ATLAS Endcap Signal Feedthrough Project

NSERC Review
TRIUMF
14th December 2001

- Overview
- Status
  - Procurement of Components
  - Feedthrough Production
  - Shipment to CERN
  - Reception Tests at CERN
- Schedule
- QA/QC
- Budget and Management
- Conclusions

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Overview

ATLAS liquid argon calorimetry has over 180k signal channels which must come through the walls of the cryostats

Each feedthrough unit carries 1920 electrical channels.

Barrel: 64 feedthrough units (+spares)

Endcap: 50 feedthrough units total
(+5 spares)

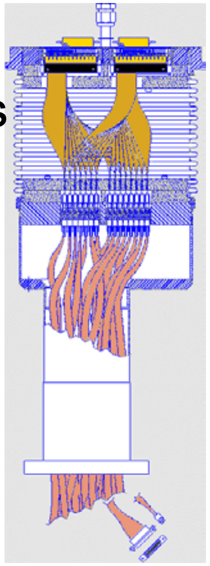
The endcap signal feedthrough project is an ATLAS common fund contribution from Canada (CHF 3360k CORE)

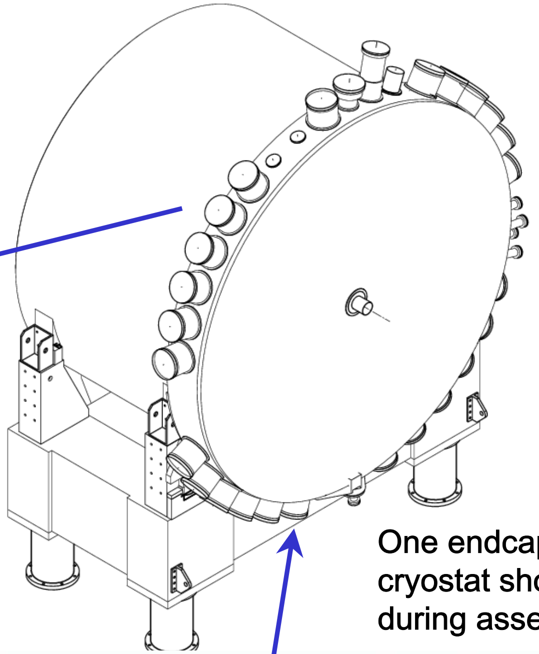
Part of the ATLAS Cryostat and Cryogenics Project

Extensively reviewed

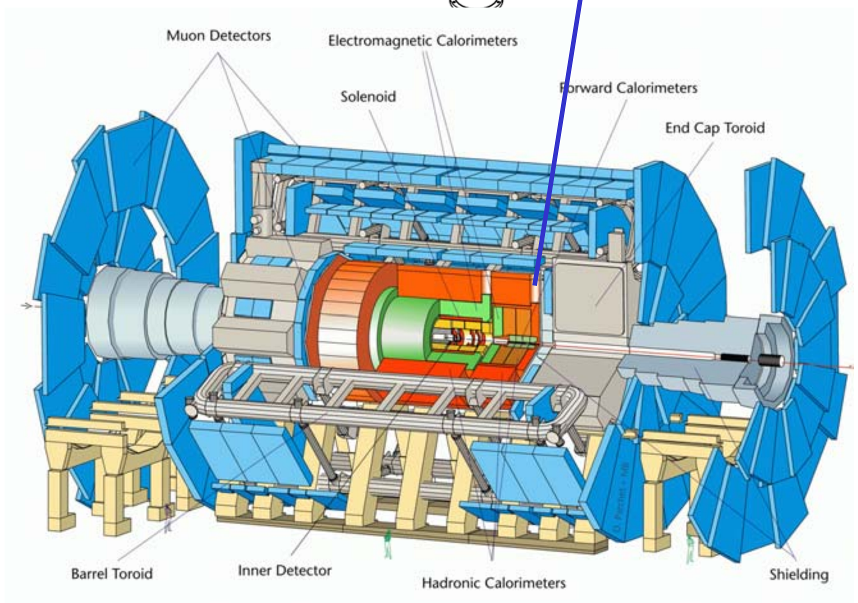
ATLAS reviews
Project Review, BNL, Jun 12-13 1997
Baseline Design review CERN, Oct 13th 1997
Production Readiness Review, CERN, Jan 29th 1999
Activity/Systems Status Overview, CERN, Feb 11-12 2001

NSERC reviews
TRIUMF, Jan 9 2000
TRIUMF, Oct 19 2000
TRIUMF, Dec 14 2001

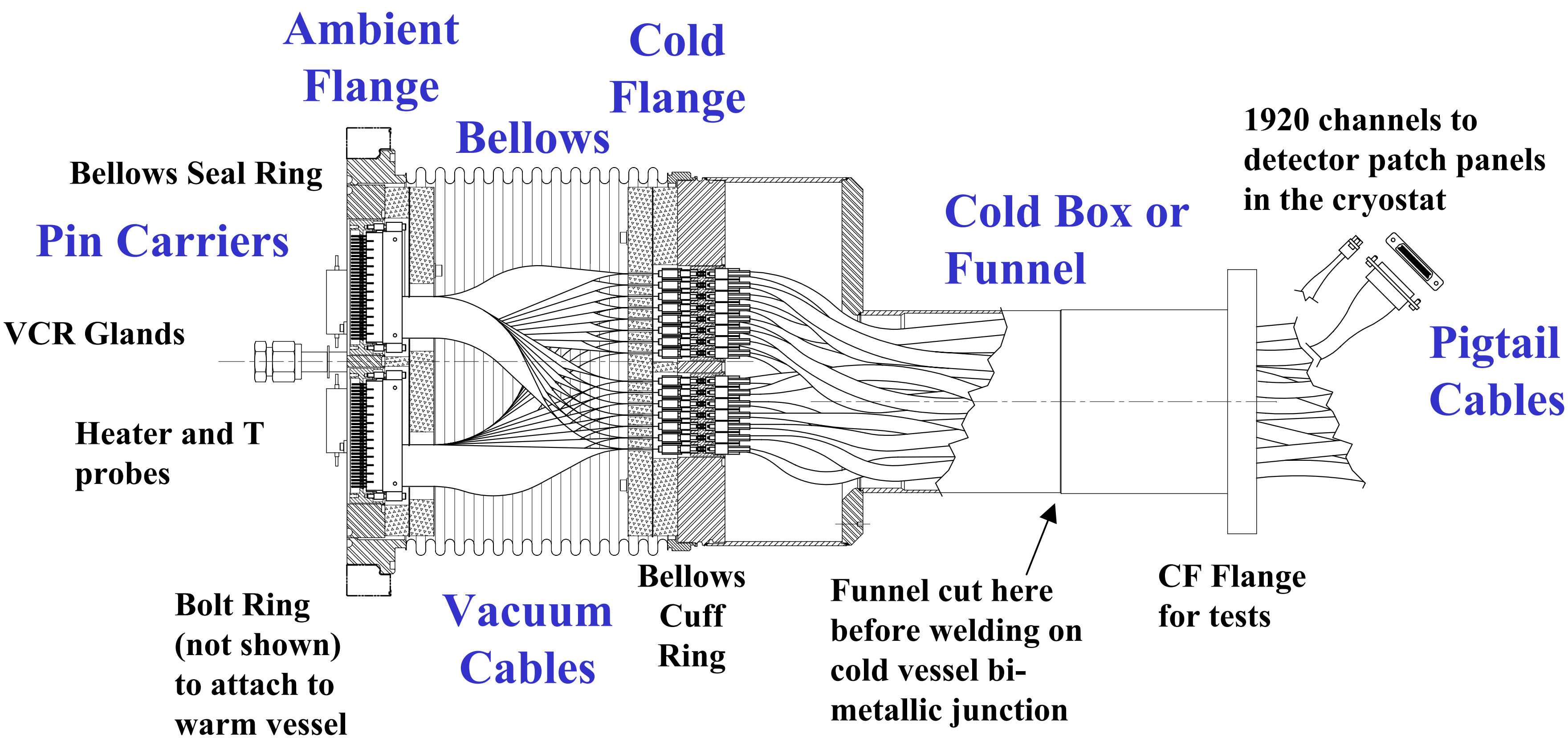




One endcap cryostat shown during assembly



Overview



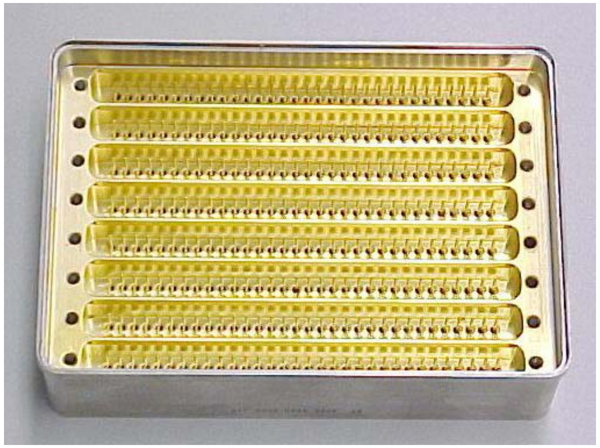
Seal ring OD = 326.4 mm

Total height = 699.9 mm

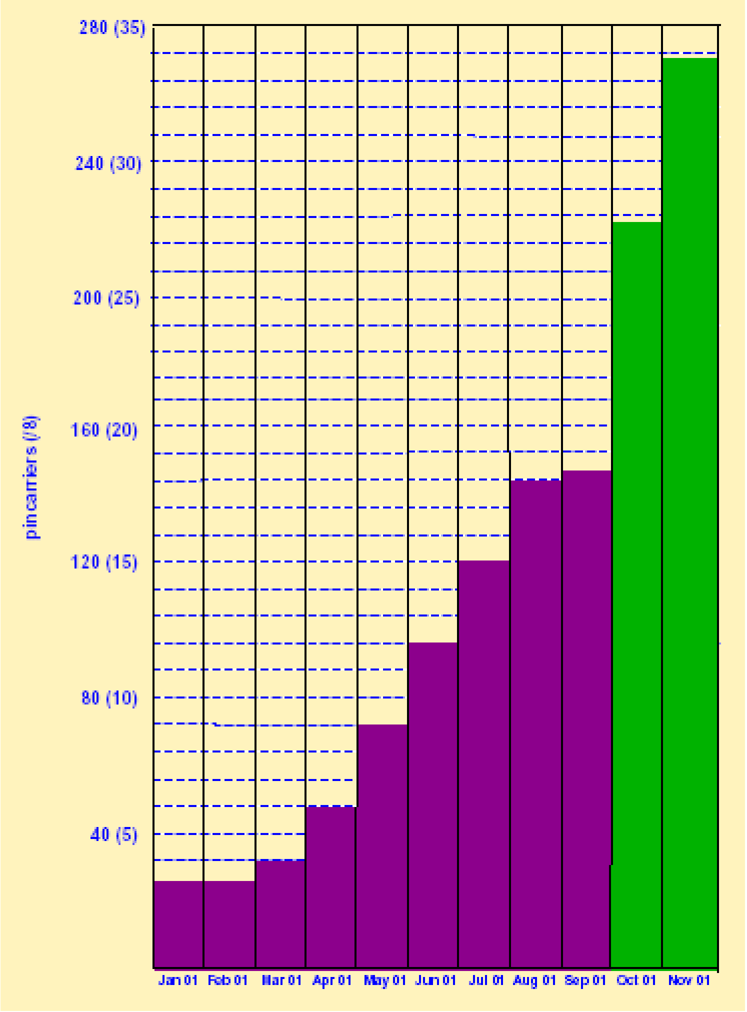
Procurement of Components

pin carriers

- Production halted August 2000 due to low inclusion steel problems
- Production restarted February 2001. All problems solved.
- HCC/GSP followed very closely, coordinated by Tom Muller at BNL
- UVic has received 270 units so far
- Delivery rate not an issue anymore
- BNL has received all the units required for the barrel feedthroughs: expect delivery rate to increase even further



pin carrier procurement
270/550 received



Procurement of Components

Other Mechanical Components

ambient flanges, cold flanges, bellows assemblies (bellows, cuff rings, seal rings), funnel assemblies, heaters components, rohacell, ambiant flange glands

ALL IN STOCK

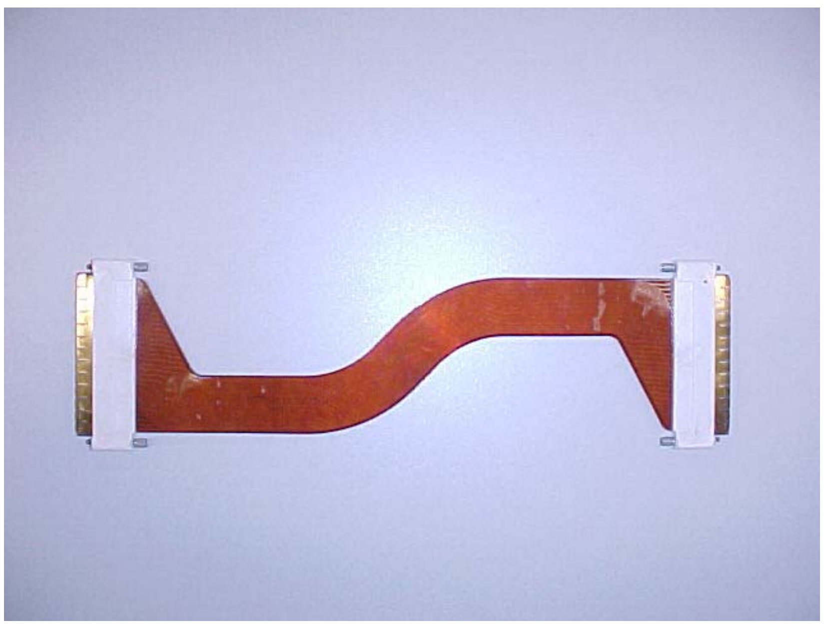
Procurement of Components

Electrical Components

Pigtails (7 types, require 750 for one endcap)
1273/1725(ordered) or 74% received

We have all we need for the first endcap

Vacuum cables (2 types, require 750 for one endcap) 1790/1790(ordered) or 100% received



Feedthrough Production

At the University of Victoria

as of 03/12/2001 22 feedthrough units produced
of which 17 at CERN

vacuum cable installation

Shipment to CERN

crated feedthroughs

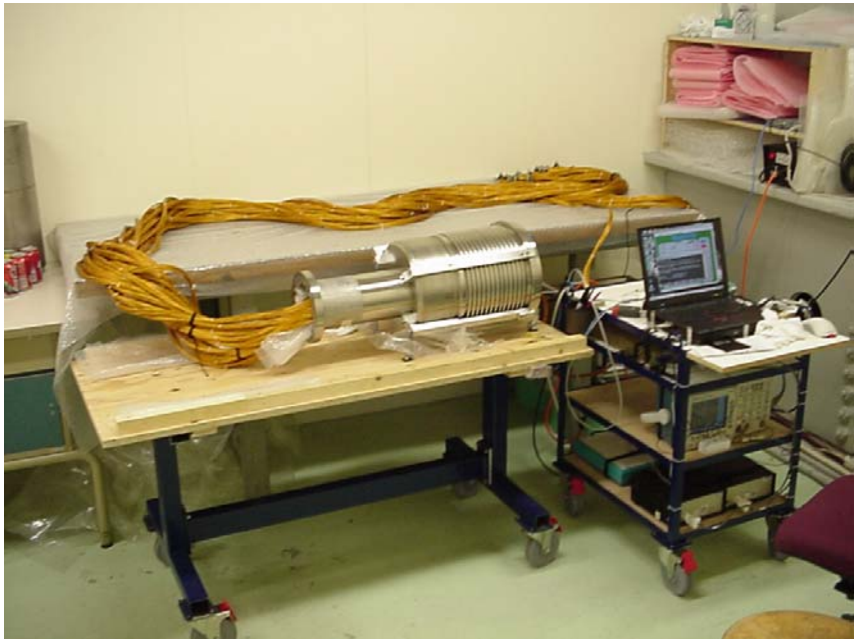
first 4 HEC feedthroughs in crate
(02/11/01)

Each feedthrough has its own crate

- they come in two sizes

4 feedthrough crates are then crated together for shipment

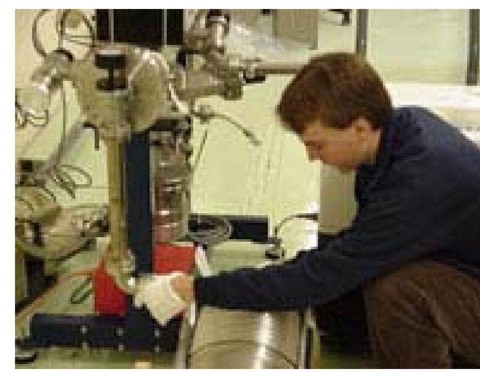
Reception Tests at CERN



Feedthrough units are tested upon reception at CERN:

- visual inspection
- leak test (ambient temperature)
- electrical test (cross-talk)

The electrical testing equipment will also be used on the cryostat after feedthrough installation



Schedule

Date	Build (total)	Type	At CERN	
30-nov-2001	(13 STD, 4 SPCL, 4 HEC and 1 FCAL built to date)			
31-dec-2001	2 (24)	(2 STD)	21	
31-jan-2002	4 (28)	(4 STD)	21	
28-feb-2002	3 (31)	(1 HEC, 1 SPCL, 1 STD)	30	(ECC+)
31-mar-2002	3 (34)	(2 STD, 1 FCAL)	30	
30-apr-2002	3 (37)	(2 HEC, 1 SPCL)	33	
31-may-2002	3 (40)	(1 HEC, 2 SPCL)	35	
30-jun-2002	4 (44)	(4 STD)	38	
31-jul-2002	3 (47)	(3 STD)	42	
31-aug-2002	2 (49)	(2 STD)	46	
30-sep-2002	4 (53)	(4 STD)	46	
15-oct-2002	2 (55)	(1 HEC, 1 SPCL)	50	(ECA)
15-nov-2002			55	

Oct 00 schedule:

ECC delivery to CERN	Jul 01
feedthrough installation	Sep 01 – Oct 01

Current Schedule:

ECC delivery to CERN	11 Feb 02
feedthrough installation	15 Mar 02 – 30 Apr 02
ECA delivery to CERN	31 Jul 02
feedthrough installation	Oct 02 ?

7 months delay in the first endcap cryostat ECC delivery to CERN

6 months delay in the feedthrough production due to pin carrier procurement problems (now all solved)

- negligible impact on project cost:
  feedthrough installation on ECA at about the same date as planned in Oct 00
- used the delay to complete
  - reception tests on all material
  - the development of the QA/QC procedure and documents
  - the testing equipment for CERN

Endcap feedthrough production proceeding very well (40% produced)

Reception tests at CERN performing as planned

The project is not on the critical path

Schedule: reception and installation

Feedthrough reception at CERN started in October 2001

Reception tests fully commissioned

Two persons at CERN for reception tests

- 2.5 months in 2001
- foresee 2 times 1.5 months in 2002

Two persons at CERN for assistance during installation

- foresee 2 times 1.5 months in 2002 (very likely to overlap with one or both reception test periods)
- foresee 2 times 2 months for warm cable installation and final electrical tests

More than half of the barrel feedthroughs (BNL) installed on the barrel cryostat.

Expect an average of about one unit installed per day for the endcap

Quality Assurance / Quality Control

QA/QC is critical to the success of the project

Very detailed document released (QA/QC version 4, Mar 01)

- updated version to be released in Jan 02
- procedures and documents have been updated after the experience gained from building the first feedthroughs

All TIS (CERN Safety) concerns have been addressed (Dec 00)

All information stored in a purpose-built database

- material traceability
- production and reception test results
- available on the web:

http://particle.phys.uvic.ca/~web-atlas/atlas/feedthroughs/status/

Quality Assurance / Quality Control

production status summary

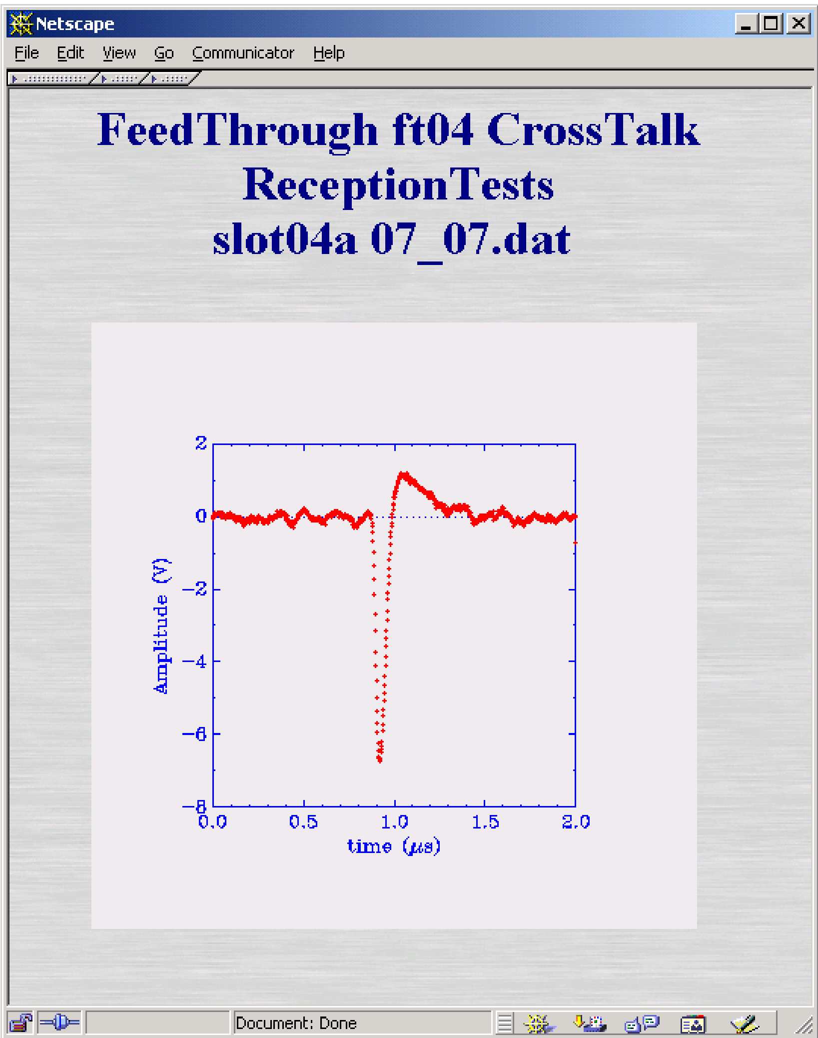
Return to ATLAS Endcap Signal Feedthroughs

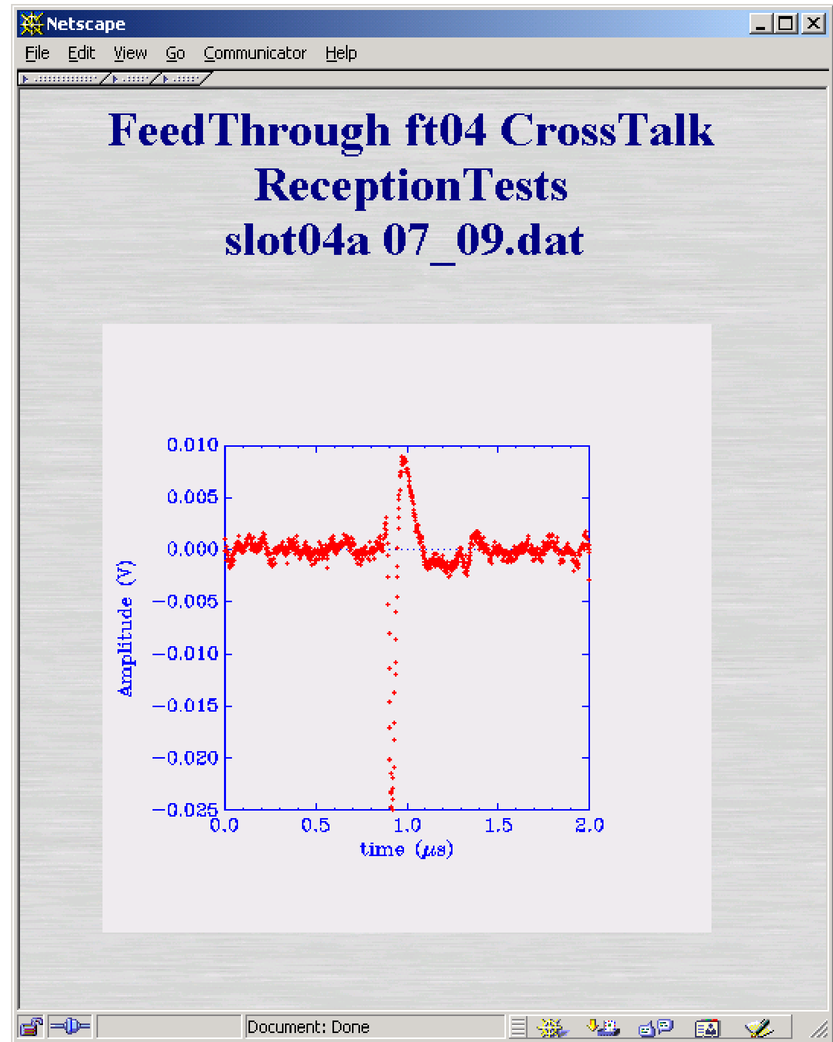
EndCap Signal FeedThrough Production Status

ser #	type	started	completed	shipped	reception tests	officially received	installed
ft00	Standard	6 Jul 00	13 Oct 00	28 Sep 01	23 Oct 01	-	-
ft01	Standard	27 Sep 00	11 Sep 01	28 Sep 01	25 Oct 01	-	-
ft02	Standard	11 Oct 00	15 Dec 00	28 Sep 01	27 Oct 01	-	-
ft03	Standard	27 Mar 01	20 Apr 01	28 Sep 01	29 Oct 01	-	-
ft04	Standard	25 Apr 01	10 May 01	16 Oct 01	12 Nov 01	-	-
ft05	Standard	7 May 01	24 May 01	16 Oct 01	8 Nov 01	-	-
ft06	Standard	23 May 01	5 Jun 01	16 Oct 01	8 Nov 01	-	-

Quality Assurance / Quality Control

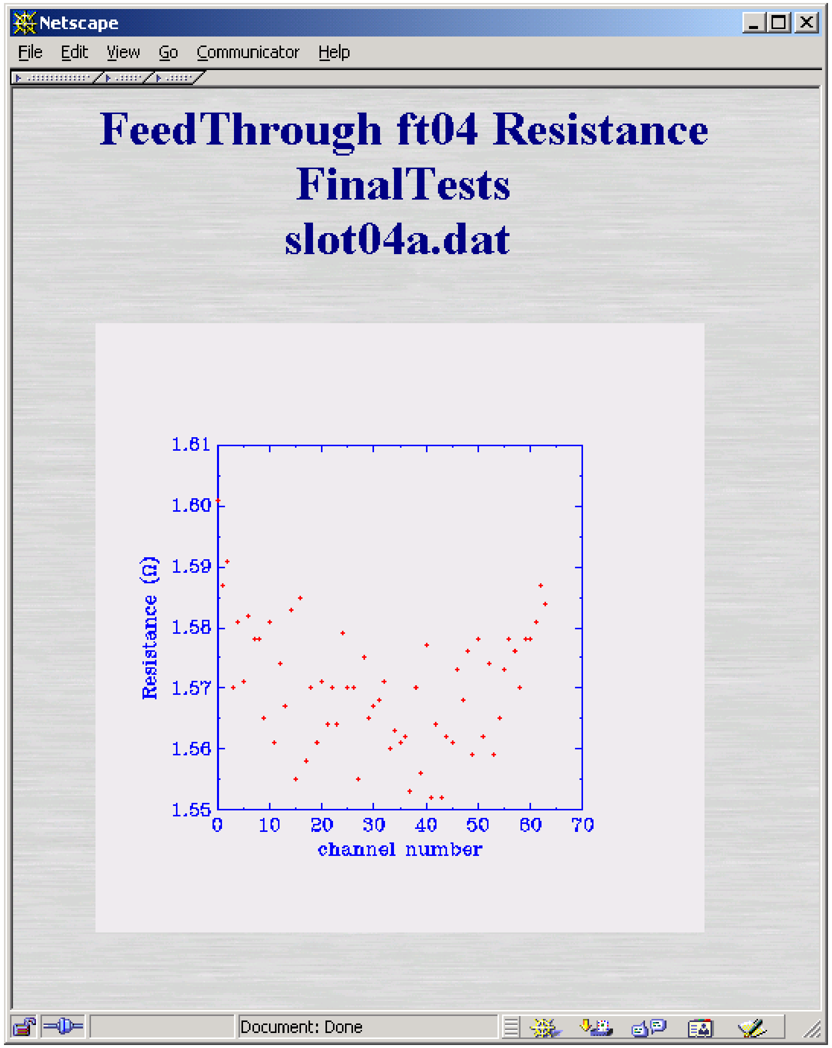
cross talk measurements at UVic and at CERN





Quality Assurance / Quality Control

resistance measurements at UVic



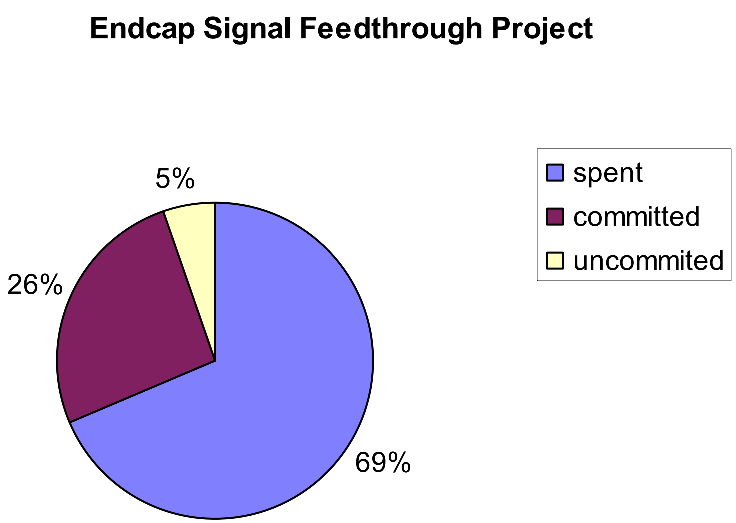
Budget and Management
Responsibilities

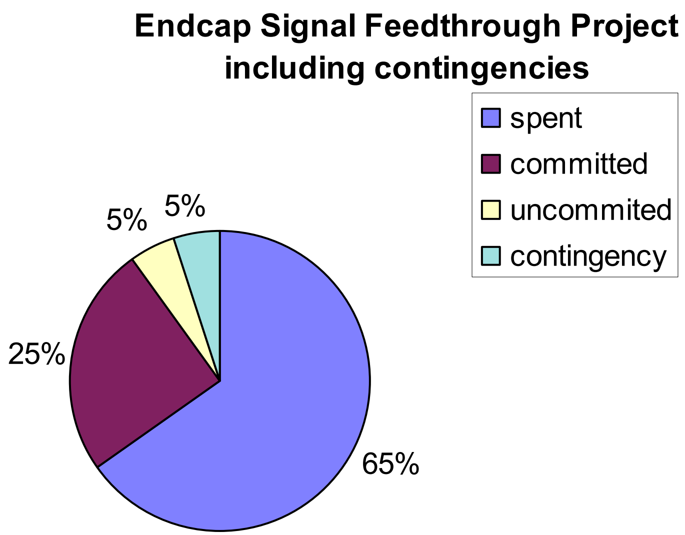
- Design
- Fabrication
  - Signal Pigtails purchased from Orsay
- Commissioning
- Transport
- Reception
  - Electrical and ambient vacuum testing
    - Leak tester provided by ATLAS CERN
- Electrical tests after installation
- Assistance during installation
  - Up to SF50k towards the cost of an orbital welder
  - Assistance during welding on the cryostat
  - Assistance for leak testing during/after installation
  - Manpower to connect warm cables to ambient flange

Budget and Management

Budget Status

MIG amount:	$4.280M	
Current budget:	$4.091M	(net of contingencies)
Contingencies:	$0.213M	





Budget and Management

Budget Summary

PBS	WBS	Description	Dec 01	MIG COST PROFILE								Dec 01			
PBS	WBS	Description	01-02	97-98	98-99	99-00	00-01	01-02	02-03	03-04	MIG	spent	commit	uncommit	contingency
			$CAN	$CAN	$CAN	$CAN	$CAN	$CAN	$CAN	$CAN	$CAN	%	%	%	$CAN
4	**1**	**Endcap Signal Feedthroughs**	**$557,615**	**$224,375**	**$266,888**	**$523,358**	**$1,233,264**	**$1,302,151**	**$422,943**	**$118,502**	**$4,091,482**	**69**	**26**	**5**	**$212,829**
4.1	**2**	**Project Setup**	**$33,604**	**$156,386**	**$207,997**	**$209,536**	**$87,019**	**$41,418**	**$79,657**	**$8,149**	**$790,163**	**88**	**6**	**6**	**$18,183**
4.1.1	3	Leak Test Setup	$10,200	$102,521	$29,420	$6,838	$39,994	$16,105	$18,621	$4,111	$217,611	87	0	13	$6,337
4.1.2	3	Electric Test Setup	$11,718	$6,109	$22,252	$32,803	$35,767	$13,371	$1,071	$764	$112,138	97	0	3	$872
4.1.3	3	Data Acquisition System	$5,749	$15,198	$5,308	$4,690	$5,550	$6,592	$2,000	$816	$40,154	91	0	9	$915
4.1.4	3	FT Assembly Tools	$0	$0	$10,135	$591	$0	$0	$49,811	$0	$60,536	18	81	1	$7,553
4.1.5	3	FT Prototypes	$0	$32,558	$140,275	$157,847	-$956	$0	$0	$0	$329,724	100	0	0	$0
4.1.6	3	Misc Project Setup Items	$5,938	$0	$607	$6,768	$6,663	$5,350	$8,154	$2,458	$30,000	67	0	33	$2,506
4.2	**2**	**FT Series Assemblies**	**$382,335**	**$0**	**$0**	**$167,287**	**$974,803**	**$1,019,389**	**$118,174**	**$15,016**	**$2,294,670**	**66**	**31**	**2**	**$154,830**
4.2.1	3	Mechanical Components	$289,985	$0	$0	$166,791	$203,563	$633,651	$20,000	$0	$1,024,005	64	35	0	$53,186
4.2.2	3	Electrical Components	$84,935	$0	$0	$399	$758,353	$365,738	$76,174	$0	$1,200,664	70	30	0	$89,244
4.2.3	3	Shipping Crates	$7,416	$0	$0	$98	$12,886	$20,000	$22,000	$15,016	$70,000	29	0	71	$12,400
4.3	**2**	**Test Cryostat Signal FT**	**$0**	**$58,428**	**$0**	**$0**	**$0**	**$0**	**$0**	**$0**	**$58,428**	**100**	**0**	**0**	**$0**
4.4	**2**	**Manpower**	**$141,675**	**$9,561**	**$58,891**	**$146,534**	**$171,442**	**$241,344**	**$225,112**	**$95,337**	**$948,222**	**56**	**32**	**13**	**$39,816**
4.4.1	3	Salaries and Benefits	$125,191	$9,561	$55,092	$129,328	$142,873	$193,844	$159,692	$76,288	$766,678	60	37	3	$15,232
4.4.2	3	Consultation and Travel	$16,484	$0	$1,016	$17,206	$20,368	$47,500	$61,455	$19,049	$166,594	33	10	57	$23,593
4.4.3	3	Other	$0	$0	$2,784	$0	$8,201	$0	$3,965	$0	$14,950	73	0	27	$991

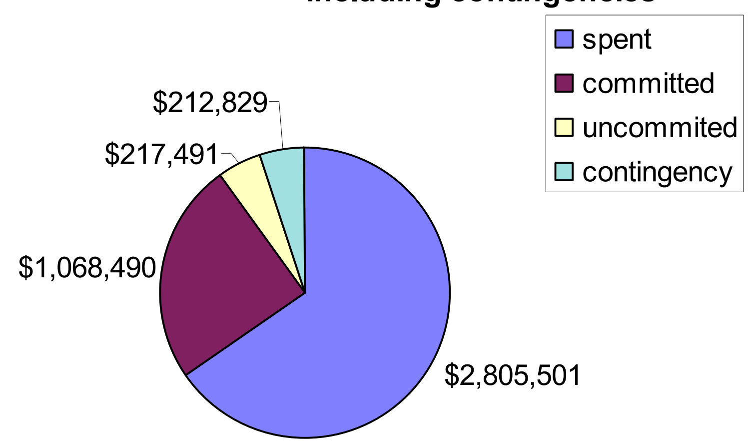
Contingencies total $213k and are dominated by exchange rates:

+15% on 1.65 $CAN/$US (pin carriers)

+25% on 0.230 $CAN/FF (pigtails)

+15% on 0.980 $CAN/CHF (orbital welder contribution)

Endcap Signal Feedthrough Project including contingencies



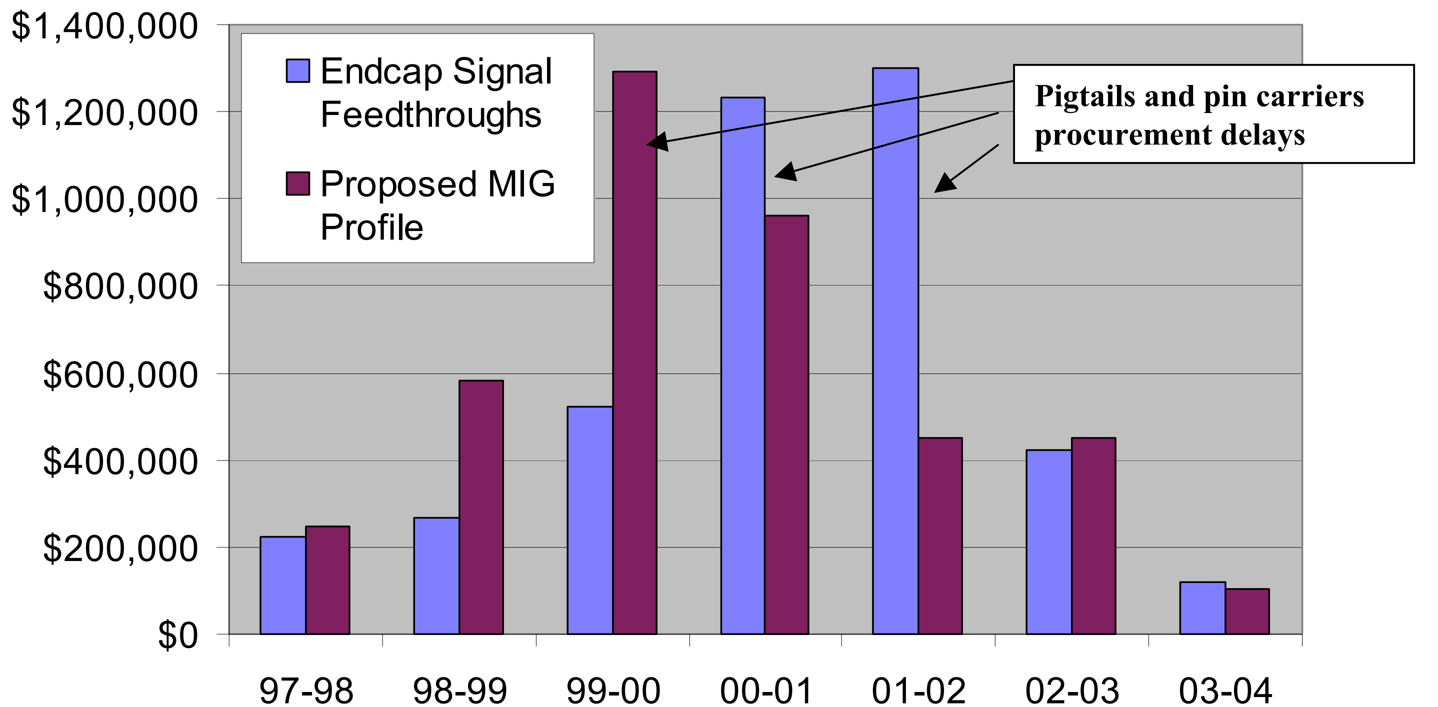
The budget total net of contingencies is $4.09M

69% of which has been spent (Dec 01)

26% of which has been committed (Dec 01)

Budget and Management

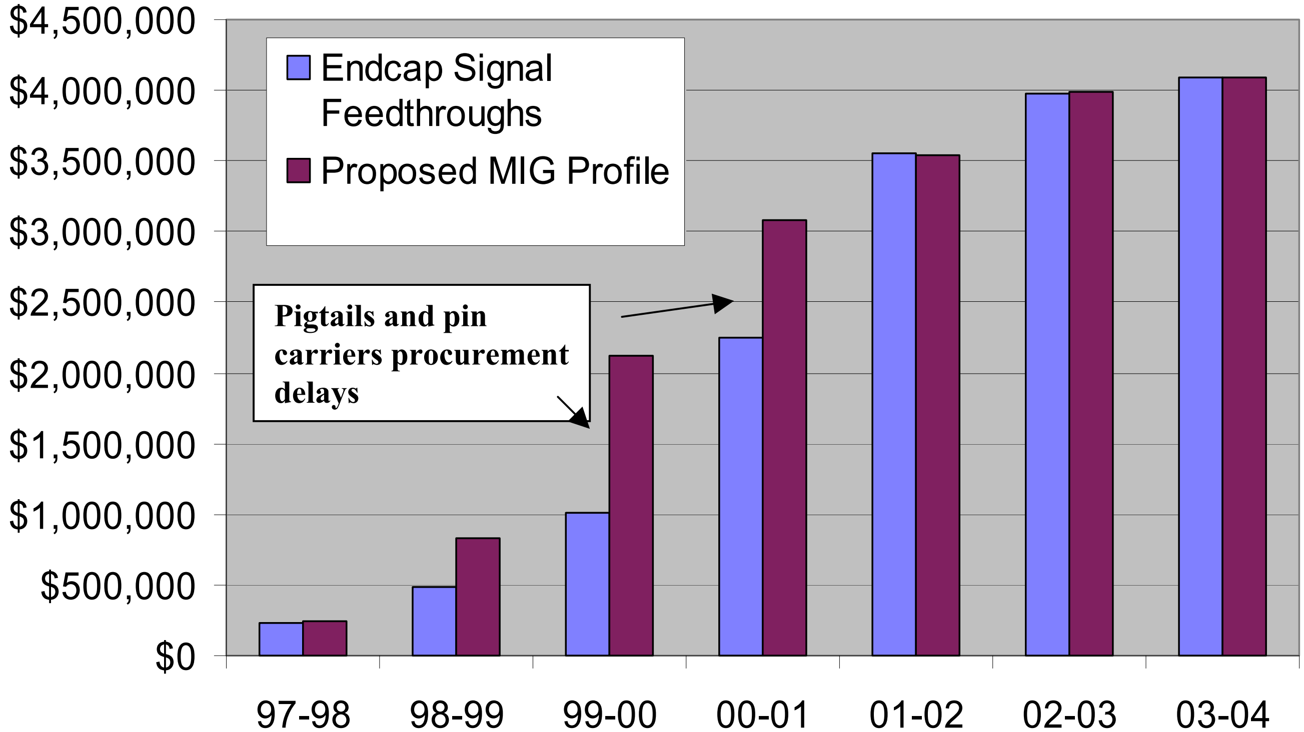
Budget Profile



Dec 01	97-98 $CAN	98-99 $CAN	99-00 $CAN	00-01 $CAN	01-02 $CAN	02-03 $CAN	03-04 $CAN	Total $CAN
Budget	**$224,375**	**$266,888**	**$523,358**	**$1,233,264**	**$1,302,151**	**$422,943**	**$118,502**	**$4,091,482**
MIG spent (UVic and TRIUMF)	**$224,375**	**$266,888**	**$523,358**	**$1,233,264**	**$557,615**	**$0**	**$0**	**$2,805,501**
Proposed MIG Profile	**$249,000**	**$584,000**	**$1,292,880**	**$960,000**	**$450,000**	**$450,000**	**$105,602**	**$4,091,482**

Budget and Management

Integrated Budget Profile



Dec 01	97-98 $CAN	98-99 $CAN	99-00 $CAN	00-01 $CAN	01-02 $CAN	02-03 $CAN	03-04 $CAN	Total $CAN
Budget	**$224,375**	**$491,263**	**$1,014,621**	**$2,247,886**	**$3,550,037**	**$3,972,980**	**$4,091,482**	**$4,091,482**
MIG spent (UVic and TRIUMF)	**$224,375**	**$491,263**	**$1,014,621**	**$2,247,886**	**$2,805,501**	**$2,805,501**	**$2,805,501**	**$2,805,501**
Proposed MIG Profile	**$249,000**	**$833,000**	**$2,125,880**	**$3,085,880**	**$3,535,880**	**$3,985,880**	**$4,091,482**	**$4,091,482**

Budget and Management

Series Assemblies Details

			MIG COST PROFILE											
PBS	WBS	Description	97-98	98-99	99-00	00-01	01-02	02-03	03-04	MIG	spent	commit	uncommit	contingency
			$CAN	$CAN	$CAN	$CAN	$CAN	$CAN	$CAN	$CAN	%	%	%	$CAN
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4.1	**2**	**Project Setup**	**$156,386**	**$207,997**	**$209,536**	**$87,019**	**$41,418**	**$79,657**	**$8,149**	**$790,163**	**88**	**6**	**6**	**$18,183**
4.2	**2**	**FT Series Assemblies**	**$0**	**$0**	**$167,287**	**$974,803**	**$1,019,389**	**$118,174**	**$15,016**	**$2,294,670**	**66**	**31**	**2**	**$154,830**
4.2.1	**3**	**Mechanical Components**	**$0**	**$0**	**$166,791**	**$203,563**	**$633,651**	**$20,000**	**$0**	**$1,024,005**	**64**	**35**	**0**	**$53,186**
4.2.1.0	4	Low Inclusion Steel	$0	$0	$61,853	$2,431	$0	$0	$0	$64,284	100	0	0	$0
4.2.1.1	4	Pin Carriers	$0	$0	$36,827	$49,719	$612,797	$0	$0	$699,344	52	48	0	$50,101
4.2.1.2	4	Warm Flanges	$0	$0	$0	$20,818	$0	$0	$0	$20,818	100	0	0	$0
4.2.1.3	4	Cold Flanges	$0	$0	$0	$21,235	$0	$0	$0	$21,235	100	0	0	$0
4.2.1.4	4	Bellow Assemblies	$0	$0	$20,564	$59,726	$0	$0	$0	$80,290	100	0	0	$0
4.2.1.5	4	Bolt Flanges	$0	$0	$18,370	$0	$0	$0	$0	$18,370	100	0	0	$0
4.2.1.6	4	Funnel Assemblies	$0	$0	$12,813	$47,315	$0	$0	$0	$60,128	100	0	0	$0
4.2.1.7	4	Pipe Fittings	$0	$0	$0	$172	$0	$0	$0	$172	100	0	0	$0
4.2.1.8	4	RF Gaskets and O'Rings	$0	$0	$0	$2,146	$854	$0	$0	$3,000	74	0	26	$199
4.2.1.9	4	Insulation	$0	$0	$4,161	$0	$0	$0	$0	$4,161	100	0	0	$0
4.2.1.10	4	Welds	$0	$0	$0	$0	$20,000	$20,000	$0	$40,000	28	72	0	$2,887
4.2.1.11	4	CF Flanges	$0	$0	$12,203	$0	$0	$0	$0	$12,203	100	0	0	$0
4.2.2	**3**	**Electrical Components**	**$0**	**$0**	**$399**	**$758,353**	**$365,738**	**$76,174**	**$0**	**$1,200,664**	**70**	**30**	**0**	**$89,244**
4.2.2.1	4	Pig Tail Cables	$0	$0	$192	$192,216	$280,000	$76,174	$0	$548,582	35	65	0	$88,851
4.2.2.2	4	Vacuum Cables	$0	$0	$0	$471,810	$39,290	$0	$0	$511,100	100	0	0	$0
4.2.2.3	4	Low Voltage Pigtail Cables	$0	$0	$0	$29,536	$30,954	$0	$0	$60,491	100	0	0	$0
4.2.2.4	4	Low Voltage Vacuum Cables	$0	$0	$0	$38,056	$449	$0	$0	$38,505	100	0	0	$0
4.2.2.5	4	Heaters	$0	$0	$207	$6,688	$3,105	$0	$0	$10,000	84	0	16	$393
4.2.2.6	4	Extra HEC Pigtails	$0	$0	$0	$10,821	$11,940	$0	$0	$22,761	100	0	0	$0
4.2.2.7	4	Temperature Probes	$0	$0	$0	$9,225	$0	$0	$0	$9,225	100	0	0	$0
4.2.3	**3**	**Shipping Crates**	**$0**	**$0**	**$98**	**$12,886**	**$20,000**	**$22,000**	**$15,016**	**$70,000**	**29**	**0**	**71**	**$12,400**
4.3	**2**	**Test Cryostat Signal FT**	**$58,428**	**$0**	**$0**	**$0**	**$0**	**$0**	**$0**	**$58,428**	**100**	**0**	**0**	**$0**
4.4	**2**	**Manpower**	**$9,561**	**$58,891**	**$146,534**	**$171,442**	**$241,344**	**$225,112**	**$95,337**	**$948,222**	**56**	**32**	**13**	**$39,816**
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4.4.3	3	Other	$0	$2,784	$0	$8,201	$0	$3,965	$0	$14,950	73	0	27	$991

Conclusions

ATLAS Endcap Signal Feedthrough Project

- Crucial component of ATLAS Liquid Argon Calorimetry
- Complex and manpower intensive
  - UVic and TRIUMF personnel
- Production is 40% done
  - 22 units built and tested, 17 units at CERN, 4 in transit (as of 3 Dec 01)
  - Reception tests at CERN have started
  - Proceeding cautiously with emphasis on QA/QC
- Extensive QA/QC programme
- All components (except pin carriers and pigtails) are in hand
- Pin carrier production and delivery not a problem anymore
- Production rate in line with cryostat schedule
  - Installation on ECC is scheduled for late March 2002
- Budget within the allocated MIG
  - Built-in contingencies
  - 95% of baseline costs either spent or committed