

**SCIENCE AND TECHNOLOGY FACILITIES COUNCIL**  
**LCFI OVERSIGHT COMMITTEE**

**Minutes of the meeting held on 17<sup>th</sup> October 2008 at STFC, Swindon**

Present: Professor Steve Watts, Chair (Manchester University)  
Dr David Christian (Fermilab), via videoconference  
Professor Alan Smith (University College London)  
Miss Rachel Boning (STFC)

By Invitation:	Professor Tim Greenshaw, Spokesperson, (Liverpool University) Dr Steve Worm, Project Manager (RAL)	For items 4-6, 8 & 9
	Dr Joel Goldstein (Bristol) Dr Andrei Nomerotski (Oxford) Dr Jaap Velthuis (Bristol) Dr Sonja Hillert (Oxford)	For items 4-6

STFC Staff: Mrs Jane McKenzie (Secretary)

**Closed Session**

**1. Minutes of the last meeting**

1.1 The minutes were approved without amendment.

**2. Actions and Matters Arising from the last meeting**

2.1 Following the announcement in the December 2007 STFC Delivery Plan that STFC would withdraw from the ILC, the Collaboration had been informed that all STFC funded ILC activities would have to come to an orderly end as soon as possible, by October 2008 at the latest. The Committee identified which elements of the project were ILC specific and which were of lasting generic value.

**2.2 Finances**

The Collaboration had been advised to discuss the financing of priority areas during FY 08/09 with the Office. A wind-down plan had been delivered and agreed with the Office. This plan assumed a spend of £1.1M in 08/09. The Oversight Committee was unsure how the £1.1M would be divided between the work packages.

**2.3 Future Plans**

A generic detector R&D funding line had been created to develop work started in the ILC projects. The Collaboration had submitted three proposals for areas of work which they considered to be generically useful.

### **3. Preliminary discussion**

3.1 The Committee was pleased by how much the Collaboration had achieved. However, the Committee felt that the report bore little relation to the Oversight Committee's recommendations and wondered how the Collaboration had been empowered to continue tasks the Committee felt that they should have stopped. This was acceptable to the Committee if the Collaboration had managed to utilise resources to carry out tasks beyond those recommended by the Committee, provided that the Collaboration had carried out the recommended activities and did not exceed the approved level of funding. Quite a few milestones had been removed and many were late. However, outstanding milestones were likely to be completed by December 2008.

#### **3.2 WP1**

The Committee wanted to know what the general applicability of this type of code was; what would happen to the code after cessation of the project; whether the UK would take responsibility for it; to what extent it could be used elsewhere; whether there was any overlap with other LHC detectors and whether the code could be used generically. It was not clear when the work would reach a point of completion and the Committee felt that the Collaboration should specify a deliverable for this work.

#### **3.3 WP2**

There was a tight timescale for ISIS2 as although the devices would be delivered shortly, there would be little time to evaluate them before the end of the project. The Committee wanted to know why there had been extended delays with the CPC-T chip packaging at e2v and why the Collaboration had had to wire bond the test devices themselves. They felt that it was disappointing that e2v CPC2 yield was poor and that the reasons for this were unclear. As the Collaboration had been advised to curtail the CPC effort, the Committee wanted to know how much effort was still going into the CPC devices. The Committee also wanted to know what the impact of Konstantin Stephanov leaving was as he had been driving the sensor development.

#### **3.4 WP3, 4 & 5**

Work in WPs 3 and 4 seemed to be going well. There had been a £8K equipment overspend in WP5. The Committee wanted to find out why this was the case and how the Collaboration had managed to do the extra work.

#### **3.5 WP6**

The Oversight Committee thought that WP6 was worth continuing and that all scientific results should be properly reported in the literature.

#### **3.6 Milestones**

Most milestones had slipped but many were now completed. The Collaboration would be advised not to complete Milestone 34 (Carbon Felt/Fibre Evaluation) as it was not clear why they were doing this. The planned finish date for Milestone 39 (Finalise improved flavour tag and vertex charge) was 2009, after

the project end date. The Committee also wanted to know what Milestone 53 (Demonstration modules produced) meant.

### 3.7 **Finances**

There was an over-spend on equipment in WP5. The Committee appeared to have slightly gone over the £1.1 million allocation for 2008/9.

### 3.8 **Future Plans**

The three areas addressed by future proposals were in keeping with the Committee's recommendations regarding the areas of generic value within LCFI. However, of the three, members felt that the FLUID proposal was the least generic. The Committee also felt that the Collaboration could perhaps have requested funds to investigate the various variants of CCDs produced during the project. The Committee hoped to learn more from the Collaboration regarding the future proposals.

## **Open Session**

### **4. Report on LCFI Collaboration Progress**

- 4.1 The Chair made the introductions and advised those present that this would be the final meeting of the LCFI Oversight Committee. The last meeting in February 2008 had been a very difficult one as the decision had been taken to close the project down. Recommendations had been made by the Oversight Committee regarding WPs 1–6. Work on the CCDs was to cease while work on ISIS2 was to continue; the other work packages were to support this wind-down and outstanding milestones were to be completed. The Committee had not seen a wind-down plan but were aware of a £1.1M envelope to complete the project. The Collaboration stated that they had informed the Office what they could do within a certain budget, and the Office had agreed to a budget of £1.1M. The scope of the revised project was greater than what they had agreed to at the last meeting as they had anticipated more drastic cuts than were required. By utilising some external resources, not having to release staff on the timescale originally thought necessary, and by much of the work being done by students, the Collaboration was able to increase their scope. Re-costings were based on the Collaboration's best estimate of work they hoped to achieve.

Professor Greenshaw stated that the presentation would be given by the respective work packaged co-ordinators. He started by giving an introduction during which the following points were made:

- 4.2 The funding crisis had had a significant impact on the project and they had suffered the loss of key personnel. Despite this they had made good progress since the meeting in February 2008.
- 4.3 The original LCFI proposal was submitted in April 2005. Initially, they were studying flavour and charge identification using fast Monte Carlo simulation, there was no public Vertex Package, and there were no LCFI performance studies. New algorithms for quark flavour and charge identification had now been introduced to the Vertex Package, which had also undergone extensive

tuning using the most recent Monte Carlo simulations and reconstruction programmes to give optimal performance. The Vertex Package was now being widely used, and the Collaboration was preparing LoIs for use of the package in ILC detectors.

- 4.4 In 2005 the Collaboration had CPC1 and CPR1, but no drive chip. The system was now up and running up to 30–50 MHz with low noise operation. Also, at the time the proposal was submitted, no results were available to demonstrate the validity of the ISIS concept. ISIS1 had now been thoroughly and successfully tested, and ISIS2 had been designed and manufactured, and the Collaboration was awaiting delivery.
- 4.5 In 2005, they had just discovered that the silicon and beryllium ladder structures did not work. A silicon carbide foam with more potential had now been developed.

Dr Hillert gave a presentation on WP1 (Physics Studies) during which the following points were made:

- 4.6 Major progress had been made in the optimisation of vertex parameters and in the evaluation of performance. LoIs were to be submitted by the end of March 2009. A draft paper on the Vertex software describing the functionality and performance of the code was in circulation with the Collaboration. There had been several extensions of the Vertex Package, and a new algorithm, ZVMST, was shown to be competitive with the existing algorithms. They were in the final stages of optimisation of LCFI Vertex code parameters and were looking at a comparison of different detector geometries. No decision had been taken on what the vertex detector for the ILC concept would eventually look like but the ILD group had agreed on a common set of parameters for the purpose of ILD benchmark studies that would form the basis of the LoI. LCFI had made major progress with its physics benchmark studies. So far only signal studies had been carried out but once the analysis technique had been improved, the effect of adding background samples would be studied.

Dr Nomerotski then gave a presentation on WP 2 (Sensor Design and Production), WP4 (External Electronics), and WP5 (Integration and Testing) during which the following points were made:

- 4.7 The Collaboration received the high-speed CPCCD devices designed to reach 50 MHz operation in March 2008. Noise performance tests were carried out on the CPC2 devices at e2V and showed that the yield was relatively poor. The reasons for this were not well understood. The CPR2A readout chips were received and tests started in March 2008. Their performance was quite impressive, and they were ready to be bump bonded to the CPC2 devices. Six CPC-T wafers of different designs were delivered in March 2008. By December 2008 all CPC-T chips would be tested. The team had designed a better version of the BVM2 called the BVM3. The CPC-T test board was delivered to RAL and Oxford in May 2008. The ISIS2 test board was assembled in September 2008, and the software and firmware were under preparation. ISIS2 had been designed and produced. It was hoped they would be able to get a first signal, but

there would not be time for any further ISIS2 work. Some of the work in these work packages had been done using external resources, including effort from a Czech university.

Dr Goldstein gave a presentation on WP6 (Mechanical Studies) during which the following points were made:

- 4.8 The new ceramic foam vacuum chuck fixtures were received in April/May 2008. These achieved a flatness better than 10 $\mu$ m. Several silicon carbide test ladders were made, and previous silicon carbide results were replicated with no significant change in the ladder. Samples with relative density of approximately 3% were obtained. The previous best had been a relative density of approximately 6%. Complicated shapes had been machined with diamond tooling leading to an understanding of the limitations in design. This would be fed into the instrument design. The Collaboration had looked at more exotic carbon foams, but the results had not been promising.

Dr Velthuis gave a presentation on WP7 (Test Beams) during which the following points were made:

- 4.9 In June 2007, preparation for the first beam test of ISIS1 started, and in October/November 2007 a successful beam test was performed at DESY. Close to the photogates, the signal-to-noise ratio was approximately 36.8 and efficiency was close to 60%. A further test beam was carried out in 2008 using the EUDET telescope, enabling the p-well ISIS devices to be studied. The p-well ISIS had lower noise and a better signal-to-noise ratio. These beam tests had resulted in a significant amount of data on both standard and p-well sensors.

## **5. Collaboration's Future Plans**

- 5.1 Three new proposals were going to the PPRP in a couple of weeks. These were FLUID, SPIDER and LSSD. The Committee queried how much of LSSD was applied physics versus how much was fundamental. The Collaboration stated that the project was more weighted to applied physics and was looking at the thermal as well as the mechanical properties of foams. The proposal covered work for future lepton colliders such as the ILC or CLIC, and future hadron colliders such as LHC upgrade, but the scope extended beyond the work done by LCFI. The Committee wondered whether there were applications outside of particle physics and whether other sources of funding for this proposal could be identified if more generic applications could be identified.

## **6 Discussion/Question and Answer Session**

- 6.1 The Committee was impressed by the work done in WP1 and recognised that Dr Hillert had ideas for the future. However, they felt that the milestone was essentially complete and could be signed off.
- 6.2 On being questioned about the impact of Konstantin Stephanov leaving, the Collaboration stated that he had completed the ISIS2 design before leaving but that the transition had been rather abrupt. Gary Chang had stepped in and taken

over management of the lab and measurements. They acknowledged that the CPC effort was to have been curtailed.

- 6.3 The Committee was pleased with the results obtained for the silicon carbide and felt that Milestone 34 was essentially completed and should be signed off. Milestone 53 (demonstration modules produced) meant a realistic model of a ladder.
- 6.4 The Collaboration stated that the over-spend in WP5 had accumulated over a number of years. Only £3K was left in the budget for that work package but additional funds were required to complete the work. The Collaboration stated that they were unlikely to go more than £20K over their original budget. This need for additional funding had not been communicated to the Office.

## **7. Closed Session**

- 7.1 The Collaboration had achieved more than had been expected of them by effectively utilising STFC and non-STFC resources. They had successfully completed the majority of their objectives and should be congratulated given the circumstances.

### **7.2 WP1**

The Committee was very impressed with the work that had been carried out in this work package. The work had been successfully completed. The LCFI Vertex Package was being used in preparation for both detector LoIs.

### **7.3 WP2**

Work had been successfully completed on the Common Parallel CCD. They had been operating a CPC2-40 device but there had been some issues, so they had switched to CPC-Ts, and investigation of decreased capacitance and resistance of CPC-T gates had been carried out. The ISIS1 devices had been successfully tested. ISIS2 devices had been made and preliminary results were expected in December 2008. The Collaboration would not have enough time to evaluate the data in any great detail. The ISIS work had held the highest risk of the whole programme. However, the Collaboration had done a very good job, and if the ISIS2 worked, this would be a major achievement.

### **7.4 WP3, 4 & 5**

The readout electronics in WP3 had been very competently put together. The CPR2A had been evaluated and both charge and voltage circuits were working. In WP4, a very competent job had been done on the external electronics and test boards had been put together for ISIS2. In WP5, more work had been carried out than expected. The Collaboration had proven the Common Parallel CCD up to 30 MHz.

### **7.5 WP6**

The Collaboration had been worried about this work package but there had been significant progress reported at the last two meetings. The Collaboration were converging on a material and mechanical design with application in many areas.

## 7.6 **WP7**

The Collaboration had done an excellent job of testing the ISIS1 device using the EUDET telescope.

## 7.7 **Milestones**

The Collaboration was unlikely to complete Milestone 60 as it would not be possible to test ISIS2 given the existing time constraints. For the purposes of this Committee, it was felt that this milestone should be signed off. Milestone 39 (finalise improved flavour tag and vertex charge) was essentially complete. Milestone 53 (demonstration modules produced) would be completed by the end of the project.

## 7.8 **Finances**

The Committee wanted to seek clarification from the Collaboration as it appeared that some figures in the finance table were estimates rather than actual figures and so it was not clear that the Collaboration were keeping to the approved allocation for 2008/9.

7.9 The Collaboration would be asked to submit a final report by 1<sup>st</sup> February 2009 outlining what had been delivered relative to the aims and objectives of the original proposal and clearly outlining scientific output.

## **Open Session**

### **8. Feedback to the LCFI Collaboration**

8.1 The Committee felt that the Collaboration had done remarkably well and should be congratulated given the circumstances. They had delivered on their original aims and objectives. The Committee hoped that the Collaboration would produce as many scientific outputs as possible and encouraged them to publish results from all work packages.

#### 8.2 **WP1**

The Committee was very impressed with the Collaboration's work and was pleased that they were able to deliver to the ILC community, who were increasingly relying on the LCFI Vertex Package for studies of quark flavour and charge identification.

#### 8.3 **WP2**

The Common Parallel CCD work had been successfully completed. There had been investigation of decreased capacitance and resistance of CPC-T gates and successful testing of ISIS1 devices. The Committee was pleased that delivery of ISIS2 was imminent. The Collaboration probably would not be able to achieve Milestone 60.

#### 8.4 **WP3, 4 & 5**

In WP3, the Collaboration had very competently put together the readout electronics, and the Committee was pleased that the CPR2A charge circuits were working. The production of external electronics in WP4 had been carried out very professionally, and test boards had been produced for ISIS2. The

Committee had not expected the CPC2 sensors to be tested but were pleased that the Collaboration had been able to successfully achieve some results.

**8.5 WP6**

After a slow start, this work package had produced results, and the Committee was impressed with the silicon carbide foam. This material was likely to have generic applications.

**8.6 WP7**

The Collaboration had done an excellent job of testing the ISIS1 device at EUDET.

**8.7 Milestones**

The Collaboration had clarified the status of the outstanding milestones to the Committee's satisfaction. Milestone 53 was likely to be completed by December 2008. Milestone 60 was unlikely to be completed by the end of the project. Milestone 39 was essentially complete.

**8.8 Future Plans**

The Committee felt that the outcomes of this project had value beyond particle physics, and it would be good to see some of the excellent work going beyond this project and having world class impact. Regarding SPIDER, ISIS was a good development but needed to be proven. LSSD also appeared to have generic value. However, the Committee was unable to see how FLUID could be applied generically outside of particle physics experiments.

8.9 The Committee requested that the Collaboration submit a final report by 1<sup>st</sup> February 2009 with outcomes relative to the original aims and objectives, deliverables, scientific outputs and PhDs to result from the project.

**Action: Collaboration**

**8.10 Finances**

The Collaboration was to clarify the finances with the Office and produce an up-to-date summary finance table with the final report.

**Action: Collaboration**

**9. Any Other Business**

9.1 There was no other business.