CALICE - Calorimetry for the International Linear Collider

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1 Introduction

The CALICE proposal for calorimetry studies for the International Linear Collider (ILC) consists of five workpackages; WP1 (completion of the current programme), WP2 (DAQ), WP3 (MAPS), WP4 (thermal/mechanical) and WP5 (physics/simulation).

The proposal was considered by the PPRP at their meetings in February and March 2005. The first workpackage, WP1, was approved directly from their own seedcorn budget and this workpackage will not be discussed further here. The PPRP recommended approval for the rest of the workpackages with some reduction in funding to one of the workpackages, WP2.

The proposal was then presented to Science Committee at their meetings in April and June 2005. Mainly due to severe budget constraints, they were prepared to approve the programme if it could fit into a fixed new money total in the three financial years FY05/06 to FY07/08. Following discussion, they agreed that this could be done by delaying parts of the programme to fall into FY08/09, even though this would lead to a higher new money and total cost overall. This modified programme is described below.

This document gives some detail on the changes to the original proposal and presents the financial summaries of the modified programme. Annex B contains tables in a similar format to those in the original proposal.

2 Changes since the proposal

The changes required by the PPRP and Science Committee are described below.

2.1 Changes from the PPRP

The PPRP rated WP2, WP3 and WP5 at the highest rating, $\alpha 5$, while WP4 was ranked at $\alpha 3$. It recommended approval of all four workpackages with a total new money cost of £1323k. This was £125k less than the proposal, with the reduction being from WP2, namely Task 2.5 (concerning the off-detector data receiver PCI boards) which was considered somewhat premature.

However, the scale of this cut was far greater than the equipment and consumables cost for Task 2.5 of £29k; indeed, the whole equipment and consumables budget for WP2 (including another four tasks beside Task 2.5) was only £143k. Hence, the only feasible way to reduce costs at this level was to cut new staff. This was done by removing N.Pezzi completely, and starting the two new RAs at RHUL (RA-3) and UCL (RA-4) later. Explicitly, RHUL RA-3 was moved to start in April 2007 while the UCL RA-4 was moved to start in December 2005. The equipment cost of WP2 was also lowered by reducing the number of PCI boards being produced. (The number could not be reduced to zero as they are required for other tasks in the workpackage.)

These staff reductions unavoidably impacted on WP5 as the RAs were also allocated to work in that area. Hence, the reductions were actually spread over the two workpackages, with the new money cost of WP2 being cut to £262k and of WP5 being cut to £272k, for a total of £534k. The original new money costs were £348k and £311k, respectively, giving an original total for these two workpackages of £659k; the difference is the PPRP cut of £125k.

One other change in the detail of the costs is from the allocation of RAL/PPD staff. This only affects WP3 as this is the only workpackage in which RAL/PPD are involved. At the time of the proposal, we were told by PPARC that six staff months (SM) of RAL/PPD effort per year was already costed in the SLA and so would not count as new money. However, since this time, PPARC have informed us that this is incorrect and the 6 SM was only in the SLA for FY05/06. Hence, *all* RAL/PPD staff effort from FY06/07 onwards should be counted as new money. Hence, compared to the new money totals presented to the PPRP, there is an increase of £40k per year, corresponding to 6 SM, for FY06/07 and FY07/08. Of course, this is purely a change from SLA money to new money and does not affect the total cost to PPARC. It does however make fitting within the Science Committee constraint on new money somewhat more difficult.

2.2 Changes from Science Committee

Science Committee required the new money within the three financial years FY05/06 to FY07/08 to be within £1350k, including working allowance and contingency. To put this in context, the programme recommended for approval by the PPRP would have cost £1731k of new money, again including working allowance and contingency.

The CALICE collaboration considered that reducing the scope of the workpackages to fit into this constraint while still attempting to complete the programme within three years was not feasible. The response was therefore to retain most of the scope of the original proposal but to spread the work over four financial years instead. This clearly will lead to delays in achieving the goals of the proposal. However, we considered the risk of losing the UK leading roles in ILC calorimeter studies due to a delay was less than losing it from a significantly reduced programme.

The delay is different for different tasks but is between six and twelve months in all cases. In addition, there was some scope reduction in the lowest priority WP4. The major effect of the delays is to push a significant fraction of the new money cost into FY08/09. However, because of this extension from three to four years of the overall length of the programme, this also pushes up the overall cost. This was reported to Science Committee and they agreed to these increases if they were not too far out of line with the ongoing costs. One increase is simply that some of the Rolling Grant staff have a "standing army" effect. However, the delays increase the new money totals also. The new RAs need to be retained until the ends of the workpackages where they contribute. However, they cannot all be simply delayed by the same amount as the workpackages as the Birmingham RA-1, Imperial RA-2 and UCL RA-4 have effort allocated to the already-funded WP1 in FY05/06. Hence, RA-1 and RA-2 could only be delayed to start in October 2005, while RA-4 starts in December 2005, and the other two, RHUL RA-3 and RAL/PPD RA-5, were delayed until April 2007. Finally, there is a small effect from indexation; delaying the programme into FY08/09 increases both the new and total costs by around 3% on average.

The new money cost of the workpackages after this modification is £1033k in FY05/06 to FY07/08 and £1574k in all four years. Including the working allowance and contingency (see below), the total new money over the first three years is then £1351k, very close to the Science Committee constraint.

The total cost to PPARC of the modified proposal, including Rolling Grant and SLA costs as well as the new money, is then £1929k in the first three years and £2724k for the four years. For comparison, the original proposal total cost, all in FY05/06 to FY07/08, was £2512k. This was considered by Science Committee to be in line with the ongoing costs.

3 Overview of workpackages in the modified proposal

The details of changes to each of the workpackages in the modified proposal are described below.

3.1 Workpackage 2 - DAQ

Overall, this workpackage has been delayed by six months. Tasks 2.1, 2.2 and 2.4 are otherwise unaffected, but the effort and scope have been somewhat reduced for Tasks 2.3. Task 2.5 was cut by the PPRP.

Task 2.5 (Off-detector receiver studies) was to develop and study PCI optical receiver cards. Because these cards are needed for other tasks, notably Task 2.3, then the cards will still be fabricated, but in smaller numbers. A significant fraction of RHUL RA-3 and UCL RA-4 effort, now delayed, was to contribute to testing in this task, so cutting the task offsets some of the impact of the effort reduction.

N.Pezzi, RHUL RA-3 and UCL RA-4 were all to contribute to Task 2.3 (Networking studies). This will be delayed by more than the overall six months due to the reduced effort available; around nine months is realistic. It will also be reduced in scope as fewer PCI cards are available; the range of network tests will be reduced and the tests will be less detailed.

In summary, the scope of Task 2.3 will be somewhat reduced although the deliverables remain, albeit with less thorough testing to deliver them. The total workpackage cost is £778k.

3.2 Workpackage 3 - MAPS

Despite being a very high priority, the MAPS workpackage has been delayed by nine months. This is because this workpackage was the most expensive in terms of new money and there was no realistic way not to incur this delay while remaining within the Science Committee overall new money constraint.

However, there have otherwise been very few other changes to this workpackage. The only other modification is that the RAL/PPD RA-5 has been delayed as described above and will now start in April 2007, which is 15 months later than originally planned, i.e. six months delayed relative to the rest of the workpackage. This RA is mainly for testing the MAPS sensors. However, even with the delay, it is still the case that the person will be in post when the first round of sensors arrive. The original extra six months before sensors became available would have been used for sensor test preparations (together with the Birmingham and Imperial RAs) and simulation studies.

We aim to make use of the time given by the nine months delay to do more detailed simulation studies before starting on the sensor design towards the end of 2005. These studies will be done by the academics involved (as there is no RA effort during this time) and this should compensate for the later start of the RAL/PPD RA-5. To help in this work, we have kept 1 SM of effort from R.Turchetta in FY05/06, despite the overall delay to the workpackage, so that he can use his experience to guide these studies.

There are no changes to the scope and deliverables of this workpackage. The total workpackage cost is £1034k.

3.3 Workpackage 4 - Thermal/Mechanical

This workpackage was the lowest priority (as recognised by the lower $\alpha 3$ rating given by the PPRP) and so has been cut hardest. There has been an overall delay of around twelve months and there are overall reductions in the scope.

Task 4.1 (Thermal studies) will be scaled back to concentrate more on software modelling rather than simulation verification. While important, the latter can be delayed until the next funding round. This change allows the equipment costs to be reduced.

Task 4.2 (Glue studies) will be done using glues supplied by our collaborators and so will have no new money cost.

Task 4.3 (Assembly studies) will make more use of existing ATLAS equipment than originally foreseen and will concentrate more on pattern recognition software than development of a prototype assembly robot.

All these changes reduce equipment costs but push the emphasis onto RG staff, hence increasing the RG effort required compared to the original proposal.

The deliverables are reduced with thermal measurements, and automated wafer placement being dropped. The total workpackage cost is £185k.

3.4 Workpackage 5 - Physics/Simulation

This workpackage has been delayed by six months. In addition, some of the allocated effort has been delayed further due to starting the RHUL RA-3 and UCL RA-4 posts later. This effort was assigned to Task 5.4 (Physics studies), while the other three tasks are unaffected. The UK will therefore be able to make less of an impact in the physics area in the first two years. However, this is an area where a Ph.D. student can sensibly contribute and we will try to make up the shortfall through this route.

The scope of the workpackage is effectively unchanged, although the deliverables for Task 5.4 will be delayed relative to the rest of the workpackage by around one year if no student effort is forthcoming. The total workpackage cost is £408k.

3.5 Working Allowance and Contingency

The working allowance is due to uncertainties on staff salary and equipment costs. Because both of these have been reduced slightly since the original proposal, the working allowance is reduced from the original £176k to £166k.

However, the contingency was evaluated for specific risks and these have not been changed by the modifications to the proposal. Hence, this remains at £152k as in the original proposal.

4 Summary

The modified proposal has a new money cost for the four workpackages of £1033k in the first three financial years (corresponding to the period of the original proposal) and £1574k over all four financial years. The cost to PPARC of the workpackages is £1611k in the first three financial years and £2406k over all four financial years. Including the working allowance and contingency, the total cost to PPARC is £2724k.

There is a delay of between six to twelve months on most tasks compared with the original proposal. One task has been cut by the PPRP. A few tasks have also been reduced in scope, although almost all of the deliverables have been retained, albeit with some delays in the deliverables.

We believe that despite these cost and scope reductions, this programme will still give the UK a leading position long-term in ILC calorimetry.

Annex B: Financial summary

Annex B1: Staff overview by institute

Staff funded from the proposal are listed below. All numbers are after indexation. All costs are given in £k and all effort is given in staff months. Some staff shown are already working on WP1 but these costs are not included here.

Birmingham					FY05/06		FY06/07		FY07/08		FY08/09		Total	
Staff Name	Grade	Start Date	End Date	Incr. Date	Cost (£k)	Effort (SM)	Cost (£k)	Effort (SM)	Cost (£k)	Effort (SM)	Cost (£k)	Effort (SM)	Cost (£k)	Effort (SM)
New RA-1	RA	Oct05	Sep08	Oct	13	4	38	11	44	12	24	6	118	33
R.J.Staley	Engineer	Apr07	Mar09	Oct	0	0	0	0	12	2	13	2	25	4
Elec. technicians	Technician	Apr07	Mar09	Aug	0	0	0	0	3	1	6	2	9	3
New Money Total					13		38		44		24		118	
RG Total					0		0		15		19		35	
Total					13		38		60		43		153	

Cambridge					FY05/06		FY06/07		FY07/08		FY08/09		Total	
Staff Name	Grade	Start Date	End Date	Incr. Date	Cost (£k)	Effort (SM)	Cost (£k)	Effort (SM)	Cost (£k)	Effort (SM)	Cost (£k)	Effort (SM)	Cost (£k)	Effort (SM)
G.Mavromanolakis	RA	Apr05	Mar08	Oct	0	0	23	6	49	12	0	0	72	18
M.J.Goodrick	Engineer	Apr05	Mar09	Oct	12	2	12	2	19	3	6	1	49	8
R.Shaw	Technician	Apr05	Mar09	Oct	4	1	7	2	8	2	6	1	25	6
C.Barham	Technician	Apr05	Mar09	Oct	3	1	10	3	14	4	13	2	40	10
New Money Total					0		23		49		0		72	
RG Total					18		29		40		26		113	
Total					18		52		89		26		185	

Imperial					FY05/06		FY06/07		FY07/08		FY08/09		Total	
Staff Name	Grade	Start Date	End Date	Incr. Date	Cost (£k)	Effort (SM)	Cost (£k)	Effort (SM)	Cost (£k)	Effort (SM)	Cost (£k)	Effort (SM)	Cost (£k)	Effort (SM)
New RA-2	RA	Oct05	Sep08	Oct	0	0	28	7	46	11	27	6	101	24
O.Zorba	Engineer	Apr05	Mar09	Oct	0	0	5	1	22	4	23	4	51	9
D.R.Price	Engineer	Apr06	Mar09	Oct	0	0	7	1	31	4	25	3	63	8
I.Clark	Technician	Apr07	Mar09	Oct	0	0	0	0	5	1	10	2	16	3
New Money Total					0		28		46		27		101	
RG Total					0		13		58		59		129	
Total					0		41		105		85		231	

Manchester					FY05/06		FY06/07		FY07/08		FY08/09		Total	
Staff Name	Grade	Start Date	End Date	Incr. Date	Cost (£k)	Effort (SM)	Cost (£k)	Effort (SM)	Cost (£k)	Effort (SM)	Cost (£k)	Effort (SM)	Cost (£k)	Effort (SM)
R.Hughes-Jones	Physicist	Apr05	Mar09	Oct	6	1	12	2	13	2	7	1	38	6
S.Kolya	Engineer	Apr05	Mar09	Oct	6	1	6	1	7	1	7	1	26	4
R.J.Thompson	Engineer	Apr05	Mar09	Oct	6	1	6	1	26	4	28	4	66	10
S.Snow	Physicist	Apr05	Mar09	Oct	6	1	6	1	7	1	7	1	26	4
J.Freestone	Engineer	Apr05	Mar09	Oct	4	1	4	1	10	2	10	2	28	6
A.Elvin	Technician	Apr05	Mar09	Oct	3	1	3	1	7	2	8	2	21	6
M.Perry	Technician	Apr05	Mar09	Oct	2	1	3	1	3	1	3	1	11	4
RG Total					33		41		72		70		217	

RAL/ID					FY05/06		FY06/07		FY07/08		FY08/09		Total	
Staff Name	Grade	Start Date	End Date	Incr. Date	Cost (£k)	Effort (SM)	Cost (£k)	Effort (SM)	Cost (£k)	Effort (SM)	Cost (£k)	Effort (SM)	Cost (£k)	Effort (SM)
R.Turchetta	Engineer	Apr05	Mar09		11	1	12	1	21	1	13	1	47	4
J.Crooks	Engineer	Jan06	Dec08		17	3	73	12	78	12	62	9	230	36
New Money Total					28		84		90		75		277	

RAL/PPD					FY05/06		FY06/07		FY07/08		FY08/09		Total	
Staff Name	Grade	Start Date	End Date	Incr. Date	Cost (£k)	Effort (SM)	Cost (£k)	Effort (SM)	Cost (£k)	Effort (SM)	Cost (£k)	Effort (SM)	Cost (£k)	Effort (SM)
M.Tyndel	Physicist	Apr05	Mar09		7	1	7	1	7	1	7	1	27	4
E.G.Villani	Engineer	Apr05	Mar09		33	5	33	5	34	5	35	5	135	20
New RA-5	RA	Apr07	Mar09		0	0	0	0	62	12	64	12	126	24
New Money Total					0		40		103		106		250	
SLA Total					39		0		0		0		39	
Total					39		40		103		106		289	

RHUL					FY05/06		FY06/07		FY07/08		FY08/09		Total	
Staff Name	Grade	Start Date	End Date	Incr. Date	Cost (£k)	Effort (SM)	Cost (£k)	Effort (SM)	Cost (£k)	Effort (SM)	Cost (£k)	Effort (SM)	Cost (£k)	Effort (SM)
New RA-3	RA	Apr07	Mar09	Aug	0	0	0	0	47	12	49	12	96	24
F.Salvatore	Physicist	Apr05	Mar09	Aug	5	1	5	1	32	6	34	6	76	14
G.Boorman	Engineer	Apr05	Mar09	Aug	0	0	5	1	10	2	5	1	19	4
B.J.Green	Engineer	Apr05	Mar09	Aug	6	1	12	2	12	2	6	1	37	6
New Money Total					0		0		47		49		96	
RG Total					11		22		54		45		132	
Total					11		22		101		95		228	

UCL					FY05/06		FY06/07		FY07/08		FY08/09		Total	
Staff Name	Grade	Start Date	End Date	Incr. Date	Cost (£k)	Effort (SM)	Cost (£k)	Effort (SM)	Cost (£k)	Effort (SM)	Cost (£k)	Effort (SM)	Cost (£k)	Effort (SM)
New RA-4	RA	Dec05	Mar09	Oct	0	0	30	8	49	12	34	8	113	28
M.Warren	Engineer	Apr05	Mar09	Oct	9	2	24	5	32	6	16	3	81	16
M.Postranecky	Engineer	Apr05	Mar09	Oct	10	2	21	4	36	6	19	3	86	15
New Money Total					0		30		49		34		113	
RG Total					19		45		68		35		167	
Total					19		75		116		69		280	

Annex B2: Overview of costs to PPARC

All costs are after indexation and are given in £k. The line labelled "New Money Totals" includes all the costs not already within the Rolling Grants (RG) or RAL SLA. This therefore includes all equipment, consumables and travel as well as the staff costs for the project RAs and RAL personnel. In addition to the costs below, the working allowance (£166k) and contingency (£152k) give a total cost to PPARC of £2724k.

		FY05/06	FY06/07	FY07/08	FY08/09	Total
Staff Effort						
Birmingham	New	13	38	44	24	118
	RG	0	0	15	19	35
Cambridge	New	0	23	49	0	72
	RG	18	29	40	26	113
Imperial	New	0	28	46	27	101
	RG	0	13	58	59	129
Manchester	New	0	0	0	0	0
	RG	33	41	72	70	217
RAL/ID	New	28	84	90	75	277
	SLA	0	0	0	0	0
RAL/PPD	New	0	40	103	106	250
	SLA	39	0	0	0	39
RHUL	New	0	0	47	49	96
	RG	11	22	54	45	132
UCL	New	0	30	49	34	113
	RG	19	45	68	35	167
Equipment						
WP2		11	37	54	16	118
WP3		0	3	95	109	207
WP4		0	0	2	17	19
WP5		0	0	0	0	0
Travel						
WP2		6	6	10	3	25
WP3		1	5	7	17	31
WP4		1	1	1	1	4
WP5		7	13	19	11	50
Consumables						
WP2		4	9	6	0	20
WP3		2	1	10	47	59
WP4		0	3	2	4	10
WP5		2	0	2	0	4
Totals						
Staff Effort RG/SLA		120	150	308	254	832
Staff Effort New		41	243	428	315	1027
Equipment		11	40	151	142	344
Travel		15	26	37	33	110
Consumables		8	13	20	51	92
New Money Totals		75	322	636	541	1574
Overall Totals		195	472	944	794	2406

Annex B3: PPARC supported contributions to workpackages by institute

All costs are after indexation and are given in £k. In addition to the costs below, the working allowance (£166k) and contingency (£152k) give a total cost to PPARC of £2724k.

	Birmingham	Cambridge	Imperial	Manchester	RAL/ID	RAL/PPD	RHUL	UCL	Equipment and Travel	Total
WP2	0	113	90	64	0	0	104	243	163	778
WP3	60	0	111	0	277	289	0	0	297	1034
WP4	0	0	0	152	0	0	0	0	33	185
WP5	92	72	29	0	0	0	124	37	54	408
Total	153	185	231	217	277	289	228	280	547	2406