# Recommendations of the 76.PRC

**Final Version - 10 December 2013**

## LHC Experiments:

### ATLAS

The DESY ATLAS group continues to make strong contributions to the experiment. The group is involved in a number of Standard Model and top physics analyses, performs a search for electroweak SUSY production and makes a strong impact in Higgs physics. The PRC notes with satisfaction, that six ATLAS papers with a strong DESY contribution have been recently published on 7 TeV data, with 8 TeV papers forthcoming. The DESY ATLAS group also makes important contributions to SCT and ALFA operations and shoulders a large responsibility in generator validation and MC production. The group is also heavily involved in the ATLAS phase-0, phase-1 and phase-2 upgrades. In particular, the PETAL 2014 is progressing very well. The group is well poised to play a leading role in the ATLAS phase-2 upgrades and securing adequate funding for the phase-2 projects is critical.

The PRC notes that the DESY ATLAS group has a broad portfolio of physics analysis commensurate with its strong technical contributions. In order to complement the central role played by the YIGs in physics analysis, the continued involvement of senior staff in physics analysis is encouraged. In view of the discovery potential of the impending 13 TeV run, a physics beyond the Standard Model search (exotics, SUSY) should be continued and possibly expanded. In order to evaluate the multiple challenges the group may face in the next running period, a compilation of manpower availability for various tasks and responsibilities in the DESY ATLAS Group would be helpful.

The PRC congratulates the DESY ATLAS group on their impressive accomplishments.

### CMS

The DESY CMS group continues to make strong efforts in physics analysis in Higgs, Top, SUSY and QCD studies including PDF. The PRC is pleased to note that papers with strong participation from the DESY CMS group members continue to be produced and published. We are also pleased that coherent plans for the analysis of the upcoming 13 TeV data exist. The group also continues to make leading contributions in tracker alignment. DESY Tier2 and NAF are crucial for CMS and CMS Germany.

The DESY CMS group members continue to take prominent leadership roles within CMS. The group maintains a healthy level of PhD students in the group.

The phase 0 upgrade projects, BCM1F and SiPM in HO are making good progress and are on schedule. For the Phase 1 Barrel Pixel Upgrade, the in house bump bonding has been established. They are on track for module production to begin in 2014. For Phase 2, strong efforts continue in module design and

sensor R&D. We note that the CMS end-cap production plans in Germany and DESY are now becoming clear. We note that it is critical for the Phase 2 project that adequate funding is secured in the coming year.

The continuation of the BCM effort beyond 2014 is unclear. As BCM is an essential part of CMS online beam and luminosity monitoring, the situation needs to be made clear in the coming year between CMS, DESY-CMS and DESY.

The PRC congratulates the DESY CMS group on their impressive accomplishments.

**ATLAS and CMS Phase 2 Upgrades**

The PRC emphasizes that it is critical for the German ATLAS and CMS community and as well for the international ATLAS and CMS collaborations that the funding for the Phase 2 upgrades for the ATLAS and CMS groups at DESY is placed in a firm footing in the coming year.

**Computing**

The PRC notes with pleasure that DESY Tier2 continues to play a prominent role in LHC computing as well as in many other areas.

The transition from NAF to NAF2 is proceeding well with Belle and other users already on board. CMS and ATLAS experiments have pilot users on NAF2. The NAF transition is to be completed by the end of 2014.

The resources for DESY Computing should be adequate through 2014; The PRC notes that there is a serious uncertainty in funding for HEP computing in Germany beyond 2014.

## HERA Experiments

**H1 and ZEUS**

We congratulate H1 and ZEUS on their efficient and successful publication output, continuing as predicted in the last years, and for the wealth of allocated talks at conferences. There is apparent secure coverage for most of the more than 20 publications planned for 2014, and the promising combined H1+ZEUS analyses get the appropriate special attention even beyond 2014. We encourage finding third party funding (e.g. DAAD) for continuing invitations of Ph.D. students from other countries to DESY, to foster finalizing publications.

H1 and ZEUS are very well setup for the software preservation (sp)-system and are already its main users, regularly basing publications on the new scheme. The different data preservation models in H1 and ZEUS represent important benchmarks for the international DPHEP effort. While H1 is prepared to cover occasional future experiment-specific data preservation tasks with existing DESY staff we encourage ZEUS to seek such existing staff to ensure a working data analysis and especially Monte Carlo

production after 2014. A viable fallback solution would be the reweighting of existing MC samples to new models.

**HERMES**

The HERMES collaboration is congratulated for their continuous progress producing high impact results and papers, especially involving data from the recoil detector. The collaboration makes steady progress towards finalizing the remaining high priority analyses and in publishing them.

The HERMES data preservation is finalized. All the final data productions and Monte Carlo files as well as the data analysis and MC production have been moved to BIRD. All the HERMES software is now running under SLD-6. The collaboration is congratulated for this large progress since the last PRC, especially under the current manpower situation. Due to manpower problems it was decided to not implement the sp-system. DESY is thanked for support for the east guests as well as for Postdocs and PhD students. It would be highly beneficial for HERMES if DESY could continue the support, as it will be critical to finalize several analyses and papers.

**Data Preservation**

The PRC notes with pleasure that efforts at DESY on data preservation (DP) continue to be strong and are recognized internationally. The effort is at the point of transitioning into a DPHEP collaboration endorsed by ICFA. Recently, CERN has signed onto the collaboration and DESY will do so as soon as practicable.

The Software Preservation (SP) system, the underlying software for DP was developed at DESY and is a well thought-out automated validation system for a broad spectrum of DP requirements, and is fully implemented and validated.

Current DP concept implies two separate types of manpower needed to sustain this effort.

The first is for the maintenance of the SP system and is independent of the knowledge specific to an experiment whose data is being preserved. This is to be done by the IT department. DESY IT is committed to maintain the SP system for the international DPHEP effort.

The second are people who can solve problems which require specific knowledge of the experiment whose data are being preserved in those cases where the SP system reports a problem. While H1 in a position to provide such manpower for a few years and HERMES does not expect major problems after 2014, ZEUS has so far found no solution for generating new MC after 2014, so that reweighting existing MC seems to be the only option left.

In total, the state of DP for the HERA experiments, which set the first benchmarks for DPHEP, is such that useful data can be preserved for all experiments, although not all capabilities may exist beyond 2014.

The PRC congratulates the accomplishments of the DP team at DESY, and notes that the Directorate and IT has committed to the long term support of the experiment-independent part of the effort. For

experiment specific DP tasks, each HERA experiment is encouraged to reexamine the possibilities of further manpower enhancements from the existing DESY staff with connections to the experiments.

PRC recommends a periodic review of the DP effort in the future to assess the scientific usefulness of this effort as well as to evaluate the success of the technical implementation.

## HERAfitter

We congratulate the HERAfitter development team in rapidly establishing a well-integrated and visible role in the HEP community (both on the experimental and the theoretical side). The definitions of a few benchmarks for the application of HERAfitter leading to a standardized set of results could be a further valuable asset for the community.

The leading role of DESY in HERAfitter on developers' side is obvious and has been strengthened recently by the dedicated IT support at DESY. Establishing this project as a pillar in the Analysis Center and, especially continuing the dedicated technical support in DESY IT including a participation in the common NAF resource provision, is indispensable for sustaining the project in the long-term and securing DESY's leading role. Participation of DESY personnel in the management of HERAfitter should be continued to be recognized and encouraged.

## OLYMPUS

The PRC congratulates the OLYMPUS collaboration for their steady progress since the last PRC meeting and the mini review in August.

The collaboration has finalized all important "calibration" measurements, i.e. magnetic field mapping, optical survey, calibration of the beam energy, and integrated them into the analysis framework. The only outstanding task is an absolute calibration of the beam position monitors, which will be critical to achieve good understanding of the comparison of data and MC for the symmetric Bhabha/Moeller luminosity detector. The ToF system is fully calibrated and digitized in the MC. There is nice progress on the detector simulation, but not all detectors have been yet fully digitized, such data-MC comparisons are still difficult. This affects especially the capability to benchmark the tracking code. The understanding of the 3 different luminosity monitors has improved compared to the mini review in August, but is still far away from the aimed for 0.1%. The collaboration has made a lot of progress to develop several event generators and benchmark them against existing data.

Unfortunately there are some concerns. The main one is the manpower in the collaboration. Unfortunately several collaborating institutes are not involved in the analysis, which leads to the fact that key software and analysis tasks are currently only covered by single experts on non-permanent positions. The collaboration should make any effort possible to increase the number of people involved in the analysis.

As it is currently not possible to judge whether OLYMPUS is able to achieve its advertised high precision results, the PRC suggests that data and MC software are pushed forward in parallel and that the collaboration relies on some more traditional software tools to obtain for example space-to-drift-time relations for the wire chambers.

The PRC would like to receive a status report by Mid-January 2014 on the analysis. Special focus should be given on presenting results, which show the luminosity monitors are understood at a level, which allows reaching the precision advertised in the original proposal and the tracking performance should be fully characterized, i.e. momentum resolution, $\chi^2$ distributions and other quantities.

The PRC is very much looking forward to hear first preliminary results at the next meeting inApril 2014.

## ILC @DESY

The PRC observes many areas of progress in the global ILC community like handover of TDR of the accelerator and DBD of the detectors, worldwide strategies for ILC, site selection in Japan and congratulates to the great achievements under GDE for the last 10 more years resulting in TDR/DBD. It recognizes the DESY group has been and should be a essential hub for the development of the ILC detectors in the world. The PRC agrees with the plan to finalize the detector design driven more by physics motivation and cost as the next step.

It is essential to keep the current momentum around the world to establish a new global framework for real construction. The PRC recommends DESY provide good and continuous support in engineering and infrastructures like test beam, high field magnet facility, computing and so on for prototyping of the ILC detectors.

## Belle @DESY

The committee congratulates Belle for remarkable progress since the DESY-Belle group was formed. They have started three new and unique physics analyses, significant contribution to the computing infrastructure both in data storage (copy of all mDST of 127 TB and MC data of 50TB) and computing farm in NAF2.0. The PRC would like to see further extension of analyses in a variety of physics areas in the near future using the world largest Belle data.

The group is now playing a significant role in the Belle-II PXD/SVD subgroup in design work of cooling, installation and so on with the mockups built in DESY. They are holding a joint workshop with 80+ participants this week in DESY, where the combined beam tests are planned in 2014 at DESY using the realistic PXD/SVD system including full DAQ readout chain with HLT and ROI scheme, CO2 cooling, slow control with EPICS and tracking and alignment procedures.

The PRC endorses the several beam tests in 2014 which should be an important step to validate all the essential components in the PXD/SVD system for the experiment ready in 2016.

## DESY Testbeam

The PRC notes that the DESY test beam facility has become an important resource for the world-wide HEP community with users from ILC, LHC, Belle and many others. We note that there is some uncertainty about the availability of the test beam in 2014. With the test beam at CERN unavailable during 2014, the DESY test beam becomes one of the two available electron test beams needed for HEP in the world, and the only one in Europe for 2014. The demand for the test beam is very high; its unavailability in 2014 would mean many delayed projects with serious implications. The PRC urges DESY to find the resources to maximize the availability of the test beam in 2014.

## Theory

The PRC has been pleased to hear about the outstanding activities from the theory phenomenology group, both in research and in reaching out to the community. No particular issues were brought to the attention of the PRC to be discussed.

The PRC considers that it could be helpful to the theory group, if for future staff recruitments a vision for future research topics were presented to the PRC.

## ALPS II

The PRC believes the science case for ALPS II remains strong. The committee senses there is increasing interest in axions, axion-like particles and hidden-sector photons (WISPS); ALPS-II therefore has an increasing profile. Although the hints of WISPS from white-dwarf cooling and anomalous gamma-ray transparency are quite weak, the PRC thinks they are interesting and add to the interest in WISPS and ALPS-II since the putative particles are in the mass and coupling search range of ALPS-II. ALPS-II gave several presentations at the recent Snowmass 2013 meeting in the United States. Of the three main approaches to searching for WISPS (RF-cavity, solar, laser), ALPS-II was clearly the most advanced of the laser programs and therefore is best positioned to find these particles. There are proposed competitors to ALPS-II, but they are either behind (as for CERN/OSQAR, which is not yet deploying locked resonators) or not funded (as for FNAL/REAPR). At present ALPS-II has the clear lead in this laser-search technology and will maintain the lead unless the collaboration or a key supplier falters, or their overall project support remains inadequate. The ALPS-II status report brought to the PRC's attention a microwave version of the shining-light-through-walls experiment, and the CERN result is indeed interesting. However, the committee suspects it will be difficult to improve that limit in the near term by much due to the difficulty of detecting microwave photons with high levels of background rejection.

The PRC feels that overall, the ALPS-II project is proceeding in sensible stages. The PRC feels that the capability to probe virtual axion-like states with the magnetic field is a highly desirable experiment configuration, so it would be very disappointing if the project stalled before ALPS-IIc magnets are commissioned.

The PRC was somewhat concerned about the readiness of the project hardware. Delivery of the cavity optics is reported as a problem. The mirrors (substrate, plating and polishing) look similar to the LIGO/GEO ones. Although such mirrors are not off-the-shelf items, several vendors are qualified to produce them. The committee suspects Gooch and Housego could also provide coatings and maybe polishing. During questions, the Collaboration stated that coatings and polishing is not a pacing issue. The PRC believes the mirror substrates are more or less off-the-shelf from Hereaus and Corning.

The stray light measurement seems very challenging, and the PRC is pleased to see this measurement has been reported as well advanced. The “breadboard” planarity was reported as an issue. This particular issue involves linked problems of vendor fabrication and metrology. There is a question of what do if the vendor cannot deliver adequate flatness. Other vendors or technologies should be investigated.

The group reported at the last PRC on the successful locking of the regeneration cavity. This was an important milestone. In general, the locking times should be extended to suitably longer times and co-locked to regeneration and production cavities. This is another key milestone. The closed-session transparencies report this milestone will be delayed, presumably due to optics-vendor delays. This is disconcerting. The locking is related to seismic noise. The PRC would like to be informed about the acceptability of seismic noise in the HERA tunnel.

The PRC is pleased to see the TES package and ADR coldbox function well and with low pulse-rate backgrounds. There was a question during the ALPS-II public presentation about backgrounds limiting the run time, but the PRC suspects the questioner may not have appreciated the laser duty factor comes into the background-free run time. Thus, this is a major milestone satisfied.

ALPS-II reported on their new approach to straightening the HERA dipoles. This process sounds challenging and the committee thinks that there may be a need for more magnet engineering for ALPS-IIc.

The PRC is concerned that the number of personnel, especially personnel with hands-on optics expertise, are too few. The PRC thinks this will become more critical as the project advances. The project reported that discussions are in an advanced stage to bring in outside collaborators. This will help ease this problem. This personnel issue is a subset of a problem where the committee feels the project is somewhat lean in funding support. Simply, the PRC gets the sense those budget numbers are too low for a project of this scale. The budget shortfall is recognized by the group. One of their solutions to this problem is to wait until the first run is over to shift the production optics to the following phase. This serial procedure will slow the project. The group mentioned several reasons the delay is bad (impacts on R&D and student theses.). But also a delay would cut into the lead ALPS-II has in the laser WISP searches.

This delay may worsen if conflicts arise with the XFEL. There is a scenario where there could be very serious delays (if, for instance, vendors are late, funding remains at a low level, core personnel cannot be hired, the XFEL does not relinquish the tunnel). The PRC does not have a solution to this, but is concerned. The group is considering a significant de-scoping of ALPS-IIb, thereby moving funds to ALPS-IIc. Scientifically and technically, this sounds like an acceptable plan. But, as part of this de-scoping, the group should identify the key technical milestones and deliverables from ALPS-IIb that will be needed for ALPS-IIC and ensure they can be accomplished with reduced funding.

An updated project schedule was presented in the closed session slides. This schedule looks too tight. In particular, the operations overlap with the installation and construction seems to overstress the limited number of key personnel. Of the schedule risks presented at the closed session, the “personnel/budget issues” seems to be the most serious.

The PRC recommends:

1. Consider consulting with LIGO/other optics experts on the ALPS-II specifications for substrates, coatings and polishing, if not already done.

2. The Collaboration reported they are locked-in to their optics vendor as contracts have been let. Regardless, since this is a key procurement, it may make sense to make enquiries to other vendors as to whether substrates are available on a shorter time-scale.

3. The Collaboration reported they did not see delays in coating and polishing. Regardless, it may again make sense to make enquiries to other vendors about the coating and polishing.

4. Establish the acceptance criteria for the mirrors and “breadboard”, if not already done. This is another place where consulting with LIGO/other optics experts may be fruitful.

5. If possible, move forward the long-term lock of the cavities milestone, as hardware delivery allows.

6. Estimate the acceptable seismic spectrum envelope, if not already done. Estimate whether the HERA tunnel environment is within the envelope, if not already done.

7. Come to a decision on whether the project needs to be re-baselined (say, ALPS-IIb descope) and establish the new project plan. If more funds or collaborators appear, than the baseline can be elevated.

8. If ALPS-IIb is descoped, develop milestones and deliverables that are critical for ALPS-IIc design and construction.

9. It would be desirable to obtain a written statement from DESY to ALPS-II regarding the expectations for XFEL operations and ALPS-II siting in the tunnel.

## Astroparticle Physics

The PRC acknowledges important advances for the flagship astroparticle experiments that DESY is involved in. Major milestones have been reached by the observation of an astrophysical neutrino flux and in the the planning of the CTA experiment.

**IceCube observatory:**
The detector continues to show excellent round-the-clock performance and delivers an increasing fraction of clean physics data. A major breakthrough was recently achieved by the observation of astrophysical flux of neutrinos. The DESY group played an important role by developing required reconstruction tools and paving the way with earlier analyses on data from the partly completed detector. As requested by the PRC, a combined analysis of all relevant channels to increase the significance of the observation was performed at DESY.
A second highlight that was presented is the determination of $\theta_{23}$ and $\Delta m^2_{23}$, where DESY contributed with a solid analysis of data with the complete detector. With twice the data currently available, competitive results are expected. In order to substantially improve on the $\Delta m^2_{23}$ determination, the range has to be extended to lower energies by a detector with higher granularity (PINGU).
The main goals for the future are to increase the sensitivity for astrophysical flux by improved cuts, the lowering of the systematic uncertainties and the discovery of point sources, e.g. by continuously improving the reconstruction techniques . DESY is involved in all of these areas.
Beyond IceCube, the goal is to use superb properties of south polar ice to host additional detectors (dark matter detector to test the DAMA/LIBRA claim, the PINGU low energy extension, a high energy extension to reach a substantially larger effective area, or surface arrays to veto atmospheric neutrinos and muons). Having reached the milestone of observing astrophysical neutrinos, funding for some extensions may be feasible. Among these projects, PINGU is the most advanced with a letter of Intent that is close to be being submitted. Its major (but not only) objective is the determination of the neutrino hierarchy. The PRC stresses that the project should enter the US-P5 process as early as possible. It also notes, that synergies between JUNO, T2K and Noυa should be included when discussing PINGU's perspective. Non-US funding agencies will only join, once the PINGU project or other upgrade projects are supported by the NSF. It was pointed out that the DESY IceCube group will suffer from departures and retirements. The open Humboldt/DESY professorship on IceCube needs to be filled quickly in order to define DESY's direction on IceCube upgrades.

**High energy Gamma Rays:** The PRC saw substantial progress in defining a clear and ambitious path of the CTA project. The site decision will be taken by spring 2014. The completed CTA array will provide substantially higher sensitivity and improved direction resolution compared to existing experiments and will open a new regime in many areas of VHE astrophysics (e.g. AGN flares, Galactic cosmic rays, dark matter, etc.). DESY leads the mid-size telescope development and array control packages and provides major contribution to site studies, analysis and software tools as well as models and theory.
In order to fully exploit the H.E.S.S. II telescope, the smaller H.E.S.S. I telecopes, which suffer from aging related drops in efficiency, will be equipped with new electronics based on the CTA readout chip. The upgrade is expected to be completed by the end of 2015. The PRC notes that a timely upgrade is necessary in order to make it worthwhile before H.E.S.S. is turned off. DESY is also involved in the first

(proof-of-principle) installation of the wide-angle, non-imaging HiSCORE array that is optimized for PeV energies.

The range of physics topics in the FERMI, H.E.S.S, MAGIC, and VERITAS experiments addressed at DESY is substantial. The presentation concentrated on attempts to understand the observed complex phenomena in a systematic way (e.g. AGN source location [MAGIC], blazar modeling [VERITAS], magnetic field point spread broadening [H.E.S.S.]) and on studies combining the information from several telescopes, such as a recent Crab nebula flare. The CTA potential was e.g. assessed in a combined work with DESY theorist on supernova remnant resolutions and by quantifying the advantages of a divergent pointing operation that would lead to an effective $20^{o}$x$20^{o}$ field of view and some sensitivity improvements at intermediate energies.

## Planck Scale Gravity Test at PETRA III

The PRC thanks V. Gharibyan for his presentation. Unfortunately several of the last PRC recommendations have not been addressed in the closed session and make it therefore difficult to draw any detailed conclusion about the possibility of the proposed experiment.

In particular, the issue from the last PRC about Lorentz scaling violation versus quantum gravity which is conceptually important for the interpretation of any measurement was not convincingly clarified. Further issues that were not satisfactorily addressed were the size of the systematic uncertainties, the stability of the apparatus and their relation to the size of effects, which are proposed to be measured. The general rule is that the systematic uncertainties should be at least an order of magnitude below the size of the effect. Slide 3 from the closed session does not show any systematic uncertainties.

The PRC recommends again that the proponent gets in contact with a theorist in the field. Suggestions could be Gia Dvali (LMU Munich), Maxim Pospelov (U Victoria), Gregory Gabadadze (NYU) or Hermann Nicolai (Albert-Einstein-Institute, Potsdam).