

CALICE: Plan for FY08/09

Because of the current financial situation at STFC, we understand that we have to reduce CALICE spending in FY08/09 to a minimum. However, there are various factors (specifically work close to being published, R&D which has applications well beyond the ILC, and UK responsibilities upholding the UK reputation as a reliable partner) which mean there is a good case for not shutting down this work immediately.

The current CALICE grant consists of five workpackages and, for each, we have planned a programme of work. We outline the cases for these programmes below. The cost of each workpackage in FY08/09 is given below, and is broken down in a spreadsheet supplied separately. The total cost of all five workpackages in FY08/09 is £564k.

WP1: Beam Tests. The CALICE collaboration has been testing “physics prototypes” of calorimeters in beams at DESY and CERN over the last two years and this will continue at FNAL throughout 2008 and into 2009. These are prototypes to measure electromagnetic and hadronic showers in detail and to compare then with simulation. A large dataset has already been taken and is currently being analysed. This work is quite generic and so the long term outcome will be an improvement in simulation models and tools not only for the ILC but also for many other experiments. However, because of the truncation of the UK programme, we shall no longer be able to see this aspect of the work through to completion.

CALICE-UK is responsible for the data acquisition and real-time monitoring of the beam test systems, and leads several aspects of the data analysis. Given the investment of effort and equipment in this area, we should reap some benefit from the results. We plan to continue with these analyses until they are published, which will be within FY08/09. This requires RA, support physicist and academic effort, which would be needed throughout most of the FY. Besides the effort shown in the spreadsheet, this includes effort from an RA who is now funded through EUDET (see below). We also have three graduate students writing theses on these data, and we need to support them until they finish their work. Following completion of these analyses, this effort would stop and the UK would have to withdraw from this work.

Since we will be unable to analyse any of the data taken in future at the FNAL runs, we will provide only the minimal effort needed to uphold the UK responsibilities. This will of course represent a significant loss of important results (low energy hadron data, which are likely to be crucial for particle flow, and digital calorimetry), and of influence within the community. We will not provide shift or run coordination effort, despite making a very significant contribution in these areas in the past; unfortunately this will place a heavy burden on our collaborators. However, we cannot reduce the UK effort completely to zero; it is effectively impossible for the data acquisition responsibility to be passed onto a non-UK group as the expertise only exists within the UK. Unless this is continued until the finish of the beam test programme, the UK will be seen to be destroying the main part of the overall CALICE collaboration programme. This task requires academic

and technical effort. The UK responsibility for the real-time monitoring will require some RA effort to maintain but, in this case, the expertise is more easily transferable and this responsibility will be handed over to non-UK collaborators during the first run period in 2008.

The total cost to STFC in FY08/09 of the revised WP1 programme is £59k.

WP2: Long Term DAQ. The UK groups in CALICE are in a world-leading position with regard to studies into practical applications of DAQ for future colliders. The concept in this workpackage is to use cutting-edge technologies as a basis for DAQ systems rather than the traditional bespoke solutions previously used in HEP. This concept needs to be tested and used in anger, specifically on large prototype detectors in a test beam, to be able to validate the approach. This approach is expected to be applicable to any future experiment and so the whole workpackage is highly generic, as was noted by the PPRP at the time the original bid was approved. The completion and demonstration of this concept is therefore beneficial to the UK groups in DAQ systems throughout HEP and not just the ILC; indeed, work is being pursued by some of our groups on the use of our DAQ systems for LHC upgrade projects. It is therefore vital to demonstrate this approach in order to maintain our lead position and the potential to build DAQ systems for any future collider detectors.

The plan is to use the EUDET collaboration large-scale “technical prototype” beam test programme for the DAQ system validation. The UK already has major deliverables and significant international partnerships within EUDET. Funding from the EU relies on the current matching funding from STFC, both legally and scientifically. Any withdrawal from delivering the DAQ system for the planned would be very damaging for the UK’s reputation as a reliable partner. Hence, we will complete the design of the EUDET DAQ system as planned but will negotiate with our international partners for them to pay for much of the physical equipment required to read out their detectors from EUDET central funding. In addition, we will drop all testing of the readout ASICs designed out the UK and will no longer take responsibility for the DAQ software. This means we make the best use of STFC funds to promote UK DAQ expertise and also can fulfil the UK responsibilities in the DAQ design. This requires academic, engineering, technical and RA effort but a low level of requisitions funds.

Because this work is highly generic, it is assumed that a proposal for future funding in FY09/10 and beyond will be submitted within 2008. This would aim to pick up the programme and develop it in a broader sense than the original ILC application. Hence, it is important that the expertise which has been built up is not allowed to disperse. In particular, this requires the rolling grant staff are retained throughout FY08/09.

The total cost to STFC in FY08/09 of the revised WP2 programme is £173k.

WP3: MAPS Sensors. The UK is developing a novel and unique approach to electromagnetic calorimetry, where active pixels (incorporating the pixel readout into the sensors) are used to produce a binary readout calorimeter of very high granularity. This has the potential to give very significant improvements in spatial and energy resolution at lower cost. In addition, as part of this work, a CMOS device processing step has been developed which has wider applications to many areas of sensor development, not only within particle physics but also to other areas of STFC science. To abandon this work at this point would be a major loss to UK leadership and would waste the resources already spent on the project. Hence, the aim here would be to complete a descope version of the current workpackage, again with the aim of a future generic R&D proposal coming online in FY09/10 to develop the project further at that time.

The first sensor was produced in the second half of 2007 and is currently under test, originally with a second design planned for early in 2008. The only way to continue the project at a reduced cost is to slow down, to reduce the effort needed, and also to produce a cheaper second sensor, specifically one much smaller than originally planned and with no “ILC-like” features. The fabrication of this smaller sensor would then be later in 2008. The level of effort needed for the external readout electronics design will be heavily reduced as the second sensor will now be consistent with the first in terms of readout, so the existing readout and DAQ system can be reused. The work needed here requires academic, RAL/TD and engineering design effort.

The tests on the first sensor need to continue during the design of the second so as to feed into the latter all knowledge gained from the former. In addition, the second sensor itself will need to be tested following its fabrication. This work will require academic, RAL/TD, RAL/PPD and RA effort.

The total cost to STFC in FY08/09 of the revised WP3 programme is £252k.

WP4: Mechanical and Thermal Studies. The effort in this workpackage will now be concentrated solely on the construction of the electromagnetic calorimeter “technical prototype” for the EUDET project. This part of the programme must continue as part of the reduced CALICE-UK work or else the UK will fail to deliver on its responsibilities. In addition, the WP2 programme described above makes no sense if there is no calorimeter with which to validate the DAQ system.

Even within the EUDET area, the scope of the work has had to be substantially reduced due to the constraints on funding. We will now no longer be able to lead the design for the ECAL module end and services integration, so this work will be carried out by our French collaborators. The work on assembling the ECAL slab active sensor units (ASU) will also necessarily be scaled back to the level of demonstrating a working solution to fixing the sensors to the PCBs. Assembly of the ASUs for the EUDET prototype will still be possible in Manchester, but the process will not be “production ready”. It will meet our commitments to EUDET and no more.

All the thermal studies will be stopped by the start of FY08/09. In addition, a planned contribution to an ILC detector endcap design will not now be started.

The effort needed for this workpackage is academic, engineering and technical. Funding for consumables, notably conducting glue and for adapting the glue robot, will be needed but this cost has been reduced to the bare minimum.

The total cost to STFC in FY08/09 of the revised WP4 programme is £28k.

WP5: Physics Studies. The UK groups within CALICE have been performing studies of the physics potential of particle flow algorithm (PFA) techniques to improve jet energy resolution. The concept of a PFA approach can be applied to any future collider detector and so this work is generic in its application, as recognised by the OsC. The development and optimisation of algorithms can only be performed in the context of detailed detector simulation models and within CALICE-UK, these studies have so far been applied to detector concepts developed for the ILC.

Despite the large future potential of this approach, the revised plan is to continue these studies throughout FY08/09 at a reduced level, such that a proposal for generic R&D into detector designs optimised for PFA can be submitted in 2008. The bare minimum effort needed to achieve this is academic, support staff and RAL/PPD. In addition to the effort shown in the spreadsheet, there will also be a University-funded RA working in this area. This work will necessarily continue to be based on existing ILC detector models as there are no alternatives available at present which have the required level of detail. This pragmatic approach also keeps the effort required within the UK to a minimum, as it avoids any need to develop and maintain new detector simulation models.

All other current studies within this workpackage, in particular those which are related to developing physics analyses to benchmark the performance of the evolving detector designs, and to assess the stability of the PFA algorithms, e.g. to tuning of hadronic physics models, will be stopped by the start of FY08/09. Similarly, the explicit study within this WP of how hadronic interaction models compare with the wealth of testbeam data accumulated by CALICE will now not be completed. This is particularly unfortunate as it is both one of the main goals of the entire project, and completely generic in its scope and benefit to all future projects using detector simulations, namely to improve the accuracy of hadronic physics modelling with in GEANT4. This is evident from several presentations made by CALICE at recent GEANT4 Collaboration Workshops.

The total cost to STFC in FY08/09 of the revised WP5 programme is £51k.