



LHCb

Minutes of the 7th RESOURCES REVIEW BOARD Meeting

(Held at CERN on 23rd October 2001)

Present:

Europe:

G. Wormser (IN2P3, Paris), B. D'Almagne;
M. Schmelling (MPI, Heidelberg);
J. Engelen (NIKHEF, Amsterdam), A. J. Van Rijn;
M. Calvetti (INFN, Roma), C. Martellotti;
J. Królikowski (State Committee for Scientific Research, Warsaw), G. Polok;
F.E. Grishaev, V.I. Savrin (Ministry of Science and Technologies, Moscow), A. Goltuvin;
G. Chapuis, (Université de Lausanne, Lausanne), A. Bay;
R. Wade (PPARC, Swindon), T. Bowcock, J. Seed;
G. Zinoviev (Ministry for Science and Technology, Kiev), B. Grynyov.

Asia:

N. Wang (National Natural Science Foundation of China, Beijing)
Yongtao Zhang, Ynglan Zhang, Q Zhou.

CERN:

R.J. Cashmore (chairman), E.M. Rimmer (secretary),
L. Maiani, D. Jacobs, A.J. Naudi, D. Schinzel, D. Schlatter, E. Tsesmelis,
E. van Hove, W. Von Rueden.

LHCb:

T. Nakada, B. D'Almagne, J. Harvey, H.-J. Hilke, A. Smith.

Apologies:

Universität Zürich, Zürich

7th Meeting of the LHCb Resource Review Board RRB, 23rd October 2001

Most documents can be found at <http://web.cern.ch/Committees/LHCRRB/LHCb/>

To benefit from rapid paper-less communications for LHC RRB business, delegates who have not done so should send their e-mail address to F. Baud-Lavigne. She should be informed of any changes in responsibilities for RRBs so that mailing lists can be kept up-to-date.

1 & 2. Introduction & Approval of the minutes of the last meeting

*R.J. Cashmore
Director for Collider Programmes*

The Chairman, R.J. Cashmore, welcomed delegates.

The Minutes of the last meeting were **approved** without changes. There were no matters arising.

3. Status of the experiment

Spokesperson T. Nakada

(LHCb RRB-D 2001-38

LHCb RRB-T 2001-38)

Nakada announced that Annecy has joined LHCb, bringing the collaboration up to 45 institutes plus 3 technical associates. Five countries have still to sign the MoU: Brazil, China, Germany/BMBF, Poland and Spain. On the Management side, B. D'Almagne has replaced I. Videau as deputy spokesperson.

Nakada gave a snapshot of B-physics results up to summer 2001, with BaBar and BELLE both reporting clear signals of CP violation in $B_d \rightarrow J/\psi K_S$ decays. For this decay mode, one year of LHCb running will be quantitatively equal to the combined running of BaBar, BELLE, CDF and D0 up to the start of LHC operation. LHCb will have a big impact on B-physics because it can detect CP asymmetries in the B_s system and can unambiguously identify effects of new physics, if there are any.

Nakada then presented a brief technical status of the various components of the experiment.

- *Cavern:* DELPHI dismantling is finished and modifications have started to accommodate LHCb.
- *Magnet:* construction in industry is well underway; completion is foreseen for May 2003.
- *VELO:* the TDR was approved in October 2001. The baseline technology of the sensors is 300 μm n-on-n while there are still two options for the electronics, SCTA-VELO (DMILL) or BEETLE (0.25 micron CMOS). The proximity of the VELO to the beam makes machine related issues very delicate. Test systems have been built to study the RF properties of the secondary vacuum box that encloses the VELO and the security mechanism that ensures the separation of the primary and secondary vacua.
- *RICH:* the TDR was approved in February 2001. There are two RICH detectors with three radiators (aerogel + C_4F_{10} and CF_4) to cover a wide momentum range from a few GeV/c to 100 GeV/c. Two choices are still open for the photon detector, a pixel HPD as baseline and a Multianode PMT as backup. It was foreseen to have a working HPD with a 20 MHz readout chip and a working 40 MHz chip by June 2001, with a technical choice in September 2001. These milestones were missed by several months as a problem with the readout chip prevented it from running above 20 MHz. This has been fixed and a new submission will be made in November 2001. The 20MHz chip will be used, together with a bump-bonded pixel chip and HPD baseplate, to test encapsulation techniques. Results are expected in November and the overall situation will be reviewed again very soon.

- *Outer tracker:* the TDR was submitted in September 2001. The technology is well defined (straw tubes and custom-made TDCs) and construction techniques are well understood.
- *Inner tracker:* an all Si solution has been adopted. The geometry is defined by outer tracker occupancy with a design that minimises the Si area. First beam tests are underway at CERN. Particular emphasis is placed on studying S/N as a function of strip length as the cost of the read-out electronics is reduced if larger strips can be used. The TDR submission has been delayed by one year to end 2002 but this does not create an overall problem.
- *Calorimeters:* the TDR was approved in February 2001. The technologies are scintillator-Pb-scintillator for the SPD and Preshower, a shashlik ECAL, and an Fe-scintillator tile HCAL, with PMTs as photon detectors. SPD/Preshower engineering designs will be finished in January 2002 and series production will start in April 2002 with a non-critical delay of some 9 months. ECAL and HCAL EDRs have been passed and modules-0 have been constructed and tested without any major difficulty. PRRs are underway and raw material for full production has been ordered. Series production will start a little later than planned but without causing problems. The calorimeter electronics are in good shape; designs of front-end ASICs are completed and several milestones have been passed ahead of schedule.
- *Muon system:* the TDR was approved at the October 2001 RB. Technologies are linked to particle fluxes; single-gap RPCs are used for $<1\text{kHz}/\text{cm}^2$ rates over half of the area and MWPCs are used in the $<100\text{kHz}/\text{cm}^2$ region. R&D on 3GEM and MWPC options is in progress for rates $>100\text{kHz}/\text{cm}^2$ occurring in $<1\%$ of the area, i.e. 3m^2 . Chamber prototypes are being tested using a BiCMOS FE-chip developed for CMS for the RPC and a custom-made $0.25\mu\text{m}$ CMOS CARIOCA chip for the MWPC.
- *Trigger:* all Level-0 components have been designed and simulated and prototype production has started. Level-1 is implemented in software and a prototype is being built using SCI technology. (Higher levels are part of the online CPU farm). It has been decided to delay the L-0/L-1 TDR by one year until end 2002 as this will have no effect on the construction schedule and will allow better synchronization with re-optimisation work described later.
- *Online Computing:* the TDR will be submitted at the end of 2001, including the complete DAQ architecture and the Experiment Control System ECS. Technologies are a flexible Network processor as baseline readout unit with an FPGA-based custom-built backup, and Gigabit Ethernet for the network.
- *Offline projects:* an OO framework GAUDI has been implemented for the reconstruction program and now similar OO work will go on for the simulation and analysis software. To fully understand the environment needed for analysis, LHCb is participating in the EU DataGrid project (WP8) and in the preparation of Tier 1 centres (newcomers are NIKHEF and Bologna) and of data challenges.

A re-optimisation effort is underway to reduce the amount of material in the LHCb detector. In particular, the VELO (rf shield) and RICH-1 (mirror) may be improvable and the tracking is being redesigned to more closely resemble a fixed target configuration by eliminating magnet stations and exploiting VELO measurements. By end 2001 new designs of the VELO and RICH-1 and the validity of the new tracking strategy should be established. By late spring 2002 the re-optimised LHCb detector should be defined allowing an Addendum to be submitted to the autumn 2002 LHCC. As no large-scale changes are involved, the re-design is compatible with the construction schedule. It is also cost neutral, with improvements balanced by simplifications. G. Wormser (FR) asked why the tracker re-optimisation gives no savings and Nakada explained that there are savings in the outer tracker but the overall Si cost has increased and some savings have been offset by a move to a Be beampipe.

Nakada concluded by noting that the LHCb detector is on schedule for a pilot run in April 2006 with full physics potential. At present there is no indication of any cost overrun and every effort is being made to keep it that way.

4. Report from the LHCC *LHCC Scientific Secretary E. Tsesmelis*
(LHCb RRB-D 2001-39)

Tsesmelis reported on the 3 LHCC LHCb meetings held in May, July and October 2001. Construction of LHCb detector started in 2001 and the LHCC considers that it is progressing well and on schedule to be ready for first collisions in April 2006. The Collaboration is studying re-optimisation of the 9 tracking stations, RICH-1 mirrors and VELO rf shields to reduce the material in front of RICH-2 and will submit a document to the LHCC in autumn 2002 describing the design and performance of the re-optimised detector. Inner Detector and Trigger TDRs will be thus submitted one year later than originally scheduled, a delay that the LHCC considers non-critical. The status of LHCb TDRs is:

	<i>Submission to LHCC</i>	<i>Research Board Deliberation</i>
Magnet	December 1999	Approved April 2000
Vertex Detector	May 2001	November 2001
Inner Tracker	End 2002	
Outer Tracker	September 2001	Expected February 2002
RICH Detector	September 2000	Approved Feb. 2001
Muon Detector	May 2001	November 2001
Calorimeter	September 2000	Approved Feb. 2001
Trigger (L0/L1)	End 2002	
DAQ	End 2001	
Computing	December 2002	

Although the LHCC has recommended approval of the VELO and Muon System TDRs, the Committee notes that VELO design changes for tracking re-optimisation will have to be presented to the LHCC before construction starts. Likewise the impact of re-optimisation on muon identification, trigger and measurement must be presented before construction gets underway.

For the subsystems, the LHCC Magnet Advisory Group noted that the dipole magnet is on track and that costs are within budget estimates. The Committee is currently considering the Outer Tracker TDR, submitted in September 2001; a recommendation is expected later in the year. Design changes to the Outer Tracker due to the re-optimisation will need to be presented later, again before construction can begin. For particle identification, the LHCC finds the decision to remove tracking station T11 after the RICH-2 detector reasonable; however, it is evaluating a detailed report.

Concerning the Resistive Plate Chambers RPCs of all four experiments, the LHCC evaluated their performance and ageing properties. The Committee recommends that the experiments should produce detailed documents showing the individual tasks involved in manufacturing to be used as a basis for preparing industrial contracts and for reviewing and monitoring production. Experiments should not move hastily into RPC production before ensuring the soundness of both their functionality and the manufacturing process. The LHCC will continue to monitor progress.

The LHCC has also reviewed the computing requirements for LHC physics. It considers that the LHC Computing Review has set out a sound model, it concurs with the creation of the LHC Software and Computing Steering Committee SC2 and it endorses the plan for the LHC Computing Grid Project. However, the Committee notes the potential lack of resources for hardware, infrastructure and manpower, and the current limited maturity of the software and analysis tools.

Cashmore noted that LHCb must report all consequences of re-optimisation to the LHCC and must be careful not to start construction prematurely. He also asked LHCb to present numerical milestone plots from now on.

5. Status of collaboration accounts *CERN Finance Division Leader A.J. Naudi*
(LHCb RRB-D 2001-36 NOT ON THE WEBSITE)

Naudi reported no changes to the distributed documents. He reminded those concerned that outstanding payments should be made as soon as possible; some are on the way but some (a small amount) have never been paid.

Naudi asked that the following be attached to the minutes, an extract from the May 10th 2001 report of CERN's external auditors, the Spanish Court of Audit, Madrid, for 2000.

"As a result of the audit we are of the opinion that the Annual Accounts 2000 properly reflect the recorded financial transactions of the year, which were in accordance with the budget provisions, the Financial Rules, the Internal Financial Regulations and other established financial procedures of CERN. The Annual Accounts with Financial Statements present fairly, in all material respects, the financial position of CERN as at 31st December 2000, subject to the observations in our report."

6. Budget issues *Resource Co-ordinator H-J. Hilke*

- *Draft 2002 Construction Budget*
(LHCb RRB-D 2001-40 LHCb RRB-T 2001-40)

The draft 2002 budget request assumes that TDRs will be approved according to the LHCC schedule:

Muon System	October 2001
Vertex Detector	October 2001
Outer Tracker	December 2001
DAQ	May 2002
InnerTracker	March 2003
Trigger	March 2003

Requests for contributions to the Common Fund:
 CERN 520 kCHF 8 kCHF minimum per Institute (more if possible).

Requests for contributions to CORE items outside the CF (kCHF):

CERN	1600	Calorimeters and RICH
Brazil	100	Muon System
France	2000	Calorimeters
Germany BMBF	445	Vertex Detector and Inner Tracker
Germany MPI	365	Inner Tracker
Italy	430	Muon System and RICH
Netherlands	780	Outer Tracker and Vertex Detector
Romania	90	Hadron Calorimeter
Russia	415	Calorimeters and Muon System
Spain	60	Calorimeter
UK	1150	RICH
Ukraine	10	Hadron Calorimeter
TOTAL	9155	

Estimated CORE payments in 2002:

Magnet	2.9 MCHF	from CF
Infrastructure	0.5 MCHF	from CF
Detectors	7.4 MCHF	direct contributions
	1.5 MCHF	from CF

- *Update on 2001 CORE expenses*

Hilke noted that payments are occurring about a year later than expected 2 years ago.

Common Fund

Commitments for contracts signed (?) end Oct. 01	5700 kCHF
Magnet	4600 kCHF
Calorimeters	1100 kCHF
Expected payments to end 2001	1400 kCHF

Direct subsystem expenses, calorimeters only:

expected commitments by end 2001	2000 kCHF
expected payments by end 2001	540 kCHF

At this point the RRB **approved** the 2002 LHCb draft construction budget as presented.

- *Draft 2002 M&O budget*
(LHCb RRB-D 2001-41 LHCb RRB-T 2001-41)

The draft 2002 M&O budget request is based on the common approach of the working/scrutiny groups

Only Category A items are considered and costs are shared by number of PhD scientists or equivalent.

M&O A costs estimates in kCHF for 2002 are:

Secretariat	45
Test beams	110
Laboratory operations	65
General services	121
Consultancy	20
Outreach	10
<hr/> TOTAL	<hr/> 371

Hilke emphasised that these are best estimates at this stage and some monies may not be fully spent, e.g. if special consultants are not required.

Discussion

- D. Schinzel, Chair, RRB M&O Scrutiny Group: the LHCb figures have been scrutinised along with those of the other experiments; they are sound and justify endorsement.
- G. Wormser: it is too soon to speak of M&O for LHCb; how can consultancy and clean room (laboratory) operations be labeled as M&O at this stage?
- DS: the Scrutiny Group cross-checked the numbers with LHCb's work schedule; LHCb is already operating and has recurrent M&O costs as well as one-off preparation costs.
- R. J. Cashmore: Wormser's remarks are relevant and perhaps some items should be looked at again, however the sums involved are rather low.
- G. Wormser (on the instigation of Cashmore): as in the case of ATLAS and CMS, the budget could be approved at the 30% level, the rest being considered with the MoU in April; however, the Scrutiny Group should recheck that all of these costs are really related to operating common items and not to construction.
- RJC: the Scrutiny Group should take note of this request.
- DS: the SG treated all experiments in the same way and certain M&O costs start early in these big experiments.
- GW: maybe, but the time schedules are different; LHCb is some 2 years 'behind' ATLAS and CMS.

RJC: there were operating expenses for ATLAS and CMS 2 years ago but they were handled in an *ad hoc* way. The LHCb M&O 2002 estimate is ~ 1/8 that of ATLAS whereas the capital cost ratio is ~ 1/6; this could be because LHCb is 'younger'.

H.J. Hilke: some items do not scale with size, e.g. crane drivers.

GW: crane drivers are not M&O.

M. Calvetti (IT): some numbers are difficult to understand (consultancy, outreach, secretariat)

DS: consultancy was not one of 8 items that were scrutinised in detail.

RJC: the items being discussed are not major and the SG has noted the request for additional checking.

With this, the RRB **approved 30% of the 2002 M&O Category A budget** as presented, on the understanding that rebates had not been applied to the figures.

Hilke then presented the proposed cost sharing by Funding Agency in kCHF:

<i>Funding Agency</i>	<i>"PhDs"</i>	<i>% "PhDs"</i>	<i>Unrebated cost</i>
Brazil	16	3.4	12.6
China	30	6.4	23.7
France IN2P3	24	5.1	18.9
Germany BMBF	14	3	11.1
Germany MPG	10	2.1	7.8
Italy INFN	88	18.7	69.4
Netherlands	18	3.8	14.1
Poland	24	5.1	18.9
Romania	7	1.5	5.6
Russia	70	14.9	55.3
Spain	14	3	11.1
Switzerland	19	4	14.8
UK	61	13	48.2
Ukraine	11	2.3	8.5
CERN	65	13.8	51.2
TOTAL	471	100	371

Discussion

A. Ferrer (SP): what is an 'equivalent PhD scientist'?

H.J. Hilke: for LHCb it is 'high-level' engineers, to first order.

RJC: it is something each collaboration has to define and agree internally; there will probably not be conformity across the four experiments.

Y. Zhang (CN): where does the number of Chinese scientists come from? It is not accurate.

T. Nakada: it came from the collaborating institutes at a time when the definition may not have been completely clear; it will be revised.

RJC: the numbers must and will be checked and agreed before any invoices are issued.

G. Wormser: 'PhD' means a physicist not an engineer; this needs clarification in the MoU.

RJC: the MoU says 'PhD or equivalent'. Many non-PhDs make very important contributions to an experiment and would therefore sign papers; that was the spirit of the idea.

B. D'Almagne (FR): the reference at the moment is those who have signed TDRs and indeed includes engineers.

7. M&O Memorandum of Understanding *D. Jacobs* (RRB-BINGO-D 2001-5)

Jacobs explained the next steps in reaching a final LHCb version of the MoU. All comments made at the Plenary Session, and any further ones, will be taken into consideration in preparing the next version of the generic BINGO draft. This document will then be transformed into four separate drafts containing annexes specific to each experiment. Hopefully these documents can be approved at the April 2002 RRBs for circulation to all signatories.

8. LHCb Computing
(LHCC LHCb T-2001-42)

LHCb Computing Co-ordinator J. Harvey

Harvey described the setting up of a collaborative framework in which to address manpower issues for LHCb core computing.

FTE requirements *per annum* by task for the period up to 2006, recent pledges not included, are:

<i>Task</i>	<i>FTEs needed</i>	<i>FTEs missing</i>
Coordination	1	0
Software Framework	11	4
Software Engineering Support	3	2
Facilities	5	3
Application Frameworks	5	4
DAQ and ECS	17	9
TOTAL	42	22

A resolution was prepared in two meetings (June 8, Aug 28) to which all countries in LHCb were represented. It was endorsed by the LHCb Collaboration Board on September 20th. The resolution defines the program of work and manpower requirements for core computing, and proposes meeting these needs by establishing bilateral Core Computing Agreements. The Collaboration Board will oversee the creation of Agreements and identify additional effort if and when required.

A Core Computing Agreement consists of multiple documents, one for each deliverable or level-of-effort arrangement, jointly signed by the Collaboration and by the Institutes or Funding Agencies concerned. They cover manpower, not cash, and have a lifetime that will be defined in the final Computing MoU to be produced after the Computing TDR is approved. A common template is used for each Agreement; it outlines 1) Parties to the Agreement, 2) Scope and Purpose, 3) Task Schedule and Major Milestones, and 4) Contacts and Reporting. The Collaboration will administer procedures and the RRB will be kept informed.

Many verbal pledges can now be translated into concrete Agreements. Among existing contributions to be formalised are event generators (Lausanne) and visualisation (Orsay). New contributors include the Rio group working on the analysis framework. Extra benefits will accrue from programmes such as the Datagrid and associated national initiatives, from common approaches adopted by the LHC Computing Grid Project and possibly from links between LHCb institutes and local computer science departments.

Cashmore expressed his satisfaction that some of this work is going on in collaboration with ATLAS. Harvey remarked that having chosen the same software framework, LHCb and ATLAS have been able to submit a common proposal to the UK team working on integrating that framework with the Grid.

9 & 10. Summary, future activities & A.O.B.

R. Cashmore

Although it had not been discussed in this particular RRB, Cashmore reminded delegates that a full status review of the LHC Machine has recently taken place. As part of this, the needs of the experiments in the experimental areas and their expectations of available technical support have been studied. Shortfalls of ~20 MCHF for the 4 areas and ~ 10 MCHF of technical effort have been identified and will be included in the final cost-to-completion plans for the LHC.

Concerning LHCb, Cashmore expressed satisfaction that many TDRs have been approved and much satisfactory progress has been achieved with no cost increases. He closed by noting that more scrutiny of LHCb M&O items is requested by the RRB before the April 2001 meeting. As RRB business is expanding, future meetings will be spread through 3 days:

Monday		Tuesday		Wednesday	
April 22 - 24					
11.00 - 12.30	Plenary	09.00 - 12.30	LHC Computing	09.00 - 12.00	ALICE
13.30 - 17.30	CMS	13.30 - 17.30	ATLAS	13.00 - 16.00	LHCb
October 21 - 23					
11.00 - 12.30	Plenary	09.00 - 12.30	LHC Computing	09.00 - 12.00	LHCb
13.30 - 17.30	ATLAS	13.30 - 17.30	CMS	13.00 - 16.00	ALICE