ATLAS Endcap Signal Feedthrough Project

NSERC Review
TRIUMF
5th December 2002

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  - Feedthrough Production
  - QA/QC
  - Shipment to CERN
  - Reception Tests at CERN
- Schedule
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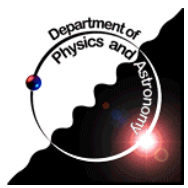
- Budget and Management
- Conclusions



Michel Lefebvre
University of Victoria
Physics and Astronomy

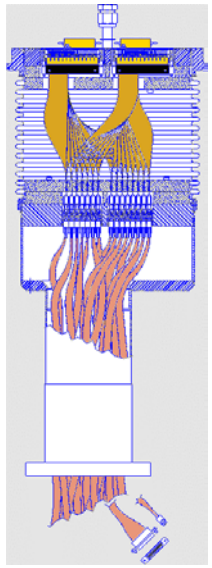
Overview

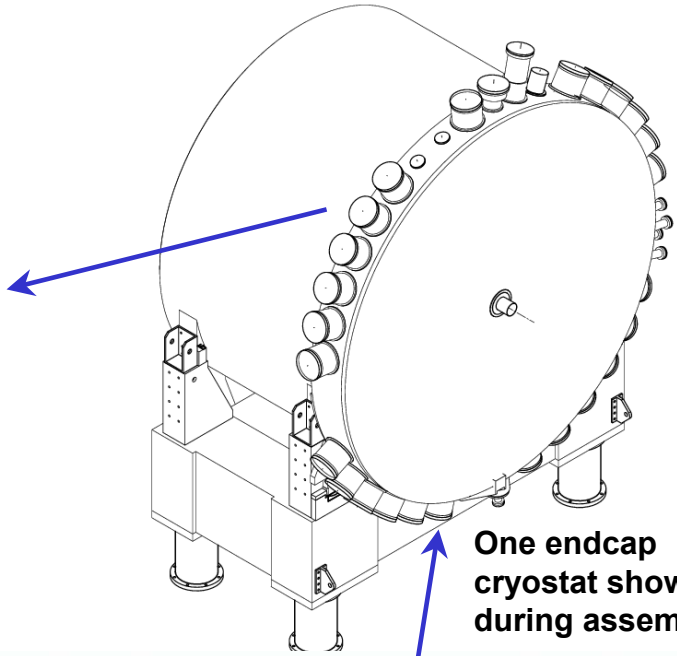
ATLAS liquid argon calorimetry has over 180k signal channels which must come through the walls of the cryostats

Each feedthrough unit carries 1920 electrical channels.

Barrel: 64 feedthrough units (+spares)

Endcap: 50 feedthrough units total (+5 spares)





One endcap cryostat shown during assembly

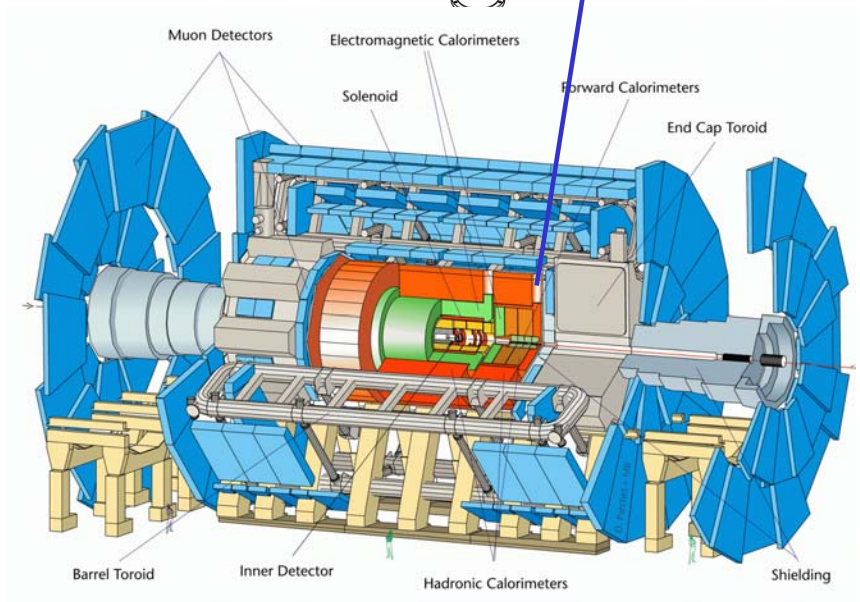
The endcap signal feedthrough project is an ATLAS common fund contribution from Canada (CHF 3360k CORE)

Part of the ATLAS Cryostat and Cryogenics Project

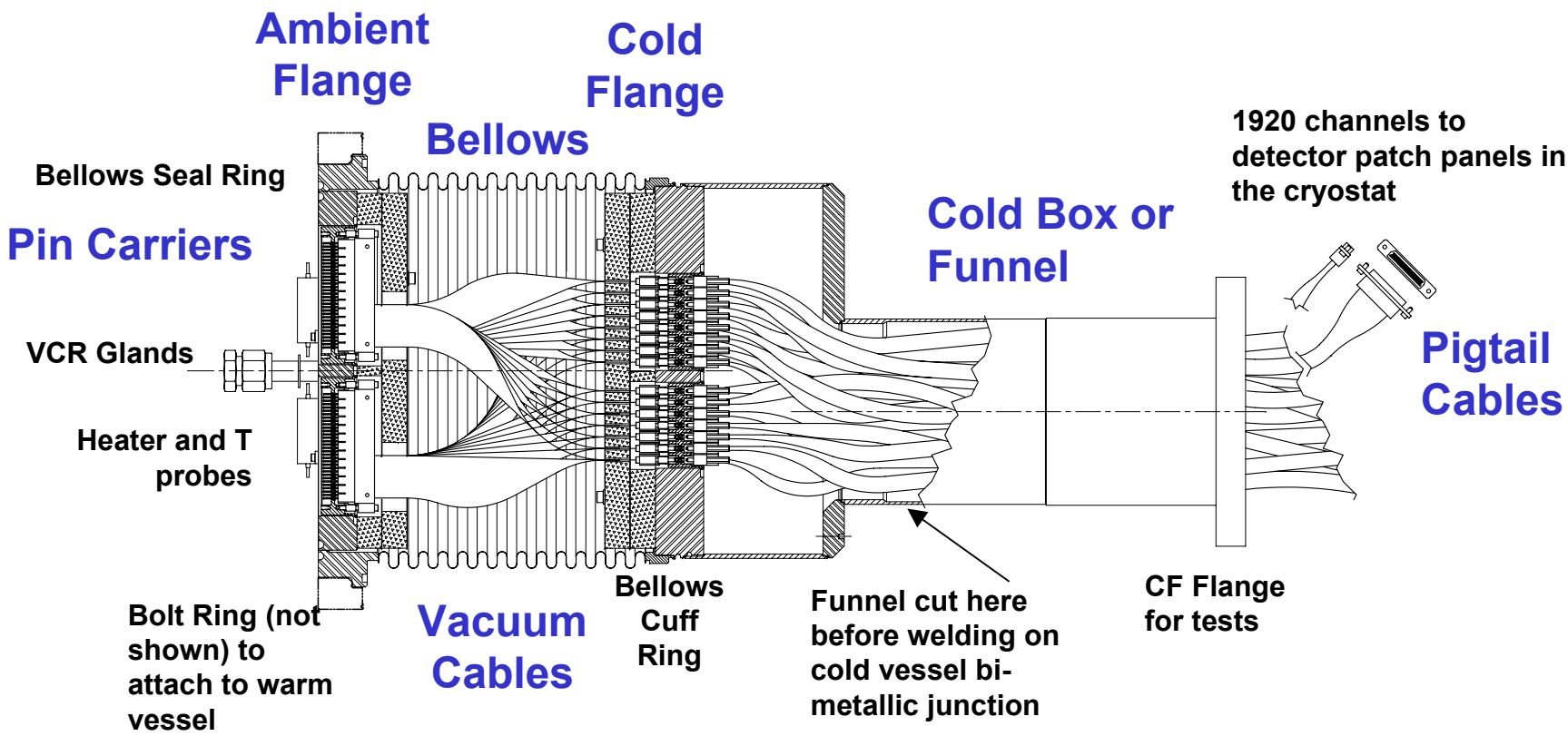
Extensively reviewed:

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, Oct 19 2000, Dec 14 2001, Dec 5 2002



Overview

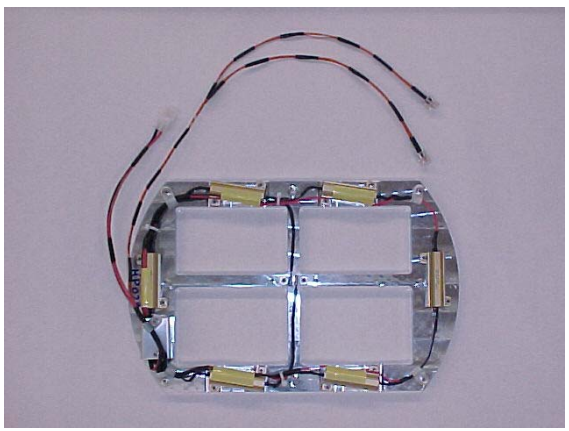


Seal ring OD = 326.4 mm

Total height = 699.9 mm

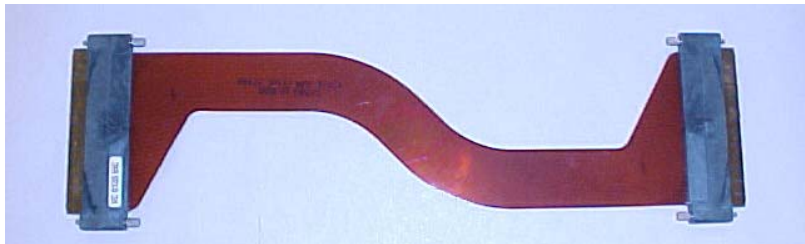
Overview

Heater plate
(require 25 for one endcap)

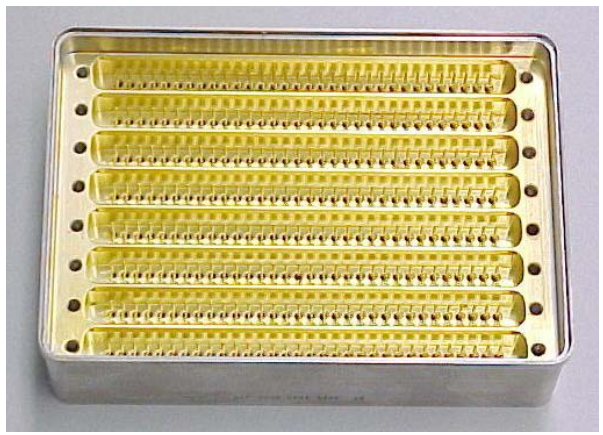


Pigtails (7 types, require
750 for one endcap)

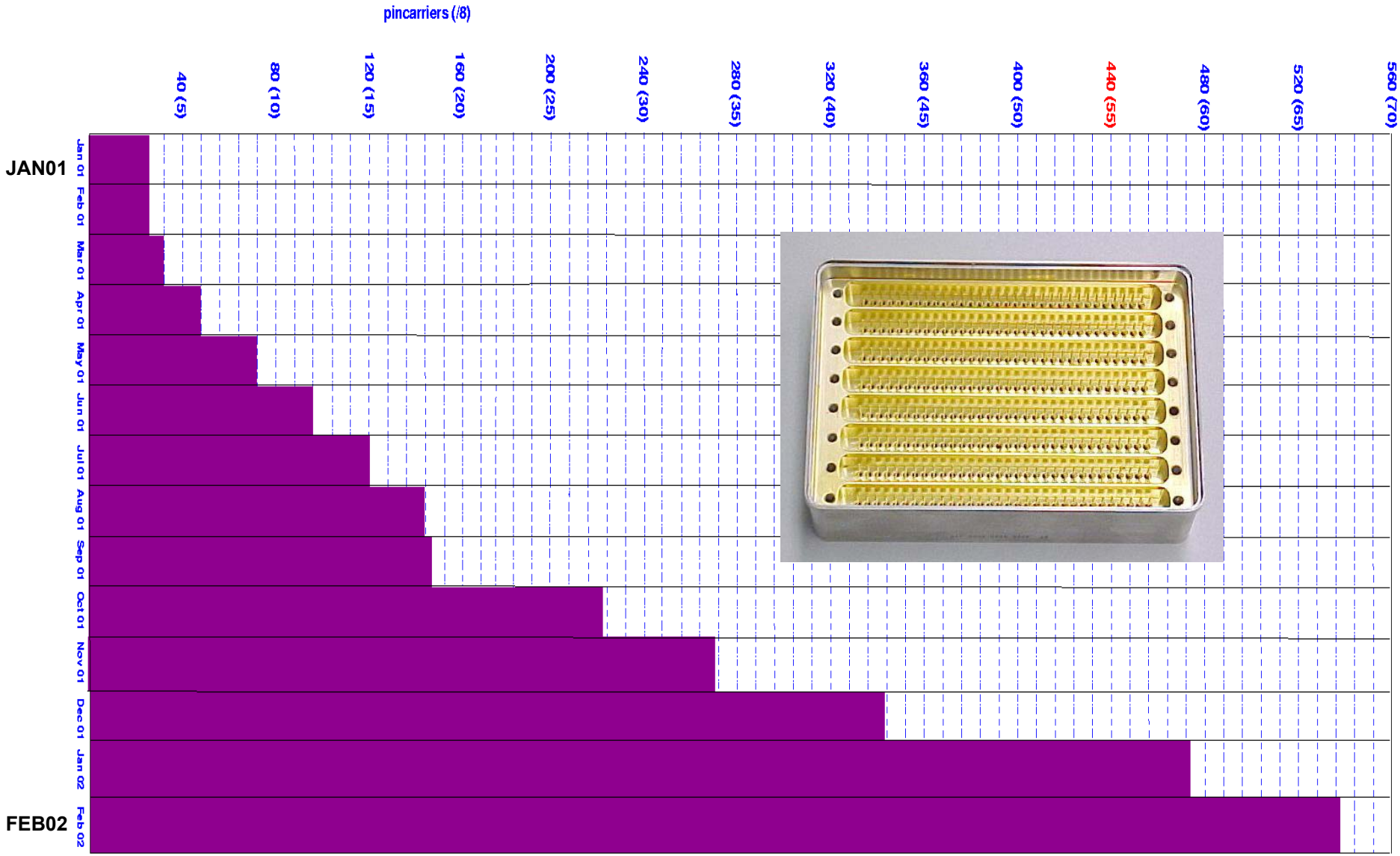
Vacuum cables (2 types,
require 750 for one endcap)



Pincarriers (2 types, require
200 for one endcap)



Pincarrier Procurement



Feedthrough Production

Production at the University of Victoria
All 55 feedthrough units produced (last on 25 Oct 2002)

Feedthrough Production

Production at the University of Victoria
All 55 feedthrough units produced (last on 25 Oct 2002)

last welds

last dye penetrant tests

last cold test

Quality Assurance / Quality Control

QA/QC is critical to the success of the project

Very detailed document released (QA/QC version 5, Mar 02)

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/

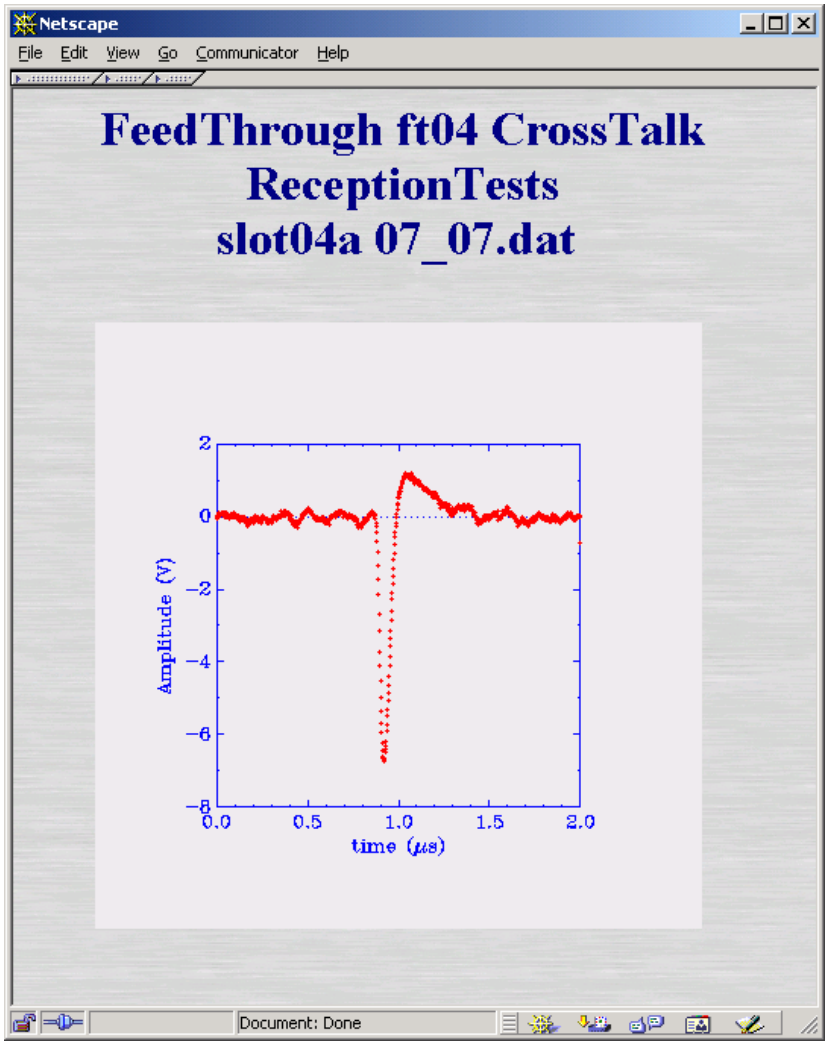
Quality Assurance / Quality Control

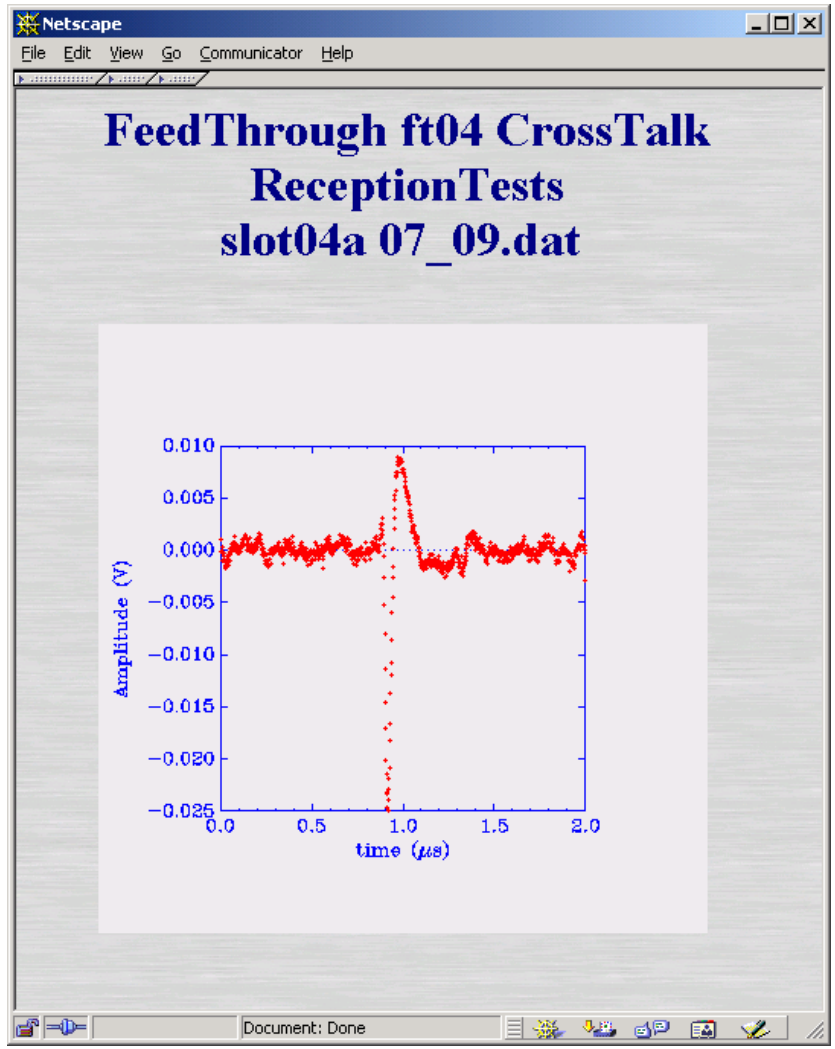
production status summary

ser #	type	started	completed	shipped	reception tests	officially received	installed position
ft00	Standard	6 Jul 00	13 Oct 00	28 Sep 01	23 Oct 01	15 Mar 02	-
ft01	Standard	27 Sep 00	11 Sep 01	28 Sep 01	25 Oct 01	15 Mar 02	-
ft02	Standard	11 Oct 00	15 Dec 00	28 Sep 01	27 Oct 01	15 Mar 02	-
ft03	Standard	27 Mar 01	20 Apr 01	28 Sep 01	29 Oct 01	15 Mar 02	-
ft04	Standard	25 Apr 01	10 May 01	16 Oct 01	12 Nov 01	15 Mar 02	-
ft05	Standard	7 May 01	24 May 01	16 Oct 01	8 Nov 01	15 Mar 02	-
ft06	Standard	23 May 01	5 Jun 01	16 Oct 01	8 Nov 01	15 Mar 02	-
ft07	Standard	25 May 01	14 Jun 01	16 Oct 01	12 Nov 01	15 Mar 02	-
ft08	Standard	30 May 01	11 Jun 01	16 Oct 01	15 Nov 01	15 Mar 02	-
ft09	HEC	26 Jun 01	25 Jul 01	2 Nov 01	29 Nov 01	15 Mar 02	-
ft10	Special	29 Jun 01	19 Jul 01	16 Oct 01	12 Mar 02	18 Mar 02	-
ft11	HEC	12 Jul 01	1 Aug 01	2 Nov 01	4 Dec 01	18 Mar 02	-

Quality Assurance / Quality Control

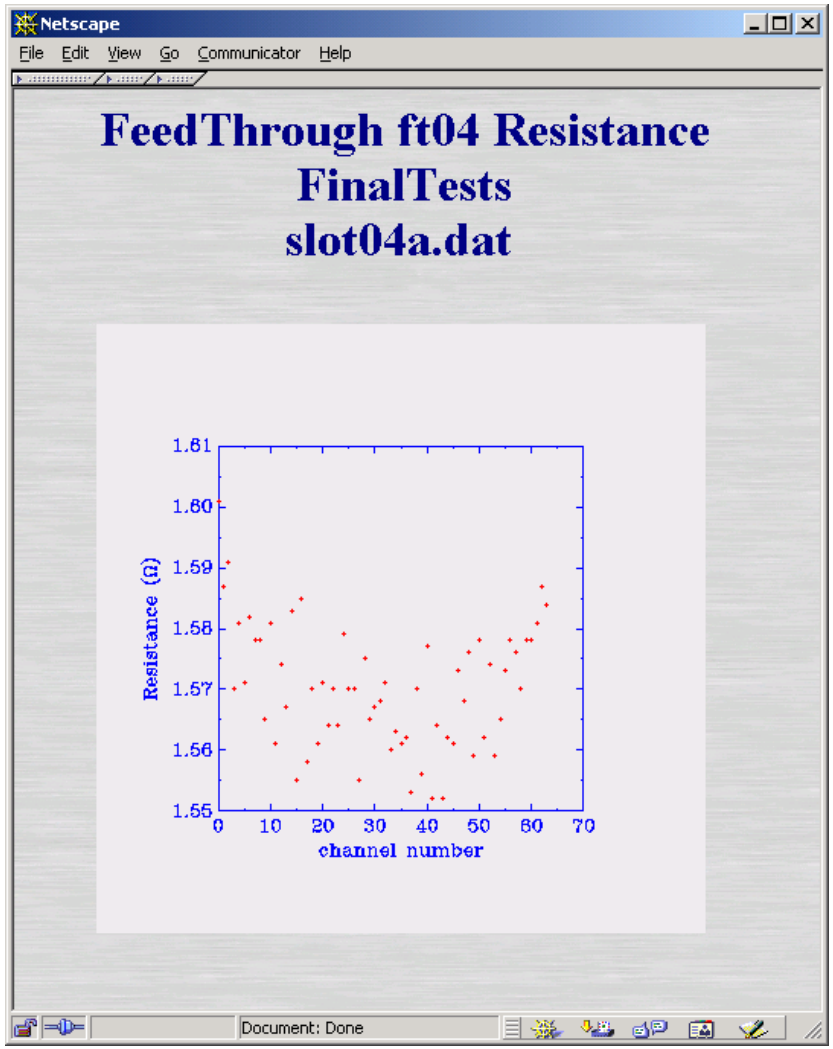
cross talk measurements at UVic and at CERN





Quality Assurance / Quality Control

resistance measurements at UVic



Shipment to CERN

crated feedthroughs

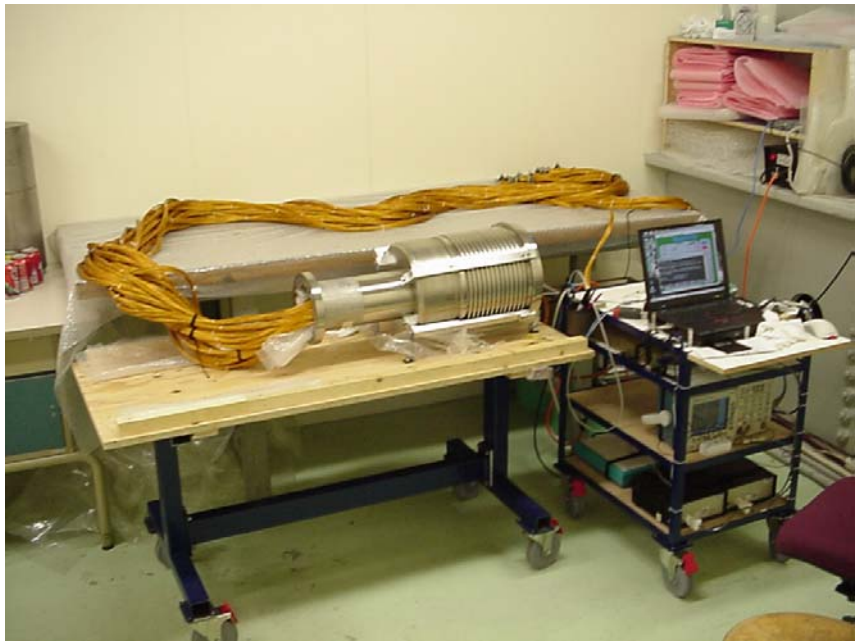
last produced feedthrough in crate
(Oct 2002)

Each feedthrough has its own crate

4 feedthrough crates are then crated together for shipment

50 feedthrough units now at CERN

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

46 units tested at CERN, the rest to be tested soon

Schedule: Endcap Cryostats

ECC arrived at CERN 20 March 2002

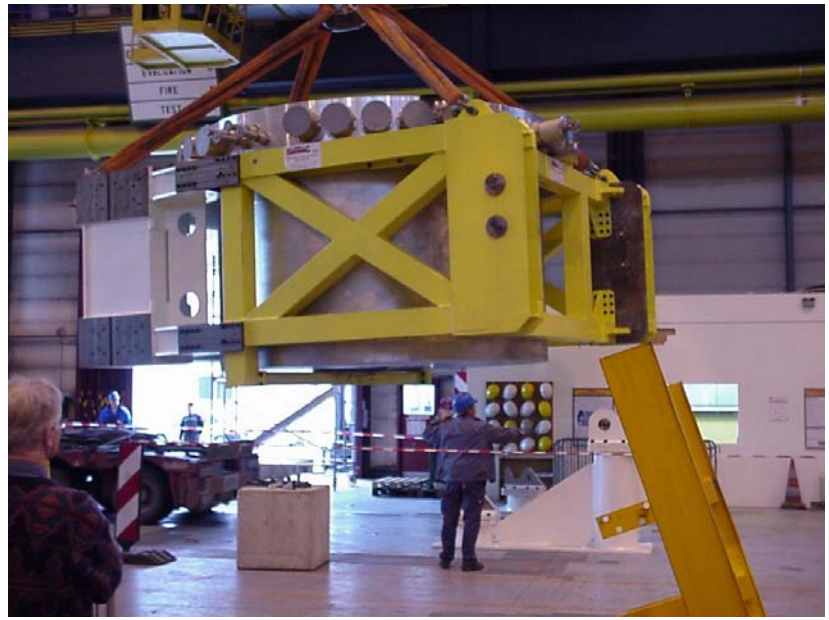
Cold test of ECC revealed problems with the inter-vessel stoppers; the heaters need replacing.

Repairs started October 2002

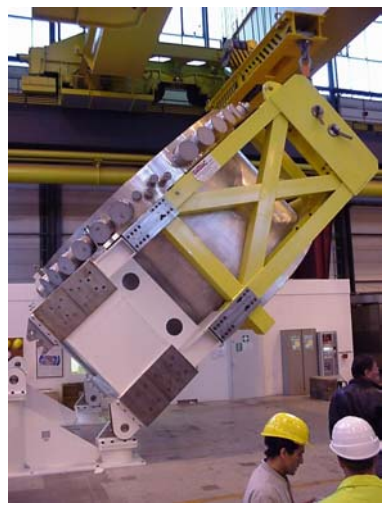
Ready for feedthrough installation beginning of Dec 2002

ECA expected at CERN in April 2003 (very preliminary)

Ready for feedthrough installation at least one month later



reception at CERN on 20 Mar 2002



rotation for cold test on 18 Apr 2002

Schedule: Installation

Two persons at CERN for assistance during installation

- foresee 1.5 months for installation on ECC
- foresee 1.5 months installation on ECA
- about 1.5 months for warm cable installation and final electrical tests

Special testing equipment has been developed for the warm cable insertion

- bent pin indicator (to give early warning of bent pins while installing a warm cable)
- a short-to-ground indicator
- a cross-channel-short indicator (to check for cross-channel shorts in the warm cable after installation)
- a pigtail ATI / baseplane interface for use during the post-installation cross talk tests (BNL was using a warm cable for their TDR test interface, which caused problems since the warm cables are not designed to stand up to many plugins)

Schedule Summary

Last feedthrough produced at UVic on Oct 25 2002

- **at the Dec 01 review we predicted 15 Oct 2002 !!**
- **limiting factor was pigtail reception**
- **radiation tests on last pigtails: awaiting results mid Dec 02**

Oct 00 Schedule:

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

Dec 01 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 ?

Current Schedule:

ECC delivery to CERN	20 Mar 02
feedthrough installation	Dec 02 – Feb 03
ECA delivery to CERN	17 Apr 03 ?
feedthrough installation	late May 03 ?

Budget and Management

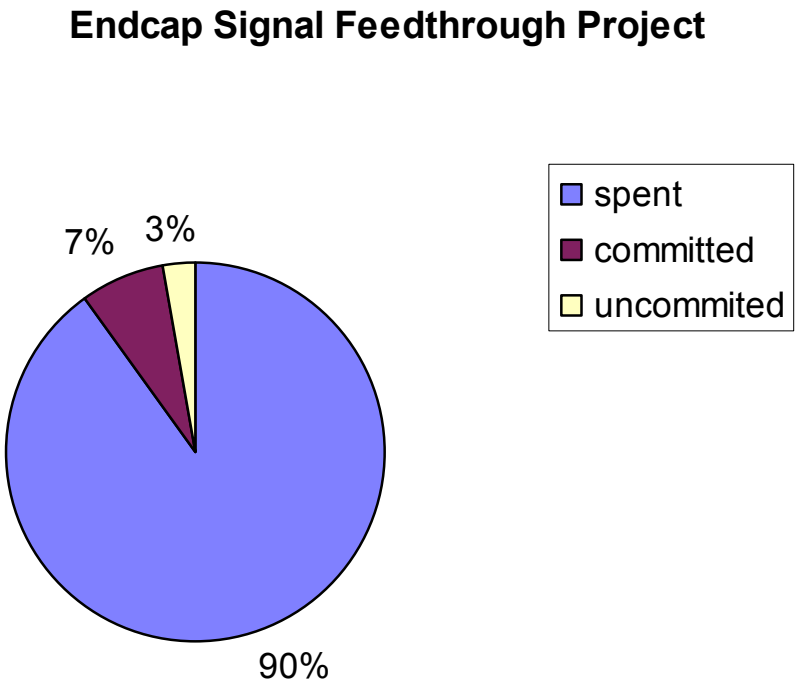
Responsibilities

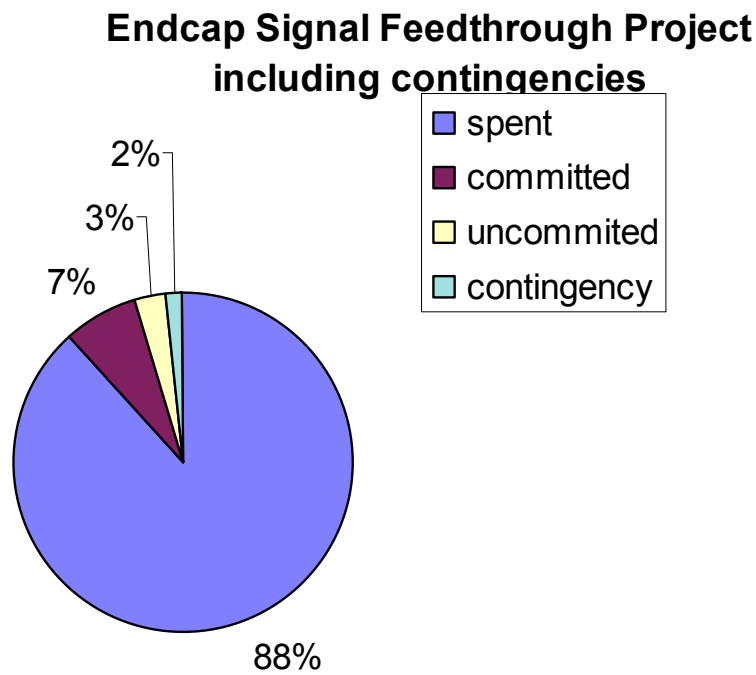
- Design
- Fabrication
  - Signal Pigtails purchased from Orsay
- Commissioning
- Transport
- Reception
  - Electrical and ambient vacuum testing
    - Leak tester provided by ATLAS CERN
- Electrical tests after installation
- Assistance during installation
  - Assistance during welding on the cryostat
  - Manpower to connect warm cables to ambient flange

Budget and Management

Budget Status

Allocated MIG amount:	$4.280M		(Dec01)
Current budget:	$3.998M	(net of contingencies)	($4.091)
Contingencies:	$0.068M		($0.213)





Budget and Management

Budget Summary

PBS	WBS	Description	Sep 02	MIG COST PROFILE								Sep 02			
			02-03	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**	**$366,616**	**$224,375**	**$266,888**	**$523,373**	**$1,233,264**	**$981,045**	**$498,227**	**$271,298**	**$3,998,471**	**90**	**7**	**3**	**$68,459**
4.1	**2**	**Project Setup**	**$4,471**	**$156,386**	**$207,997**	**$209,536**	**$87,019**	**$38,763**	**$10,745**	**$11,174**	**$721,620**	**98**	**0**	**2**	**$4,112**
4.1.1	3	Leak Test Setup	$1,382	$102,521	$29,420	$6,838	$39,994	$13,692	$5,150	$3,547	$201,163	96	0	4	$1,579
4.1.2	3	Electric Test Setup	$328	$6,109	$22,252	$32,803	$35,767	$12,562	$1,307	$2,029	$112,830	97	0	3	$752
4.1.3	3	Data Acquisition System	$1,241	$15,198	$5,308	$4,690	$5,550	$5,771	$1,500	$1,146	$39,164	96	0	4	$351
4.1.4	3	FT Assembly Tools	$0	$0	$10,135	$591	$0	$0	$0	$0	$10,725	100	0	0	$0
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	$1,520	$0	$607	$6,768	$6,663	$6,737	$2,788	$4,451	$28,014	80	0	20	$1,430
4.2	**2**	**FT Series Assemblies**	**$249,044**	**$0**	**$0**	**$167,302**	**$974,803**	**$712,338**	**$285,585**	**$123,526**	**$2,263,554**	**93**	**6**	**1**	**$36,880**
4.2.1	3	Mechanical Components	$5,666	$0	$0	$166,791	$203,563	$611,856	$32,579	$1,024	$1,015,813	97	3	0	$3,848
4.2.2	3	Electrical Components	$239,146	$0	$0	$414	$758,353	$86,050	$239,646	$118,778	$1,203,241	90	10	0	$29,820
4.2.3	3	Shipping Crates	$4,232	$0	$0	$98	$12,886	$14,432	$13,360	$3,724	$44,500	71	0	29	$3,213
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**	**$113,101**	**$9,561**	**$58,891**	**$146,534**	**$171,442**	**$229,944**	**$201,897**	**$136,598**	**$954,869**	**76**	**15**	**8**	**$27,467**
4.4.1	3	Salaries and Benefits	$85,912	$9,561	$55,092	$129,328	$142,873	$189,244	$135,704	$94,617	$756,420	81	19	0	$7,220
4.4.2	3	Consultation and Travel	$27,189	$0	$1,016	$17,206	$20,368	$40,582	$66,193	$41,981	$187,345	57	0	43	$20,246
4.4.3	3	Other	$0	$0	$2,784	$0	$8,201	$119	$0	$0	$11,104	100	0	0	$0

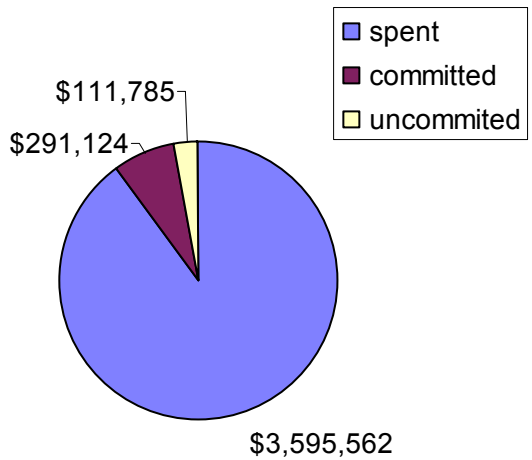
Contingencies total $68.5k and are dominated by:

- **exchange rate: +25% on 0.244 $CAN/FF or 1.60 $CAN/Euro (pigtails)**
- **contingency on travel for installation**

The budget total net of contingencies is $3.998M

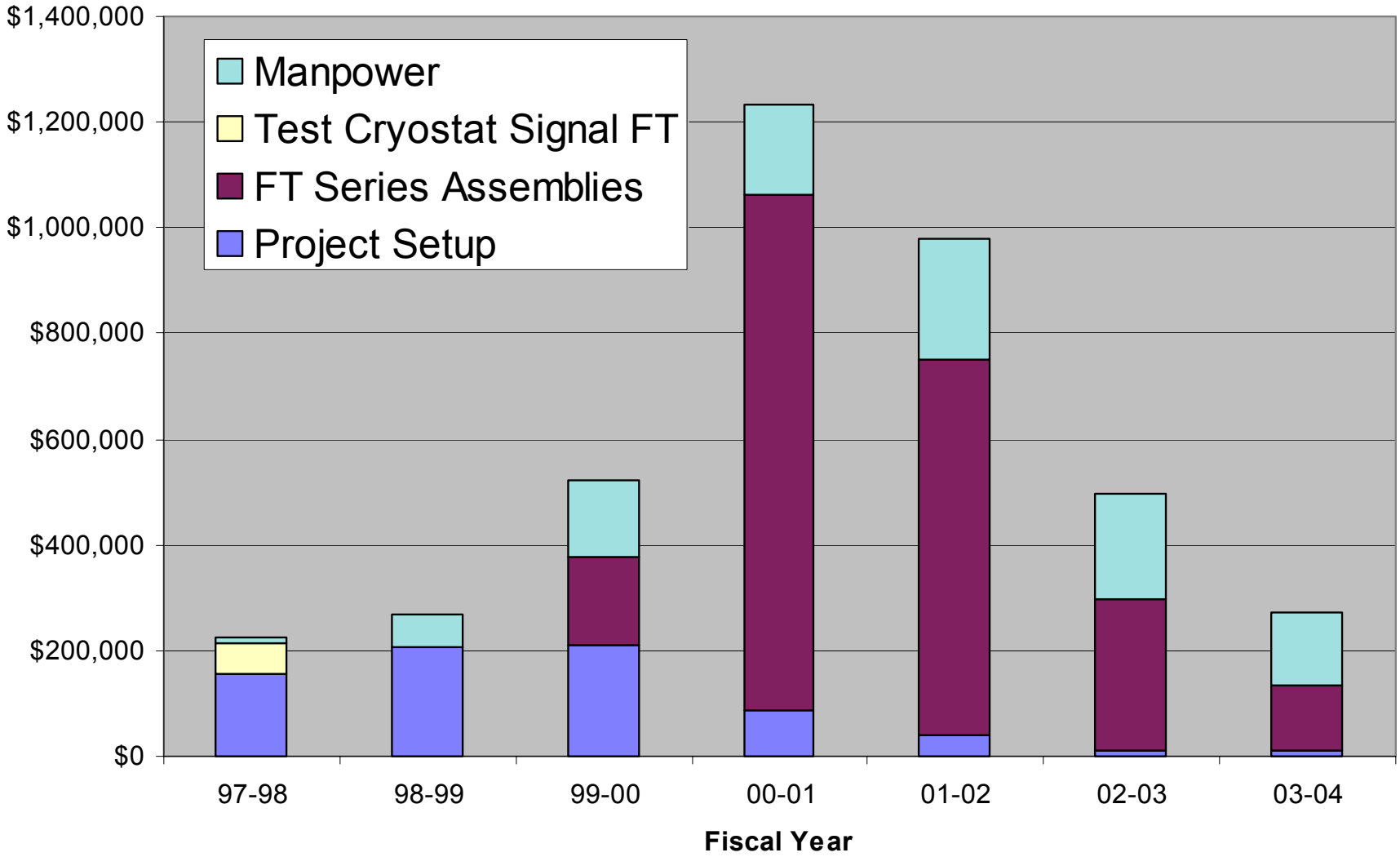
90% of which has been spent (Sep 02)

7% of which has been committed (Sep 02)



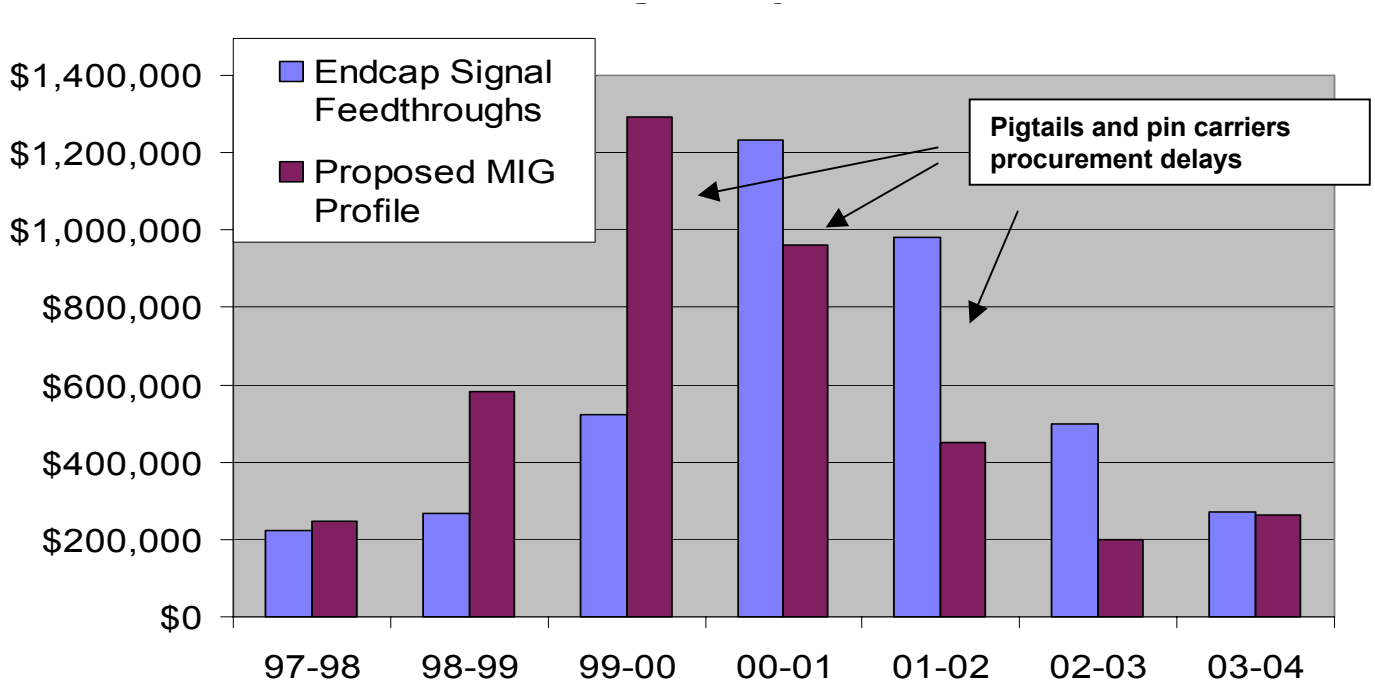
Budget and Management

Budget Profile



Budget and Management

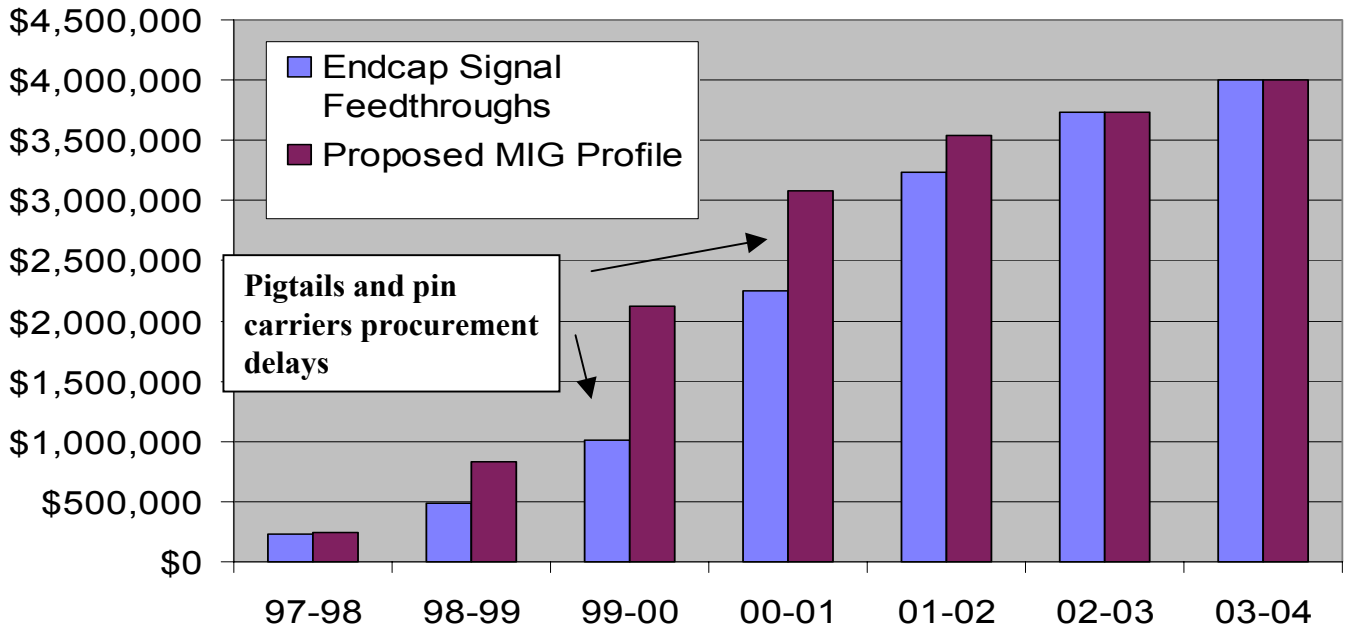
Budget Profile



	97-98	98-99	99-00	00-01	01-02	02-03	03-04	Total
Sep 02	$CAN	$CAN	$CAN	$CAN	$CAN	$CAN	$CAN	$CAN
Budget	**$224,375**	**$266,888**	**$523,373**	**$1,233,264**	**$981,045**	**$498,227**	**$271,298**	**$3,998,471**
MIG spent (UVic and TRIUMF)	**$224,375**	**$266,888**	**$523,373**	**$1,233,264**	**$981,045**	**$366,616**	**$0**	**$3,595,562**
Proposed MIG Profile	**$249,000**	**$584,000**	**$1,292,880**	**$960,000**	**$450,000**	**$200,000**	**$262,591**	**$3,998,471**

Budget and Management

Integrated Budget Profile



	97-98	98-99	99-00	00-01	01-02	02-03	03-04	Total
Sep 02	$CAN	$CAN	$CAN	$CAN	$CAN	$CAN	$CAN	$CAN
Budget	**$224,375**	**$491,263**	**$1,014,636**	**$2,247,901**	**$3,228,945**	**$3,727,173**	**$3,998,471**	**$3,998,471**
MIG spent (UVic and TRIUMF)	**$224,375**	**$491,263**	**$1,014,636**	**$2,247,901**	**$3,228,945**	**$3,595,562**	**$3,595,562**	**$3,595,562**
Proposed MIG Profile	**$249,000**	**$833,000**	**$2,125,880**	**$3,085,880**	**$3,535,880**	**$3,735,880**	**$3,998,471**	**$3,998,471**

Budget and Management

Series Assemblies Details

PBS	WBS	Description	MIG COST PROFILE											
			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
4	**1**	**Endcap Signal Feedthroughs**	**$224,375**	**$266,888**	**$523,373**	**$1,233,264**	**$981,045**	**$498,227**	**$271,298**	**$3,998,471**	**90**	**7**	**3**	**$68,459**
4.1	**2**	**Project Setup**	**$156,386**	**$207,997**	**$209,536**	**$87,019**	**$38,763**	**$10,745**	**$11,174**	**$721,620**	**98**	**0**	**2**	**$4,112**
4.2	**2**	**FT Series Assemblies**	**$0**	**$0**	**$167,302**	**$974,803**	**$712,338**	**$285,585**	**$123,526**	**$2,263,554**	**93**	**6**	**1**	**$36,880**
4.2.1	**3**	**Mechanical Components**	**$0**	**$0**	**$166,791**	**$203,563**	**$611,856**	**$32,579**	**$1,024**	**$1,015,813**	**97**	**3**	**0**	**$3,848**
4.2.1.0	4	Low Inclusion Steel	$0	$0	$61,853	$2,431	$0	$21,079	$0	$85,363	75	25	0	$3,162
4.2.1.1	4	Pin Carriers	$0	$0	$36,827	$49,719	$593,509	$0	$0	$680,055	100	0	0	$0
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	$871	$0	$0	$3,017	100	0	0	$0
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	$17,477	$11,500	$1,023	$30,000	77	23	0	$686
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**	**$414**	**$758,353**	**$86,050**	**$239,646**	**$118,778**	**$1,203,241**	**90**	**10**	**0**	**$29,820**
4.2.2.1	4	Pig Tail Cables	$0	$0	$192	$192,216	$1,413	$238,210	$118,778	$550,809	78	22	0	$29,695
4.2.2.2	4	Vacuum Cables	$0	$0	$15	$471,810	$39,290	$0	$0	$511,115	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	$2,004	$500	$0	$9,399	95	0	5	$125
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	$936	$0	$10,161	100	0	0	$0
4.2.3	**3**	**Shipping Crates**	**$0**	**$0**	**$98**	**$12,886**	**$14,432**	**$13,360**	**$3,724**	**$44,500**	**71**	**0**	**29**	**$3,213**
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**	**$229,944**	**$201,897**	**$136,598**	**$954,869**	**76**	**15**	**8**	**$27,467**
4.4.1	3	Salaries and Benefits	$9,561	$55,092	$129,328	$142,873	$189,244	$135,704	$94,617	$756,420	81	19	0	$7,220
4.4.2	3	Consultation and Travel	$0	$1,016	$17,206	$20,368	$40,582	$66,193	$41,981	$187,345	57	0	43	$20,246
4.4.3	3	Other	$0	$2,784	$0	$8,201	$119	$0	$0	$11,104	100	0	0	$0

Budget and Management
FY03-04 Salary and Travel Details

Salaries

- **Paul Poffenberger (1/2 of FY03-04 requested in MFA)**
- **Fiona Holness (contract until end of 2003)**

Travel to CERN for installation FY03-04:

- **2 times 1.5 months for Poffenberger**
- **2 times 1.5 months for Holness**
- **2 weeks for Birney**

We benefit from R. Langstaff, R. McPherson and S. Chekulaev's presence at CERN

Training of HQP

Aaron Dowling	**(Aug 98 – Oct 02)**
Alisa Dowling	**(Now TRIUMF Engineer)**
M. Fincke-Keeler	**(RA)**
F. Holness	**(Lab technologist)**
J. Lindner	**(Coop Student)**
R. MacDonald	**(Coop Student)**
R. McDonald	**(Coop Student)**
E. Muzzerall	**(Coop Student)**
P. Poffenberger	**(RA)**
G. Vowles	**(Aug 98 – Jan 02, now at UofT)**
W. Wiggins	**(Coop Student, CUPC2002 presentation)**

Conclusions

ATLAS Endcap Signal Feedthrough Project

- **Crucial component of ATLAS Liquid Argon Calorimetry**
- **Complex and manpower intensive**
  - **UVic and TRIUMF personnel**
  - **Training of HQP**
- **Production at UVic finalized on 25 Oct 2002**
  - **50/55 units at CERN**
  - **Extensive QA/QC programme**
- **Starting installation**
  - **Difficult operations that require great care**
  - **Our expertise is necessary**
- **Budget under the allocated MIG** ($4.28M)
  - **Management of personnel resources and related field travel**
  - **$3.998M + $0.068M contingencies**
  - **97% of baseline costs either spent or committed**