CERN-RRB-2006-059 26 April 2006

Status of the LHCb Experiment LHCb RRB at CERN 26 April 2006

on behalf of the LHCb Collaboration

Tatsuya NAKADA CERN and EPFL



Contents

- I) Construction Status
- II) Physics Update
- III) Cost and Funding
- IV) Conclusions







Major machine cryo-work at IP8 completed Radiation hardness of cryo electronics, remaining concern ⇒being addressed by the machine group Sector test will interrupt the installation work for 3 to 4 weeks

Many parallel works to cope with delays!



cabling, piping



power, cooling



prepare for detector installation



LHCb RRB Status Report

IP8 now...









-Al VELO tank exit window completed -25 mrad Be section completed -10 mrad Be 1st section completed -10 mrad stainless steel section completed



Complete components all at CERN now

-10 mrad Be 2nd section constructed, delivery by the end of May to CERN after testing -Other auxiliaries in production at CERN

3) Magnet (funded by Common Fund)

Final B field measurement for two weeks with all the Fe structure and for both polarities in December 2005



Field measurement device in the magnet

the field was measured with a precision of 3×10⁻⁴
→fulfils the requirement
good symmetry between the two polarities: ΔB/~ 3×10⁻⁴
→small "fake" P violation

Magnet is now operational



4) VErtex LOcator (funded by CH, DE, GB, NL) VELO tank and its control Right detector assembly system ready for installation in progress







Right detector at NIKHEF



Paddle gluing at Liverpool



Module PRR completed Series production starts now →large delay 42 modules to be produced by September 2006



5) RICH (funded by CERN, CF, GB, IT)



RICH-2 installed



RICH-1 gas enclosure ready for installation and now at CERN



Due to the cost and delivery time RICH-1 spherical mirrors Be (Russia) → C-fibre (USA): tight







LHCb RRB Status Report

No further delay in HPD production and test

HPD production status as of 19th April 2006



HPD, L0+HV+LV boards



186 HPD delivered so far2 HPD tested / dayat Edinburgh and Glasgow4% rejected after test

RICH-2 HPD column

mechanics from Genova being loaded at CERN





6) Outer Tracker (funded by CERN, CF, CN, DE, NL, PL)

Module production completed at all sites (NIKHEF, HD, Warsaw) and being prepared for transport to CERNAll the 12 C-frame delivered to NIKHEF and being dressed with cables, tubes etc.

All the parts for the support structure delivered to CERN



connecting two small modules around the beam pipe



C-frame dressing







7) Silicon Tracker (funded by CERN, CH, DE, ES, UA)

All the Si sensors from HPK for IT and TT in hand



IT ladders at CERN IT bonding facility

TT ladders at ZH

TT mechanics at ZH



26 April 2006

IT mechanics at EPFL

8) Calorimeter System (funded by CERN, CF, ES, FR, RO, RU, UA)

E-cal and H-cal systems completed and calibration system being installed





SPD/Preshower

All modules are at CERN from Russia Supermodule assembly completed, QC well advanced Pb converter walls installed



Completed Supermodule equipped with the LED monitoring system at CERN



Pb converter walls at IP8



9) Muon System (funded by CERN, CF, IT, RU)

Chamber Production





chamber dressing at LNF

About 1100 produced and tested: tight schedule but good progress!



Chamber dressing started with some delay in delivery of front-end boards



Chambers fully dressed and equipped with front-end boards at LNF

Assembly of the chamber supporting wall from IT started



Supporting wall for M5 station and suspended platform at IP8





10) Trigger and Online

(funded by CERN, CF, CH, DE, FR, ES, IT, NL)

Production of some L0 trigger electronics, e.g. Ecal/Hcal front-end board, about to start in FR Prototyping of remaining L0 trigger components progressing e.g. Pile-up vertex finder, NL







Full system test at CERN and 1MHz readout implementation and HLT software in progress





Force10 E1200 network switch to be used by CERN IT Department as well



11) Computing

Continuous improvement of software detector geometry calibration and alignment new event model consolidating the changes in LCG application software ROOT-SEAL merging new math library etc.

Preparation for Data Challenge 06

Event generation phase is about to start Followed by full chain of event reconstruction and stripping a la real data GRID analysis with GANGA

II) Physics Update

B_s physics is one of the main subjects for LHCb... B_s oscillation will be one of the first LHCb results -should be seen very fast within the Standard Model -if not seen after several month, for sure new physics Recent results from TeVatron @ 1 fb⁻¹: oscillation frequency D0: preferred value = 19 ps^{-1} , 17 to 21 ps⁻¹ at 90% CL @ $1 \sim 2\sigma$ significance CDF: $17.33 \pm 0.42 \\ -0.21$ (stat) ± 0.07 (syst) ps⁻¹ @ $\sim 3\sigma$ significance

the seen strength of $B_s - \overline{B}_s$ transition amplitude = good agreement with the Standard Model expectation



LHCb will see this with > 5σ significance with a few weeks of good data \Rightarrow one of the frist physics results

The crucial question is the phase of $B_s - \overline{B}_s$ transition amplitude with CP violation in $B_s \rightarrow J/\psi\phi$, $J/\psi\eta$, ... Sensitive to new physics (SM contribution is small) CDF 260 pb⁻¹ Run 2 data: 203 untagged $B_s \rightarrow J/\psi(\mu\mu) \phi$ D0 450 pb⁻¹ Run 2 data: 513 untagged $B_s \rightarrow J/\psi(\mu\mu) \phi$ $\Rightarrow 8 \text{ k} \sim 16 \text{ k events by the end of 2009}$ cf. LHCb 2 fb⁻¹ (10⁷ s data): 100k untagged $B_s \rightarrow J/\psi(\mu\mu) \phi$

 \Rightarrow We must be ready to fully exploit the 2008 data taking!

III) Cost and Funding

Cost:	75.045 MCHF MoU (Nov 2000)	75.341 MCHF Now (+0.4%)
Funding:	73.30 MCHF MoU request	70.257 MCHF MoU signed (not by Brazil)

Adopted strategy to deal with the 5.084 MCHF shortfall

- Secure funds to complete the detector construction first without jeopardizing the 2007 data taking, by

 a) shifting money essentially from CPU's to detectors
 b) asking extra contribution to funding agencies for items they are involved
 →2007 data processing capacity at IP8 limited
- 2) Seek extra contribution for needed CPU's

For 1), a solution for subsystems

Muon system

Shifting Common Fund Shifting Italian contribution from L0 and DAH New contribution by IT(847 kCHF), CERN(185 kCHF)

OT system

Shifting Common Fund New contribution by DE-BMBF(381 kCHF) and NL(381 kCHF)

RICH system

Shifting Common Fund Shifting Italian contribution from DAH Shifting GB contribution from DAH New contribution by CERN(614 kCHF), GB(44 kCHF)

A total of 2.452 MCHF new contribution

BMBF new contribution still to be approved



As a result, 2632 kCHF missing for the DAQ/CPU farm

Total cost of the DAQ/CPU farm: 5.1 MCHF DAQ and farm infrastructure: 1.680 MCHF CPU: 3.420 MCHF Current contributions: 2.468 MCHF Switzerland, 500 kCHF CERN, 1486 kCHF CF, 482 kCHF (GB and IT contributions have been reallocated)

Syracuse now contributes 400 kCHF for CPU Remaining shortfall in CPU = 2.232 MCHF

In 2007, we will start with 1/3 of required CPU's no serious effect for the commissioning run



Current understanding of the cost-funding matrix

Summary Table for April 2006 RRB in kCHF

Funding	Total	Common Fund	Project	VELO	ST	OT	RICH	CALO	Muon	L0	DAQ	ECS, TFC	Magnet	Infra-
agencies	funding	funding	funding						detector		CPU farm	Comp. infrastru.		structure
Brazil	0	0	0	0	0	0	0	0	0	0	0	0	0	0
China	100	28	72	0	0	72	0	0	0	0	0	0	0	0
France	7500	2100	5400	0	0	0	0	3820	0	1580	0	0	0	0
Germany-BMBF	4138	864	3274	370	356	2548	0	0	0	0	0	0	0	0
Germany-MPG	2200	834	1366	0	1366	0	0	0	0	0	0	0	0	0
Italy	10847	2850	7997	0	0	0	1172	0	6395	430	0	0	0	0
Netherlands	6681	1800	4881	1250	0	3381	0	0	0	250	0	0	0	0
Poland	500	140	360	0	0	360	0	0	0	0	0	0	0	0
Romania	300	90	210	0	0	0	0	210	0	0	0	0	0	0
Russia	2500	700	1800	0	0	0	0	1370	430	0	0	0	0	0
Spain	2000	570	1430	0	800	0	0	430	0	0	0	200	0	0
Switzerland	7900	2250	5650	2142	2508	0	0	0	0	0	500	500	0	0
UK	10344	2940	7404	1060	0	0	6344	0	0	0	0	0	0	0
Ukraine	200	60	140	0	70	0	0	70	0	0	0	0	0	0
CERN	13499	3520	9979	0	770	289	1614	3740	495	0	1486	1585	0	0
Funding sum	68709	18746	49963			1			1					
CF contribution				0	0	900	687	5290	1240	0	482	0	5774	4373
CF usage sum			18746						1					
Project Funding			68709	4822	5870	7550	9817	14930	8560	2260	2468	2285	5774	4373
Muon-filter in kin	d contribution	n from CERN	4000											
Project Funding w	with CERN in	kind	72709			1								
Project Cost			71341	4822	5870	7550	9817	14930	8560	2260	5100	2285	5774	4373
Muon-filter			4000											
Project Cost with	Muon filter		75341											
Balance			-2632	0	0	0	0	0	0	0	-2632	0	0	0
US contribution to	o CPU-farm		400											
Total]													

Cost	75341	Funding	73109	Balance	-2232
COSt	10041	Tunung	75107	Dalance	2606



Remaining 2.232 MCHF needed in 2007 as new contribution for full physics exploitation in 2008

Current	situation for new contributions			
Approved:	FR(500 kCHF)			
Requested:	DE-BMBF(450 kCHF), GB(400 kCHF)			
	IT(200 kCHF), US-NSF(600 kCHF)			
(makes a total of 2.15 MCHF, i.e. 82 kCHF left)				
In discussion:	ES, NL			

We plan to conclude this by the next RRB in Oct 2006 so that the final cost-funding matrix can be approved

IV) Conclusions

- 1)LHCb generally making good progress, e.g.
 -Magnet installed and commissioned
 -RICH-2 mechanics, Ecal and Hcal installed
 -OT module and PS supermodule production completed
 -HPD and Muon chamber in production as planned
- 2)The schedule is very tight, e.g. production of Si modules, RICH-1 mirrors, Muon chamber installation But we are fully committed to be ready for the first beam
- 3)Solution for financing the detector construction found
- 4)New contribution is being asked for the missing CPUs, 2.232 MCHF (2/3 of required CPUs), for 2008 data taking -500 kCHF approved (FR)
 - -1.650 MCHF requested (DE, GB, IT, US) We plan to conclude the discussion by the next RRB

LHCC milestone plot (April 2006)



