (daytime, bright Moon), VERITAS was able to provide an interesting limit on the spectral continuation of the source. GRB follow-up will be key component of the HESS II observing program.

The PRC was encouraged to learn of the steady progress towards completion of the HESS II camera upgrade and that targeted upgrades of some of the MAGIC hardware are being carried out. We also learned about the development of HISCORE – an array of wide-angle non-imaging Cherenkov telescopes to be installed in Tunka, Siberia. HISCORE is a proof-of-principle instrument that benefits from collaboration with Russia and could be a useful concept when considering upgrades to CTA in the future. A question arose regarding the timeline for HESS II operations. The upgraded telescopes should be ready for operation in 2016 and baseline plan for three years of operations would follow that date. It is understood that HESS II would continue operations until surpassed by CTA, which could come by the end of the decade.

Progress on CTA continues along many fronts. Technically, DESY's contributions to both the MST and ACTL systems are progressing extremely well. The full-scale prototype is being routinely exercised and studies on the mirrors (focusing and characterization) on ongoing. In ACTL, the development of the data acquisition and the telescope control and monitoring are well underway and reaching mature levels. CTA as a whole plans to carry out the full critical design review (CDR) at the end of 1<sup>st</sup> quarter or 2015, after which point those qualified systems would be ready to enter the pre-production phase.

Beyond the technical aspects of CTA, progress is being made towards the selection of sites for CTA and in the area of governance. In April 2014, the CTA Resource Board (RB) made the decision to start negotiations with Chile and Namibia to host the southern CTA array. These negotiations should continue throughout 2014 with the final site selection being made at the end of the year. The site decision for the northern CTA array was somewhat delayed. In terms of governance, an interim legal entity needed for the pre-construction phase is close to being finalized. This entity will be setup as a German limited-liability partnership (GmbH). Discussions regarding the roles of the CTA Consortium (rights, duties, etc.) and the CTA Observatory (CTAO) are now underway within CTA and the RB.

Planning for the application for funding for CTA construction in Germany is now well underway. The PRC was shown a very useful strawman scheme to illustrate possible contributions to CTA from Germany. The German application will be led by DESY and could be submitted by the end of 2014. DESY will

concentrate on the MST systems, but will also be involved in the Large Size Telescopes (LSTs) and Small Size Telescopes (SSTs) where its expertise can be of value. A possible timeline for the production of the first MSTs was also shown.

*The PRC commends the CTA group for initiating serious funding and timeline planning and for showing these early plans to the PRC. We encourage to group to update the plans at the next PRC meeting (Fall 2014). We also recommend that DESY submit a bid to host the CTA headquarters (or possibly a CTA data centre).*