CMS: Financial Plan

for April 2002 RRB

At the last CMS RRB meeting (October 2001, RRB13) CMS presented best estimates of the Cost-to-Completion, indicating a global shortfall of 67.9 MCHF, which included 12.4 MCHF for Commissioning and Integration (C&I). It was agreed that CMS should draw up a financial plan to cover this shortfall for the April 2002 RRB (RRB14) in close consultation with the funding agencies. The plan proposed in this document is a first iteration towards the final plan, which, after approval by the RRB, should be described in an amendment to the Memorandum of Understanding for the Construction of CMS.

The proposed financial plan is based on the following assumptions:

- First LHC beams to circulate in April 2007 with first collisions in June 2007.
- The initial low luminosity detector, for the first physics run in 2007, is the complete CMS detector minus the items needed at high luminosity namely the 4th endcap muon stations (ME4/1 and ME4/2) and the 3rd forward pixel disks.
- At RRB13 (Oct. 2001) CMS presented a best estimate of the Cost-to-Completion of the complete initial detector, indicating a global shortfall of 67.9 MCHF.
- On the initial detector, cost savings of ~ 2 MCHF, and staging corresponding to ~ 3 MCHF have been identified thus reducing the shortfall from 67.9 MCHF to 62.7 MCHF.
- Preliminary discussions with funding agencies indicate that this reduced shortfall could be covered with additional funds.
- If the shortfall is not fully covered we will:

  Apply additional staging of items, already identified, corresponding to 8.5 MCHF.

  Look for a saving of up to 5 MCHF by using a common LV supply system for the whole experiment. This is currently under technical study and a decision will be made in June 2002.

  Look for additional collaborators – contributions in the order of 10 MCHF with a maximum of ~15 MCHF might be expected.

1. Update on Cost-to-Completion

Since the last RRB the Collaboration has continued to scrutinise the cost and funding of the various sub-detectors. Money matrices (not shown) have been produced for all subdetectors down to level 3 of the product breakdown structures (PBS). Table 1 gives the best estimates of the total cost of the initial low luminosity CMS detector and of the contributions by funding agency and by sub-detector. The initial detector is the complete CMS detector minus the items needed at high luminosity namely the 4th endcap muon stations (ME4/1 and ME4/2) and the 3rd forward pixel disks. The total cost of the initial detector is 513.2 MCHF and includes Commissioning and Integration (C&I), which is considered to be a part of the construction cost. The total assured funding is estimated to be 450.4 MCHF. The shortfall has now decreased from 67.9 MCHF to 62.7 MCHF.

Table 1: Best Estimate of Cost and Contributions by Funding Agency and Sub-Detector in kCHF (April 2002)

		Magnet	Tracker	ECAL	HCAL	Muons	TriDAS	Comput.	Infrastr.	C&I	Tot. Det.	Tot. CP	Tot. Ctr.
Austria		1,100	1,350			100	1,250	100			2,700	1,200	3,900
Belgium		1,480	3,420					100			3,420	1,580	5,000
Bulgaria (as a CERN Member State)						600					600		600
CERN		15,900	16,900	13,200		2,300	12,970	200	23,730		45,370	39,830	85,200
China (1)		1,215				3,000					3,000	1,215	4,215
Croatia		80		200							200	80	280
Cyprus		200		400							400	200	600
Estonia		90										90	90
Finland		1,480	2,400				1,020	100			3,420	1,580	5,000
France	CEA	1,760		3,000			840				3,840	1,760	5,600
	IN2P3	6,000	6,750	6,750				200			13,500	6,200	19,700
Germany		5,150	7,250			4,400		200			11,650	5,350	17,000
Greece		1,480		1,360			2,060	100			3,420	1,580	5,000
Hungary		310			500	100	90				690	310	1,000
India		900		1,000	2,500						3,500	900	4,400
Iran					510						510		510
Italy		16,800	19,500	3,600		14,500	100	500			37,700	17,300	55,000
Korea		815				1,385	400				1,785	815	2,600
Pakistan		625				1,820					1,820	625	2,445
Poland		940					2,060				2,060	940	3,000
Portugal		630		1,115			255				1,370	630	2,000
RDMS	Russia			2,100	5,437	3,310			1,200		10,847	1,200	12,047
	Dubna Member States			400	5,715	1,000					7,115		7,115
Spain		1,790				4,110		100			4,110	1,890	6,000
Switzerland	Universities		2,500								2,500		2,500
	ETHZ	25,000	1,900	42,500			5,500	600			49,900	25,600	75,500
	PSI	2,610	3,600	1,720			500	70			5,820	2,680	8,500
Taipei		730		1,600							1,600	730	2,330
Turkey		310			690						690	310	1,000
United Kingdom		2,650	2,700	2,700			850	200			6,250	2,850	9,100
USA	DOE	26,960	1,480	3,965	27,358	21,135	8,750				62,688	26,960	89,648
	NSF	3,600	990	2,015	4,704	335	765	1,130			8,809	4,730	13,539
Estimated Value of Contributions (1)		120,605	70,740	87,625	47,414	58,095	37,410	3,600	24,930		301,284	149,135	450,419
Estimated Cost (2)		124,120	77,636	111,860	47,414	68,388	37,410	3,600	28,105	14,650	342,708	170,475	513,183
Balance of Contributions vs Cost (1)-(2)		-3,515	-6,896	-24,235		-10,293			-3,175	-14,650	-41,424	-21,340	-62,764

(1) China: The overall MoU commitment of China to the Muon system is 3.55 MCHF. Only 3 MCHF of deliverables have been identified so far.
Discussions are in progress to identify 0.55 MCHF of additional Muon deliverables in the Barrel system, with the aim of reducing further the Muon shortfall.

Table 2 gives the evolution of the shortfall from RRB13 to RRB14. The reduction of the shortfall by 5 MCHF comes from :

i) 2 MCHF saving in the Hadron Calorimeter (HCAL) by reducing the number of longitudinal samplings.

ii) 1.5 MCHF of staged spending: the number of electronics channels has been reduced in endcap muon station ME1/1.

iii) 1.5 MCHF of staged spending: re-stage the electronics of ME4/1: the cost of the initial detector discussed at RRB 13 (Oct 2001) contained the restored ME4/1.

The physics impact is small and the LHCC has already approved these changes.

Table 2: Evolution of Cost-to-Completion

	RRB13 (Oct 01)			RRB14 (Apr 02)		
	Cost (kCHF)	Funding (kCHF)	Shortfall (kCHF)	Cost (kCHF)	Funding (kCHF)	Shortfall (kCHF)
1. Magnet	124,120	120,900	3,220	124,120	120,605	3,515
2. Tracker	77,636	70,200	7,436	77,636	70,740	6,896
3. ECAL	111,860	87,800	24,060	111,860	87,625	24,235
4. HCAL	44,400	42,400	2,000	47,414	47,414	0
5. Muons	71,300	58,000	13,300	68,388	58,095	10,293
6. Tridas	37,700	37,700	0	37,410	37,410	0
7. Computing	3,600	3,600	0	3,600	3,600	0
8. Infrastructure	28,100	24,800	3,300	28,105	24,930	3,175
9. C&I	12,450		12,450	14,650		14,650
Xtra Work SX5	2,200		2,200			0
TOTAL	513,366	445,400	67,966	513,183	450,419	62,764

1. Magnet Cost unchanged. Funding of the Magnet has decreased by 300 kCHF: in kind delivery from Russia did not materialise.
2. Tracker Cost unchanged. 0.5 MCHF funding from the Swiss Universities restored for the Tracker.
3. ECAL Cost unchanged. Funding from Russia reevaluated.
4. The HCAL shortfall of 2 MCHF is now covered by reducing the longitudinal sampling. The HCAL money matrix is balanced.
   The HCAL Cost and Funding have been reevaluated taking into account contributions from US and in kind contributions from RDMS.
5. The cost of the Muon system has been reduced by 3 MCHF:
   The ME1/1a electronics has been simplified (save 1.5 MCHF) and the ME4/1 electronics has been re-staged (stage 1.5 MCHF).
6. Cost of the DAQ reevaluated. New modular architecture to be presented in the DAQ TDR (Dec 2002).
7. Computing unchanged.
8. Infrastructure Cost unchanged. Funding reevaluated: In kind delivery from Russia (Rotating Shielding).
9. C&I belongs to Completion costs. Detailed costing (14.65 MCHF) scrutinised. Extra work in SX5 (2.2 MCHF) is now part of C&I.

The cost and funding of the Hadronic Calorimeter (HCAL), for which the construction is nearly complete, have been reevaluated to 47.4 MCHF. Following the decision to save 2 MCHF in the readout, the HCAL money matrix is now balanced. The contributions to HCAL are dominated by contributions from USA and in-kind contributions from Russia and Dubna Member States (RDMS).

The deficit in the Muon system has been reduced by 3 MCHF as explained above. The cost and funding for the rest of the detector has not changed.

The item 'extra work in SX5' of 2.2 MCHF has been absorbed into C&I, which has therefore increased from 12.45 MCHF to 14.65 MCHF.

Notes of explanations concerning the evolution of cost and funding for each subdetector are given at the bottom of Table 2.

After the final plan has been agreed and approved by the RRB the shortfall will be capped at 62.7 MCHF.

2. Commissioning and Integration (C&I)

As we come closer to the end of the construction phase a number of items, not included in the construction MoU, have been identified, which are necessary to put the detector together and to commission it. A new category of cost was created called Commissioning and Integration (C&I). There is no overlap with M&O costs. C&I costs have the same profile as the construction costs and clearly belong to the Cost-to-Complete category. C&I costs are general costs which are not related to any particular

sub-detector and are to be borne by the whole Collaboration. Since the last RRB C&I costs have been scrutinised by the Collaboration and by the RRB scrutiny group. The assembly and commissioning scenario of CMS consists of two phases:

- Assembly and partial commissioning in the surface hall SX5
- Final assembly and commissioning in the underground cavern UXC55

The new CMS schedule requires that the magnet yoke stay longer in the surface hall. However the time available for cabling and commissioning in the underground area is still barely sufficient. The costs of all activities related to partial commissioning of CMS on the surface have been moved from the detector into C&I costs. C&I costs have been classified into three categories.

i) Additional facilities for commissioning on surface

Nearly all the cables can be installed on the yoke in the surface hall, if disconnects are provided for all detectors. Patch panels/slice connections allow the custom on-detector cabling task to be factorised out from the 'industrial ' cabling from the experiment to the service cavern.

To save commissioning time underground it is desirable to perform vertical slice tests of CMS in the surface hall SX5 with 'final' DAQ. This requires extra facilities that were not initially foreseen such as: temporary control room with electronics, gas and water distribution, electrical & optical cabling, power supplies, etc.

ii) Detector installation, opening and access facilities

CMS has been designed to be easily maintainable by opening the magnet yoke as needed. This requires a special Magnet closing system precise enough to maneuver large pieces during the last few centimeters without damaging detector equipment.

The opening scenario has been improved, allowing retraction of the endcaps by up to 10 m. This new scenario requires extra temporary support and protection of the beam pipe and extra tooling on both sides.

The magnet sections, equipped with heavy-duty air pads, will slide on the floor of the UXC5 cavern. It has been decided to install 40 mm steel plates welded together to provide a steel floor in UXC5.

Safe work around magnet yoke elements requires safety access systems including cherry pickers.

iii) General services

The installation scheme is now better understood. It requires additional infrastructure: a local workshop in SX5 and basic infrastructure for storage. It also requires additional manpower: a team of crane drivers, a team for subdetector survey and calibration using photogrammetry techniques, engineering designers and draughtsmen to support the extended surface phase and associated activities and a reinforced core team in the surface hall providing the base support for installation of magnet and detectors.

Table 3 gives the detailed breakdown of CMS C&I costs, as well as the needed profile of expenditures up to the end of the construction phase in 2006.

Table 3: Commissioning and Integration

	CMS C&I	COSTS (kCHF)						
No.	Item	2002	2003	2004	2005	2006	2007	TOTAL
9.1	**Additional facilities for commissioning on surface**							
9.1.1	Mixed water cooling	270	30	0	0	0	0	300
9.1.2	Gas distribution	90	10	0	0	0	0	100
9.1.3	Control room (barrack) refurbishment	32	40	8	0	0	0	80
9.1.4	Smoke detection	0	75	75	0	0	0	150
9.1.5	LV system (1 generator)	0	120	30	0	0	0	150
9.1.6	Temporary 10 tons lifting gear in SDX	0	0	160	40	0	0	200
9.1.7	Electrical and fiber optical cabling in SX5	0	160	40	0	0	0	200
9.1.8	Common Electronics	80	560	160	0	0	0	800
9.1.9	Pre-cabling, pre-testing facilities	100	600	200	100	0	0	1000
9.1.10	Basic DSS for equipment protection	0	64	16	0	0	0	80
9.1.11	Semi clean-room	20	60	20	0	0	0	100
	TOTALS	**592**	**1719**	**709**	**140**	**0**	**0**	**3160**
9.2	**Detector installation, opening and access facilities**							
9.2.1	Duplication of tooling	0	0	0	36	84	0	120
9.2.2	Dummy end flanges (EB, EE, SE)	0	60	140	0	0	0	200
9.2.3.1	Magnet closing system (grease pads)	0	280	120	0	0	0	400
9.2.3.2	Magnet closing system (corner&closing pieces)	525	225	0	0	0	0	750
9.2.3.3	Magnet closing system (winches for 10m opening in UX5)	0	170	595	85	0	0	850
9.2.4	Controls for magnet and magnet power supply	0	126	126	126	42	0	420
9.2.5	Beampipe and vacuum tooling, beam pipe support	0	0	32	224	64	0	320
9.2.6	Floor plates in UX 5	96	336	48	0	0	0	480
9.2.7	Cherry pickers and access platforms	0	300	0	0	0	0	300
	TOTALS	**621**	**1497**	**1061**	**471**	**190**	**0**	**3840**
9.3	**General services**							
9.3.1	Workshops	90	150	150	120	90	0	600
9.3.2	Heavy transport	290	412	508	726	484	0	2420
9.3.3	Survey	86	86	86	86	86	0	430
9.3.4	Infrastructure for storage	60	210	30	0	0	0	300
9.3.5	Extra engineering design for integration and cabling	196	406	602	196	0	0	1400
9.3.6	CMS technical support team	300	500	600	600	500	0	2500
	TOTALS	**1022**	**1764**	**1976**	**1728**	**1160**	**0**	**7650**
	GRAND TOTAL	**2235**	**4980**	**3746**	**2339**	**1350**	**0**	**14650**

The 2002 budget request for C&I has increased from 1.8 MCHF to 2.2 MCHF compared to that in RRB13. Serbia has agreed to contribute to the Magnet corner pieces (item 9.2.3.2) for a value of 400 kCHF and its manufacture has been brought forward leading to the increase mentioned above. Of the remaining 1.8 MCHF, we can cover ~ 0.6MCHF by approved funds from items in DAQ. We would be grateful if the April RRB can agree to at least fund the C&I costs for 2002.

3. Proposal for Sharing of Cost-to-Completion

The shortfall of 62.7 MCHF corresponds to 17.3% of the current investment (funding), not including that from Switzerland. We are not asking for further investments from Switzerland, since it is providing an exceptional investment of 88.5 MCHF and in addition participates, together with CERN, in the Engineering Center. We propose to divide the shortfall of 62.7 MCHF into a common part of 21.3 MCHF (14.6 C&I + 3.5 Magnet + 3.2 Infrastructure, corresponding to an increase of 6% of the investment) and a detectors part of 41.4 MCHF (corresponding to an increase of 11.3% of the investment).

Table 4 shows a proposal for how to cover the shortfall per sub-detector (columns) and per funding agencies (rows). We request all funding agencies to contribute to the common part pro-rata of their capital investment.

The 400 kCHF contribution from our new collaborators from Serbia has been introduced in Table 4. An entry for Brazil has also been introduced even though a formal application has not yet been received but for which a commitment to procure YE4 for a value of 0.5 MCHF has been taken already.

Table 4: Proposed Sharing of Costs in kCHF

		CP= C&I, Magnet, Infrastr.	Tracker	ECAL	HCAL	Muons	TriDAS	Tot. Det.	Total CMS
Austria (1)		141	459					459	600
Belgium		290	580					580	870
Brazil		500							500
Bulgaria (as a CERN Member State)		35				71		71	106
CERN		5,000		8,500				8,500	13,500
China		500				200		200	700
Croatia		16		33				33	49
Cyprus		35		71				71	106
Estonia		16							16
Finland		290	580					580	870
France	CEA	340		660				660	1,000
	IN2P3	1,000		3,000				3,000	4,000
Germany		833	870			1,000		1,870	2,703
Greece		291		589				589	880
Hungary		58							58
India		256		518				518	774
Iran		500							500
Italy		2,200	4,500	1,700		4,500		10,700	12,900
Korea		152				306		306	458
Pakistan		143				285		285	428
Poland		175				353		353	528
Portugal		117		235				235	352
RDMS	Russia	900		1,350				1,350	2,250
	Dubna Member States								
Serbia		400							400
Spain		350				1,000		1,000	1,350
Switzerland	Universities								
	ETHZ								
	PSI								
Taipei		136		274				274	410
Turkey		58							58
United Kingdom		530		1,000				1,000	1,530
USA (2)	DOE	6,000		6,200		2,800		9,000	15,000
	NSF								
Completion Cost (1)		**21,300**	**6,900**	**24,200**		**10,300**		**41,400**	**62,700**
Extra Contributions (2)		**21,262**	**6,989**	**24,130**		**10,515**		**41,634**	**62,896**
Balance (2) - (1)		**-38**	**89**	**-70**		**215**		**234**	**196**

(1) Austria: contribution agreed provided that the missing funds for the Drift Tube Trigger and the Global trigger Processor can be obtained from other sources

(2) USA: The total project money available for the construction period is fixed. Because of good cost performance the US groups have been able to contribute extra items which were not part of their MoU obligations. For the period 1998-2001 these extra contributions amount to 9.4 MCHF including 3.8 MCHF of Cost Book deliverables. For the rest of the construction period it is assumed that a similar good cost performance could lead to an extra contribution of 15 MCHF of Cost Book deliverables. Indeed 2.8 MCHF have already been committed in 2002 for ME1/1 electronics.

The Collaboration considers that Table 4 represents a good basis for discussions with the funding agencies. The CMS link-persons to funding agencies have agreed to contact and inform their respective funding agencies. In some cases direct discussions between the CMS management and the funding agencies have taken place. Preliminary indications from many Funding Agencies are positive.

In case the shortfall is not fully covered we shall apply further staging or saving and look for additional collaborators. This plan is discussed next.

4. Additional Sources for Reduction of Shortfall

4.1 additional staging or savings

The exact detector configuration in April 2007 will depend on the ability to cover the shortfall, guided by physics priorities. Additional staging that has already been identified amounts to 8.5 MCHF and comprises:

TRIDAS:	– start with 50% of DAQ Capacity	~ 8 MCHF
Infrastructure:	– reduced cooling and ventilation in SCX	~ 0.5 MCHF

Staging does not lead to savings in the long term but modifies the spending profile. A potential saving of up to 5 MCHF arising from the use of a common LV supply system for the whole experiment is under technical study. A decision will be made in June 2002.

Finally, if required, we will have to consider the possibility of staging one or both of the ECAL endcaps (staging ~ 10–20 MCHF). However the physics damage will be quite significant. Furthermore, a substantial delay in the construction of the crystals endcap is likely to jeopardize it completely.

4.2 additional collaborators

CMS continues to attract new collaborators. In March three new groups were approved to join CMS: Belgrade (Serbia), Milan and Naples (INFN, Italy). Discussions with additional new collaborators are progressing:

Brazil	Computer farm, YE4, forward physics	YE4 (0.5 MCHF) funded? Application in June?
Ireland	Computer farm, ECAL electronics?	Application in June?
Mexico	Silicon tracker in collaboration with US	In progress
New Zealand	Computer farm, Pixels	Application in June
Thailand	ME electronics boards	In progress
US (Heavy Ions)	1/4 of filter farm, zero degree calorimeter	Proposal submitted 15 March to DoE

Contributions in the order of 10 MCHF with a maximum of ~15 MCHF might be expected.

5. High Luminosity Upgrade

Some items in the high luminosity detector have already been staged. The list below shows that these items correspond to ~ 18MCHF. The decision to build many of these items will only be taken after inspection of the first physics data.

ME4/2 mechanics and electronics	9.2 MCHF
ME4/1 electronics	1.5 MCHF
ME4/1 assembly in PNPI	0.5 MCHF
Restore ME1/1a electronics	1.5 MCHF
Extra neutron shielding	1.0 MCHF
3rd forward pixel layer	~2.5 MCHF
Double RPC RE2 station	~2.0 MCHF
Extra installation costs	?

6. Desired Funding Profile

In order not to delay the construction of CMS, the shortfall for each sub-detector has been reallocated, whenever possible, to contracts that are not yet on the critical path. Table 5 gives for each sub-detector the list of critical contracts or items after this reallocation. It also gives the year in which payments have to be made.

Table 5: CMS Cost-to-Completion, Payment Profile

CMS COST-TO-COMPLETION		PAYMENTS (KCHF)							
No.	Item	2002	2003	2004	2005	2006	2007	2008	TOTAL
1	**Magnet**								**3500**
1.1	Heavy Lifting Operation	0	0	3500	0	0	0	0	3500
2	**Tracker**								**6900**
2.1	Silicon Sensor Procurement	0	0	500	0	0	0	0	500
2.2	Front-End Drivers (FED)	0	0	0	1900	0	0	0	1900
2.3	Front-End Controllers (FEC)	0	0	0	300	0	0	0	300
2.4	Cables Installation	0	0	1500	0	0	0	0	1500
2.4	Cooling Plant	0	0	800	0	0	0	0	800
2.5	Power Supplies	0	0	1900	0	0	0	0	1900
3	**ECAL**								**24200**
3.1	Endcap Crystals	0	2470	3300	3300	1930	0	0	11000
3.2	Electronics	0	500	2500	0	0	0	0	3000
3.3	Electronics Spares	0	0	0	1200	0	0	0	1200
3.4	Barrel Crystals (Reimburse loan from DAQ)	0	0	0	3000	4000	0	2000	9000
4	**Muons-DT**								**3600**
4.1	Sector Collector+ Power Supplies	0	0	2200	0	0	0	0	2200
4.2	Power Supplies	0	0	0	1400	0	0	0	1400
5	**Muons-CSC**								**2800**
5.1	ME1/1 electronics, cables and connectors	2800	0	0	0	0	0	0	2800
6	**Muons-RPC-Barrel**								**1600**
6.1	Cooling System	0	250	0	0	0	0	0	250
6.2	Gas Piping (needed in 2002, reimburse HV later)	0	500	0	0	0	0	0	500
6.3	HV System	0	600	0	0	0	0	0	600
6.4	Others	0	0	250	0	0	0	0	250
7	**Muons-RPC-Endcaps**								**2300**
7.1	Cooling System	0	300	0	0	0	0	0	300
7.2	Gas Piping (needed in 2002, reimburse CF later)	0	0	0	300	0	0	0	300
7.3	HV System	0	700	0	0	0	0	0	700
7.4	VLSI, cables	0	300	0	0	0	0	0	300
7.5	Kapton (needed in 2002, reimburse CF later)	0	0	0	300	0	0	0	300
7.6	RE1 Panels (China)	200	0	0	0	0	0	0	200
7.7	RE Bakelite (needed in 2002, reimburse CF later)	0	0	0	200	0	0	0	200
8	**Infrastructure**								**3200**
8.1	Beam Pipe	0	100	700	0	0	0	0	800
8.2	SCX Cooling and Ventilation Plant (2nd Phase)	0	0	0	0	0	500	0	500
8.3	Neutron Shielding ME chambers	400	200	0	0	0	0	0	600
8.4	YE4 (Support of RE4 and Shielding of ME4)	0	500	0	0	0	0	0	500
8.5	YE4 Ancillaries	0	100	0	0	0	0	0	100
8.6	Forward Cylindrical Shielding (FCS)	500	0	0	0	0	0	0	500
8.7	FCS Ancillaries	0	200	0	0	0	0	0	200
	TOTALS	**3900**	**6720**	**17150**	**11900**	**5930**	**500**	**2000**	**48100**
9	**C&I**	2235	4980	3746	2339	1350	0	0	**14650**
	GRAND TOTAL	**6135**	**11700**	**20896**	**14239**	**7280**	**500**	**2000**	**62750**

For Magnet, Tracker and Muons-DT no new funds need to be committed before 2004. For ECAL one critical contract must be signed in 2002: the procurement of endcap crystals (11 MCHF). In the ECAL cost we have used an exchange rate of 1.65 CHF/$. The shortfall due to this has been allocated to the endcap crystals. In order to place this contract, for which we hope that ETHZ will be able to take the commitment, at least 11 MCHF of ECAL shortfall has to be covered. The payments for the endcap crystals are spread over the period 2003-2006.

For Muons-CSC the commitment of 2.8 MCHF for ME1/1 electronics has been taken by US groups already.

Critical commitments for the Endcap RPC in 2002 include: Contract for Gas piping (300 kCHF), procurement of Kapton cables (300 kCHF) and procurement of Bakelite (200 kCHF). We obtained permission from the RRB to borrow from the Common Fund (Computing) to cover these critical items. These monies will have to be reimbursed in 2005. Another critical commitment in 2002 is the procurement of honeycomb panels for the thin RPCs RE1/2, RE1/3 to be assembled in China. We hope that China will be able to make this additional commitment.

For the infrastructure there are two critical procurements in 2002: Neutron Shielding which needs to be installed soon on the endcap yoke (400 kCHF) and the forward cylindrical shielding around HF (FCS, 500 kCHF), for which the construction has to start soon (additional contribution from Iran is envisaged). It is envisaged to cover the cost of the the neutron shielding, corresponding to ~ 0.4MCHF, by approved funds from items in DAQ.

It is clear that once the commitments have been received any problems associated with cash-flow will need to be addressed.

7. Conclusions

CMS has drawn a draft financial plan based on a request for additional funds amounting to 62.7 MCHF. The proposed plan is a first iteration. Feed back from the RRB concerning additional funds is requested, such that a final plan could be approved in the October RRB. Final approval will lead to an amendment of the construction MoU, which should be signed by all funding agencies. The final plan must include a funding profile, which is needed to keep CMS on schedule. A first draft of the desired funding profile is given in Table 6 for the cost-to-complete, C&I, M&O (cat A and Cat B) and for the high luminosity upgrade. Commitment in 2002 for the coverage of the shortfall is necessary in order not to delay the construction of CMS.

Table 6: CMS Financial Plan - Desired Funding Profile – Physics Run in 2007

(MCHF)	2002	2003	2004	2005	2006	2007	2008	2009	2010	SUM	Σ(02-07)
Construction	90.00	81.10	65.00	12.00	6.00					**254.10**	254.10
Cost to Complete	3.90	6.72	17.15	11.90	5.93	0.50	2.00			**48.10**	46.10
C&I	2.24	4.98	3.75	2.34	1.35					**14.65**	14.65
M&O Cat A	1.00	2.01	3.30	5.35	7.30	9.20	14.20	14.20	14.20	**70.76**	28.16
M&O Cat B	0.81	1.63	3.72	4.88	6.95	8.00	8.00	8.00	8.00	**49.99**	25.99
Hi L Upgrades						10.00	8.00			**18.00**	10.00
TOTAL	**97.95**	**96.43**	**92.92**	**36.47**	**27.53**	**27.70**	**32.20**	**22.20**	**22.20**	**455.59**	378.99