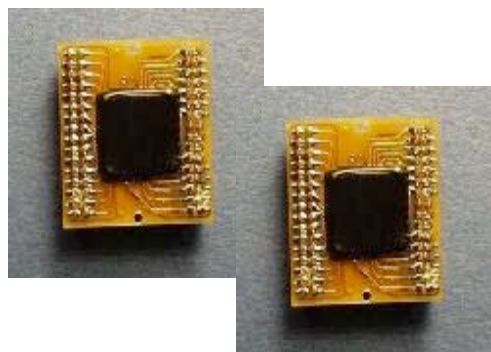


# Status Report on UFE TRD Front-End Electronics Space Qualification Tests

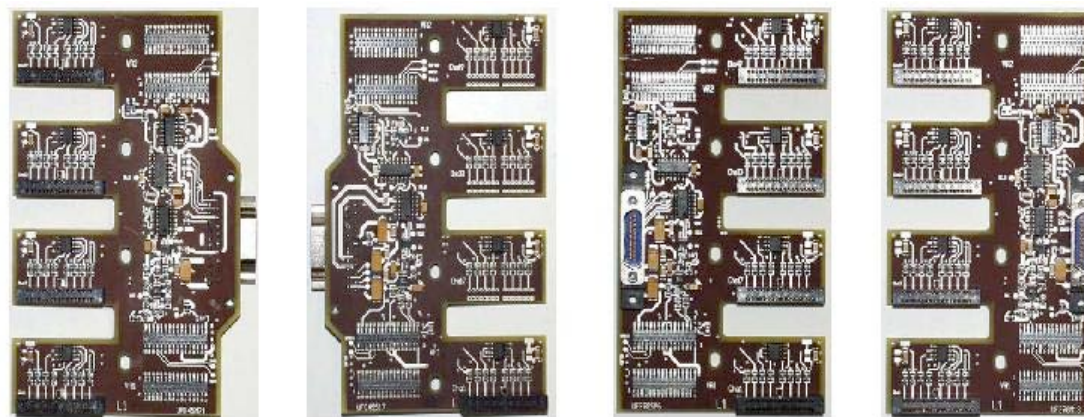
C.H. Chung, W. Karpinski



# Production of UFE (FM)

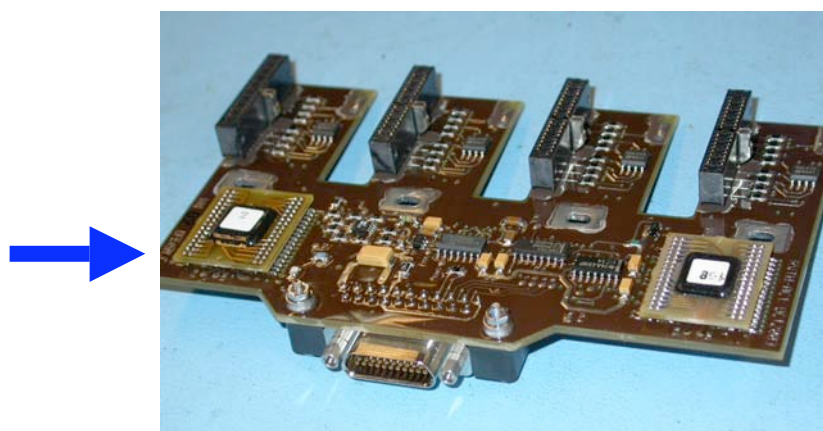


+



VA Hybrid Chips Test

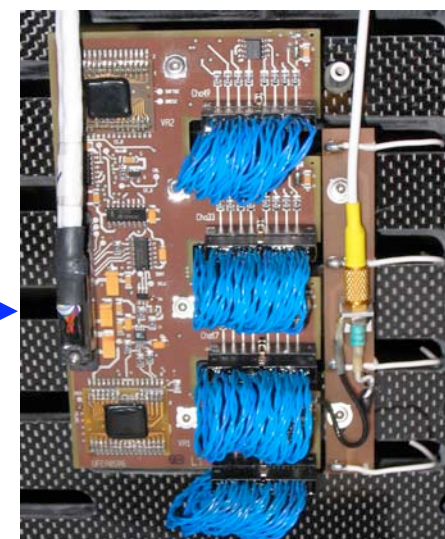
Production of 4 Types PCB



Functional Tests

S.Q.T.  
Coating

We are Here !

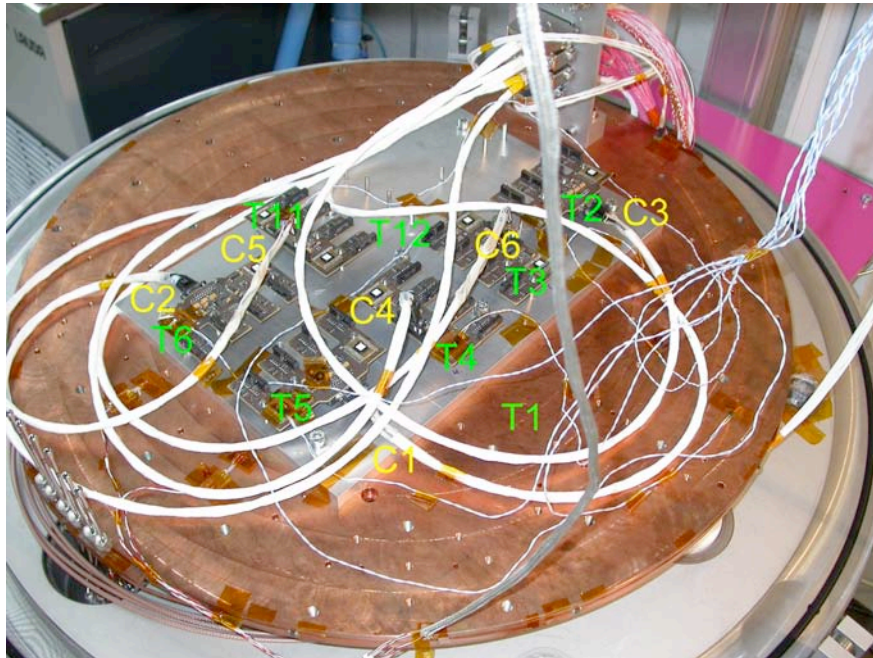


Integration



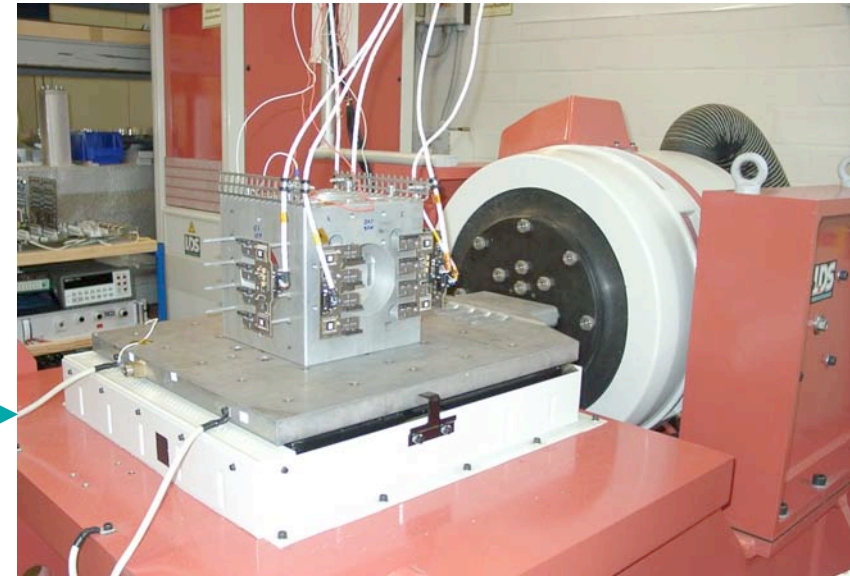
# Space Qualification Tests

Under Power with Calibration Sequence



1<sup>st</sup> Thermal Vacuum Test  
Temperature Profile:  $-40^{\circ}\text{C} \dots +80^{\circ}\text{C}$   
Pressure below  $1 \times 10^{-5}$  mbar

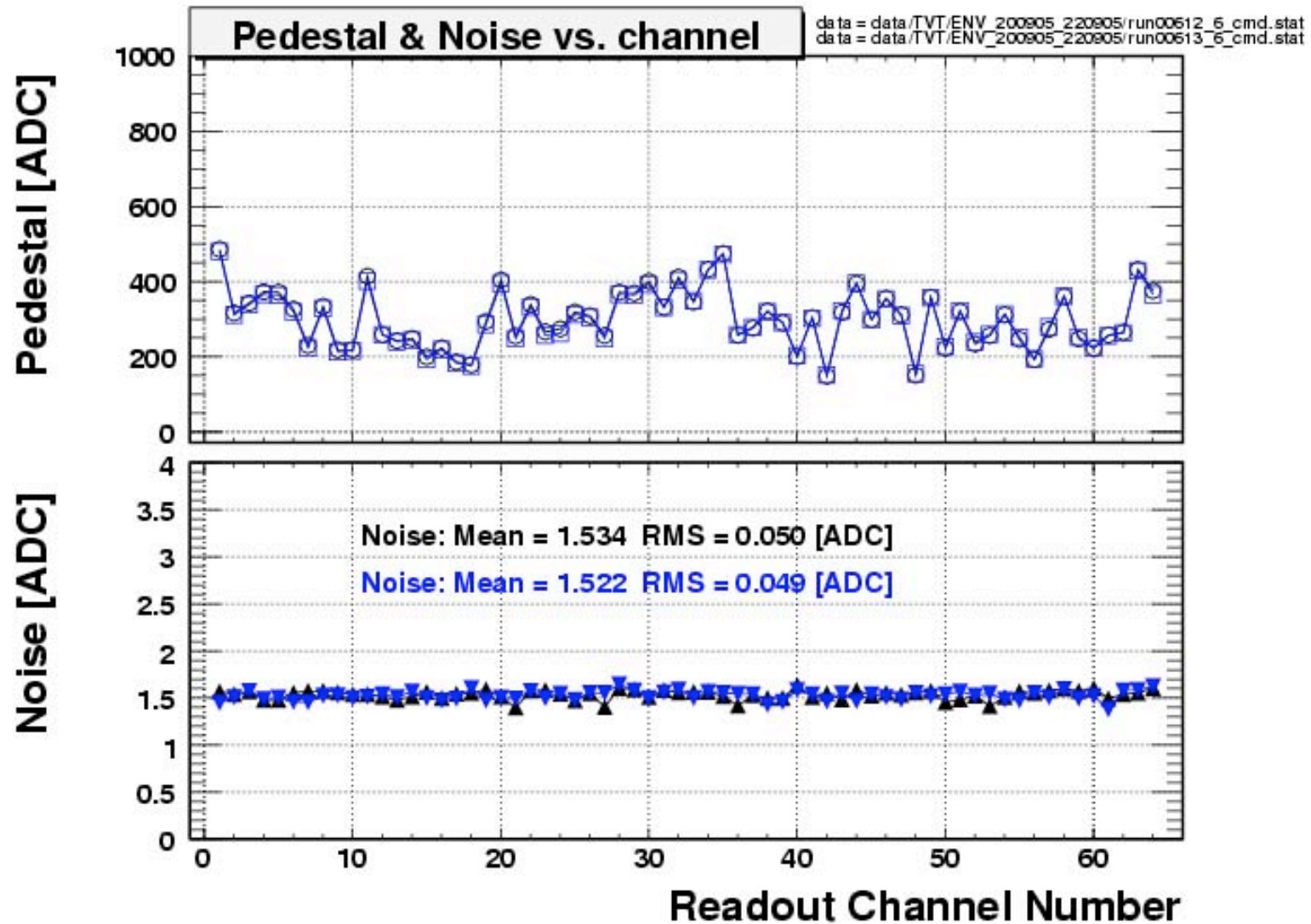
2<sup>nd</sup> Thermal Vacuum Test  
Same as 1<sup>st</sup> TVT condition



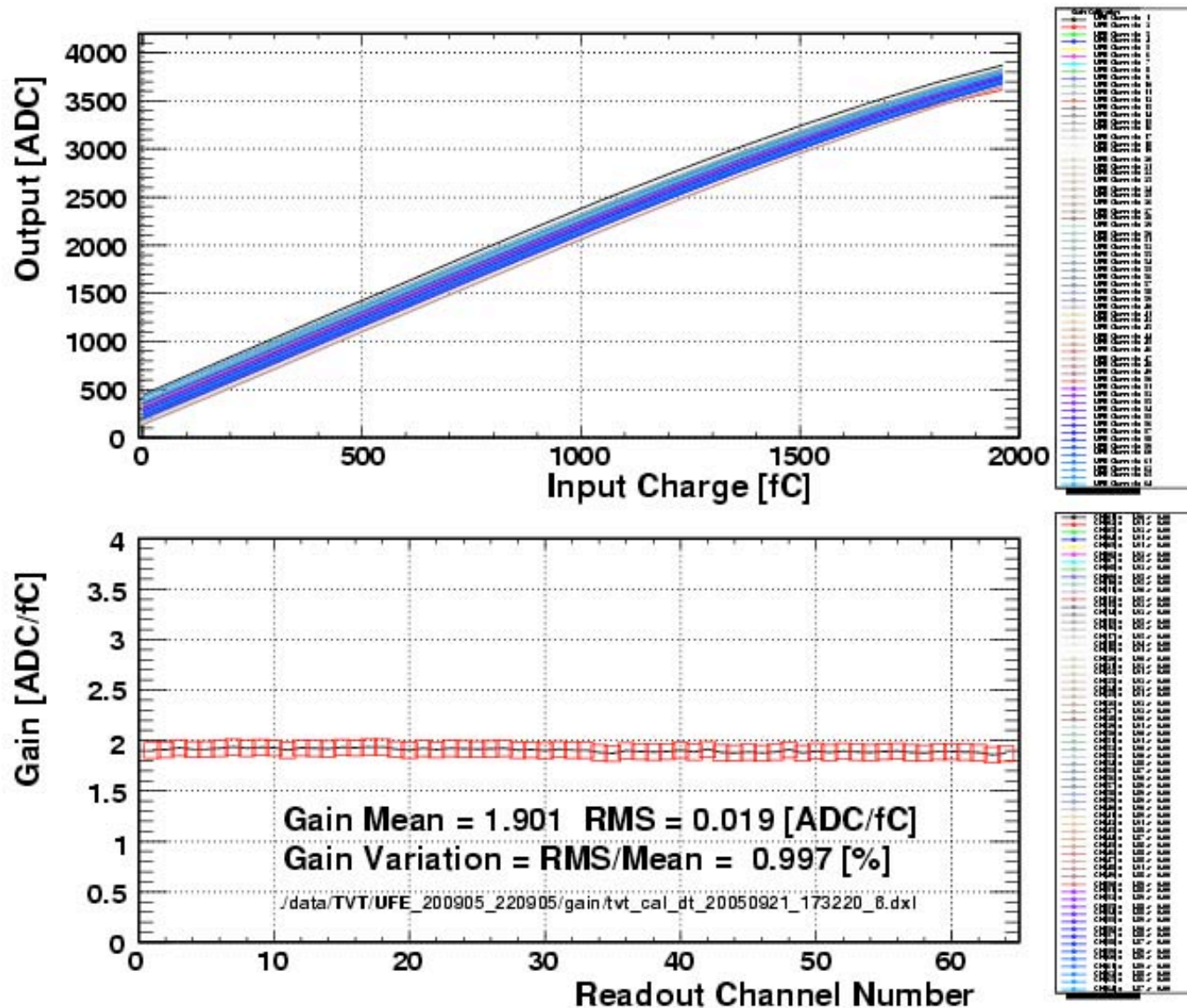
Random Vibration  
X,Y and Z Direction  
 $a_{\text{RMS}} = 6.8\text{g}$ , 80-500 Hz for 90 sec

Conformal Coating

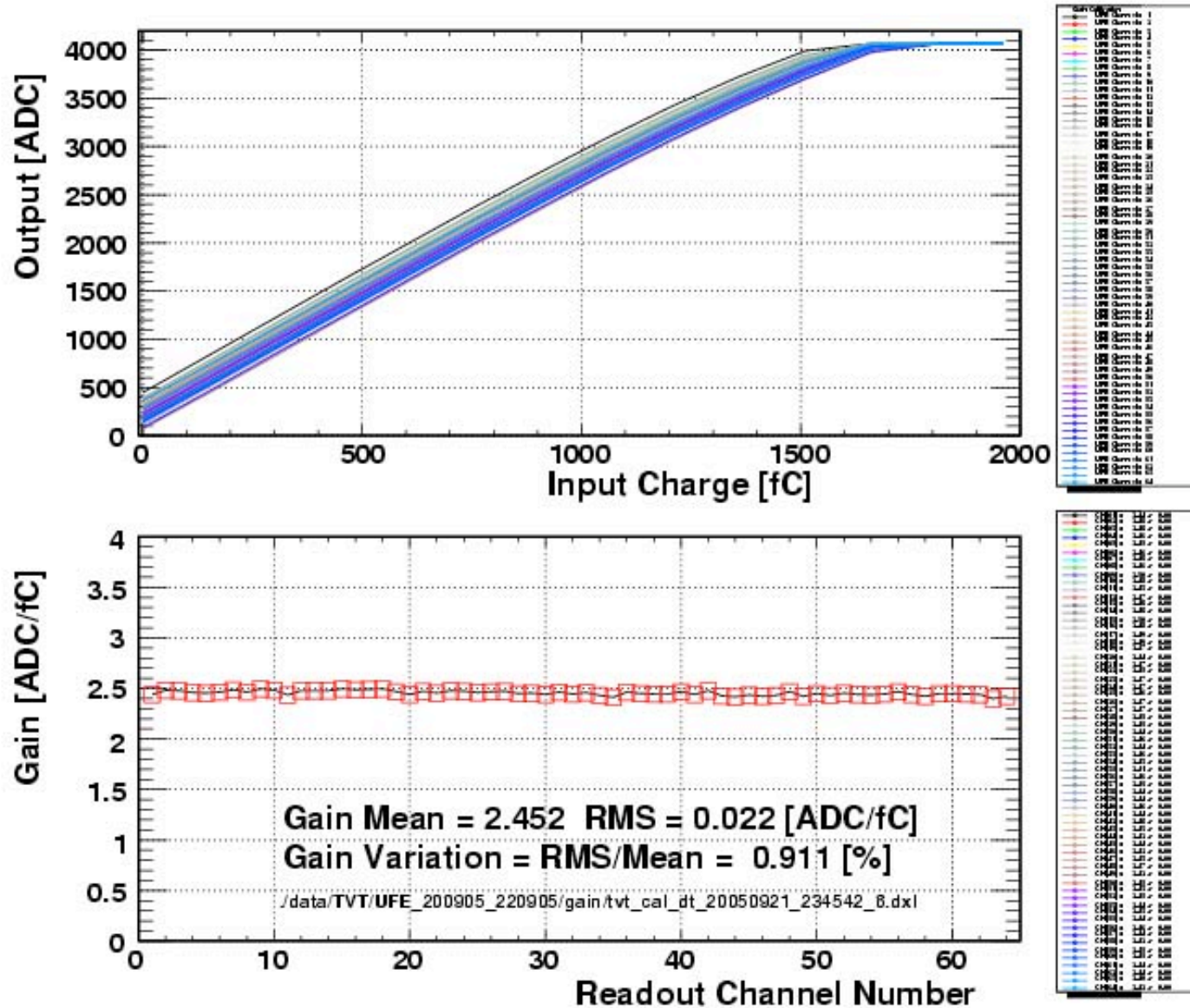
# Pedestals before/after UFE SQ



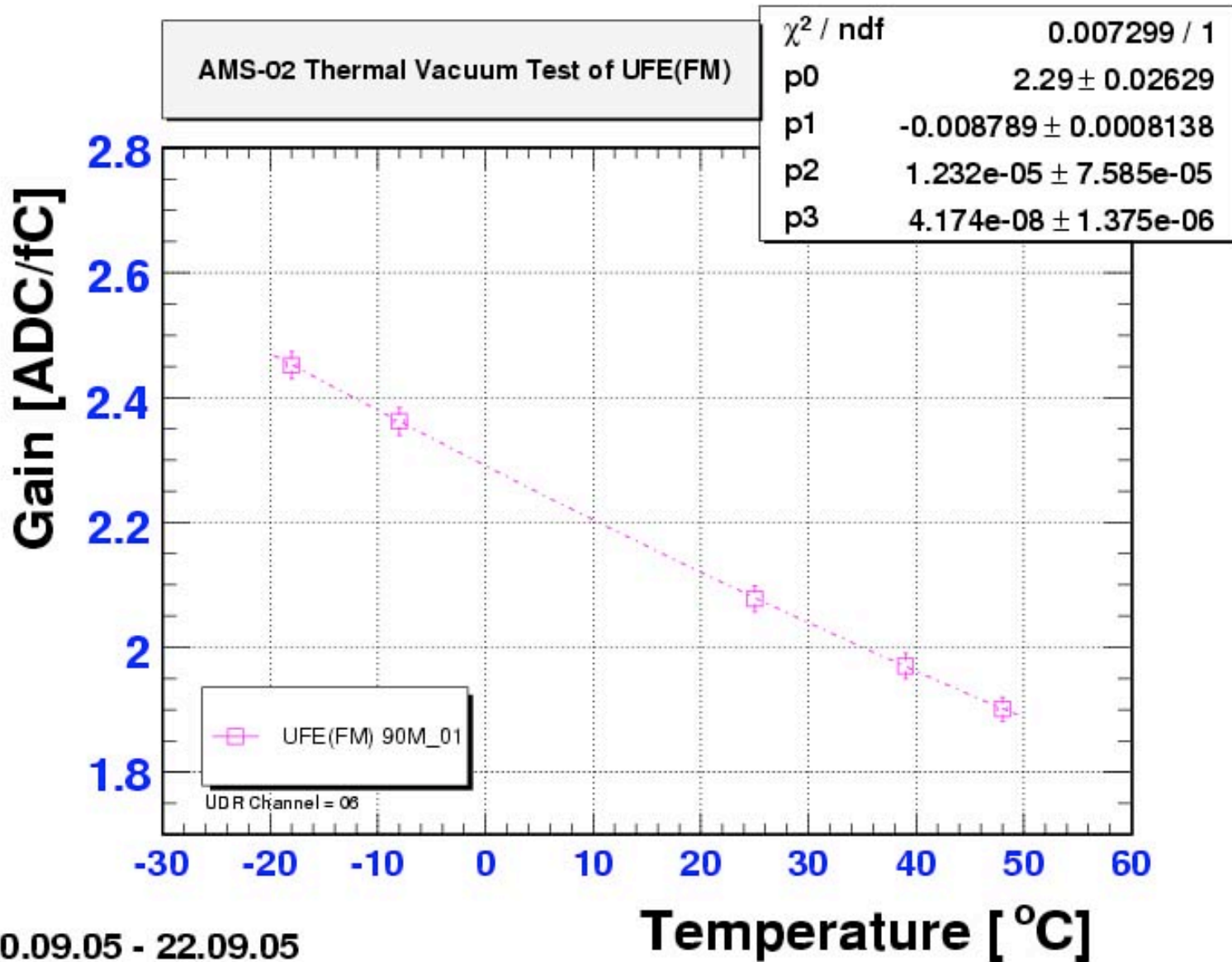
# Gain Calibration at T=+50°C



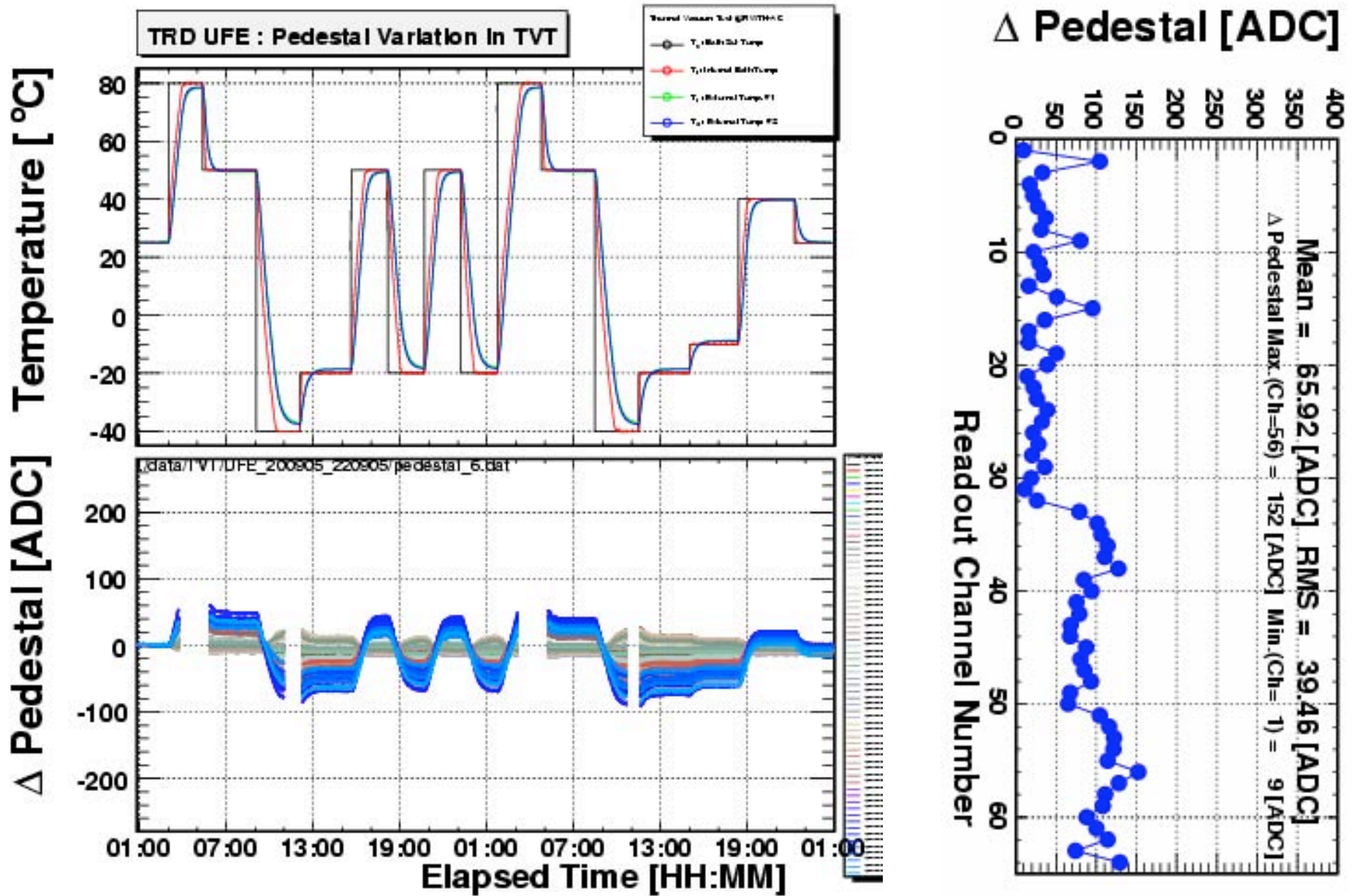
# Gain Calibration at T=-20°C



# UFE Gain vs Temperature



# Pedestal Position vs. Temperature







# Summary and Milestones

**UFE(FM) Production : Finished (19.07.2005)**

Total = 100 UFES (FM = 82, FS = 18)

**Functional Tests : Finished (20.07.05)**

**UFE Space Qualification Tests (Mar.05 ~ Jan.06)**

1<sup>st</sup> Thermal Vacuum Test = 100 (Done)

Random Vibration Test = 42 (Done)

Conformal Coating = 42 (Done)

2<sup>nd</sup> Thermal Vacuum Test = 42 (Done)

Random Vibration Test = 58 (Oct.05)

Conformal Coating = 58 (Nov.05)

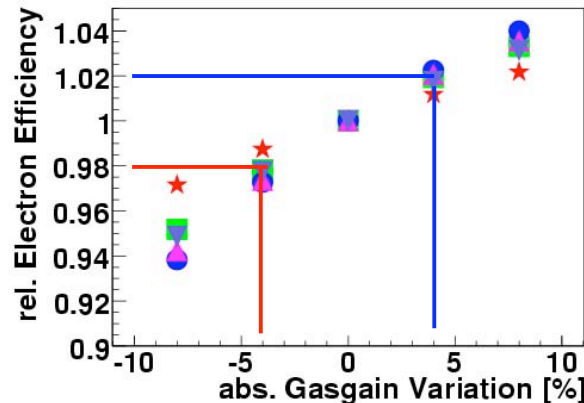
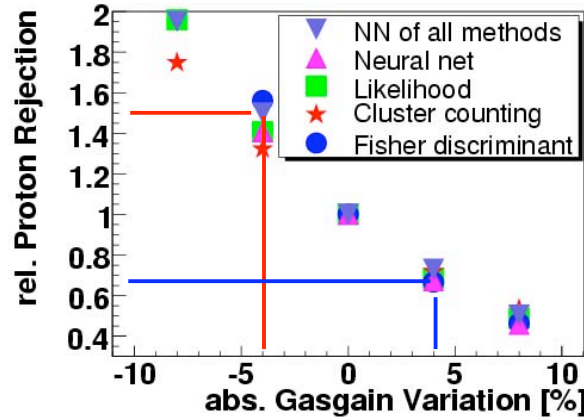
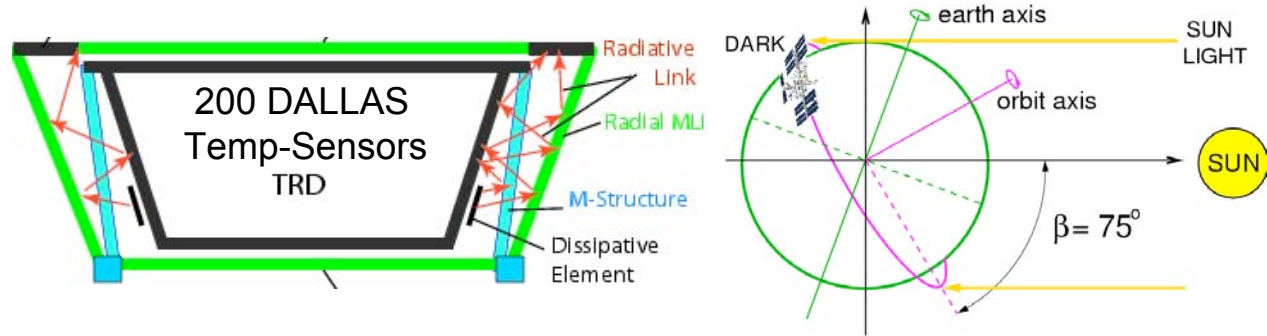
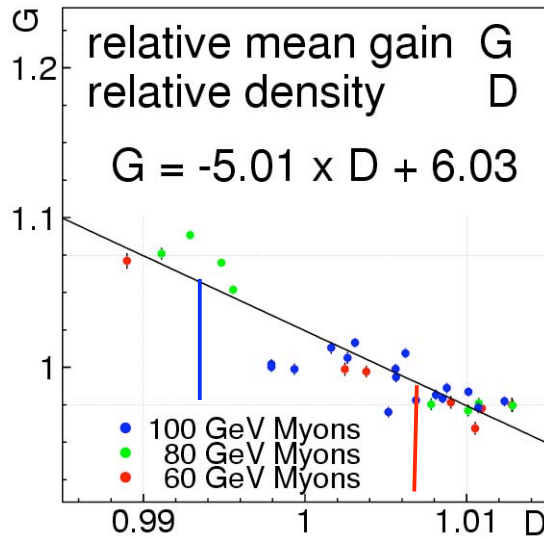
2<sup>nd</sup> Thermal Vacuum Test = 58 (Jan.06)

**UFES available for Octagon-Integration from Sep.05**

# TRD Gas Group Space Qualification Tests

C.H. Chung, K. Lübelsmeyer

# TRD Thermal Model



From  $\bar{T} = +35 \text{ }^\circ\text{C}$  to  $-15 \text{ }^\circ\text{C}$  in 15 days ( $\Delta T$ )

$\Delta T = \pm 2 \text{ }^\circ\text{C}$   $\frac{\Delta T}{\bar{T}} = 0.7\% \rightarrow \Delta G/G = 4\%$   
 $\rightarrow$  Prot.Rej.  $\sim 1.5$       Positron.Eff.  $\pm 2\%$

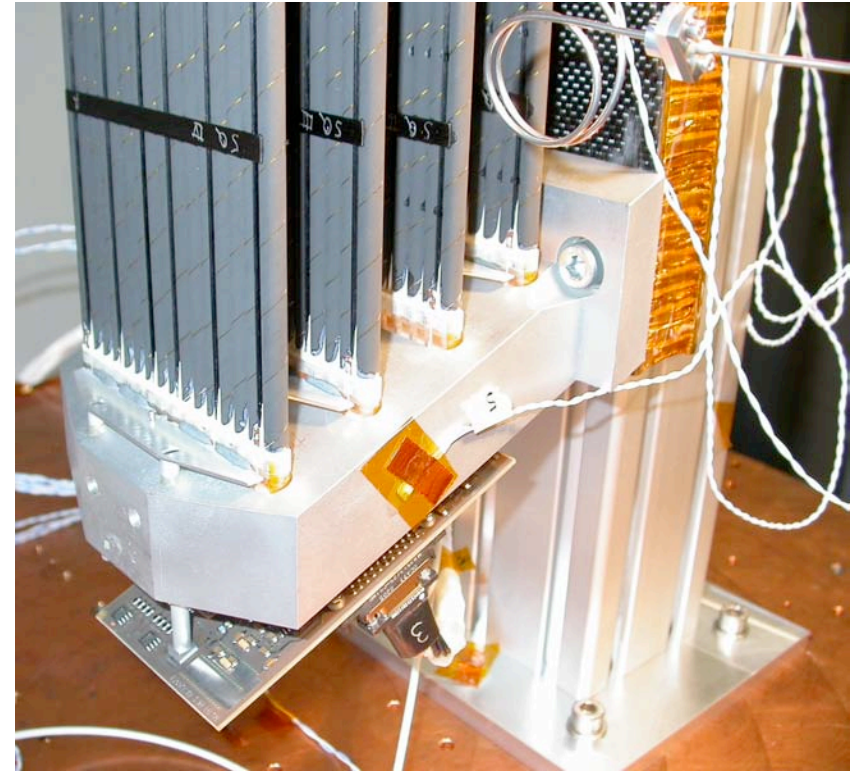
Vertical Gradient:      Averages over Particle Track

Horizontal Gradient:      Differs from Track to Track

Worst Hot and Cold at  $|\beta| = 75^\circ$ : Dep. on ISS Roll

$\rightarrow$  Need Flexible Temperature-Sensor Readout-Scheme  
 High/Low Granularity      Fast (15min) / Slow (2h) Update

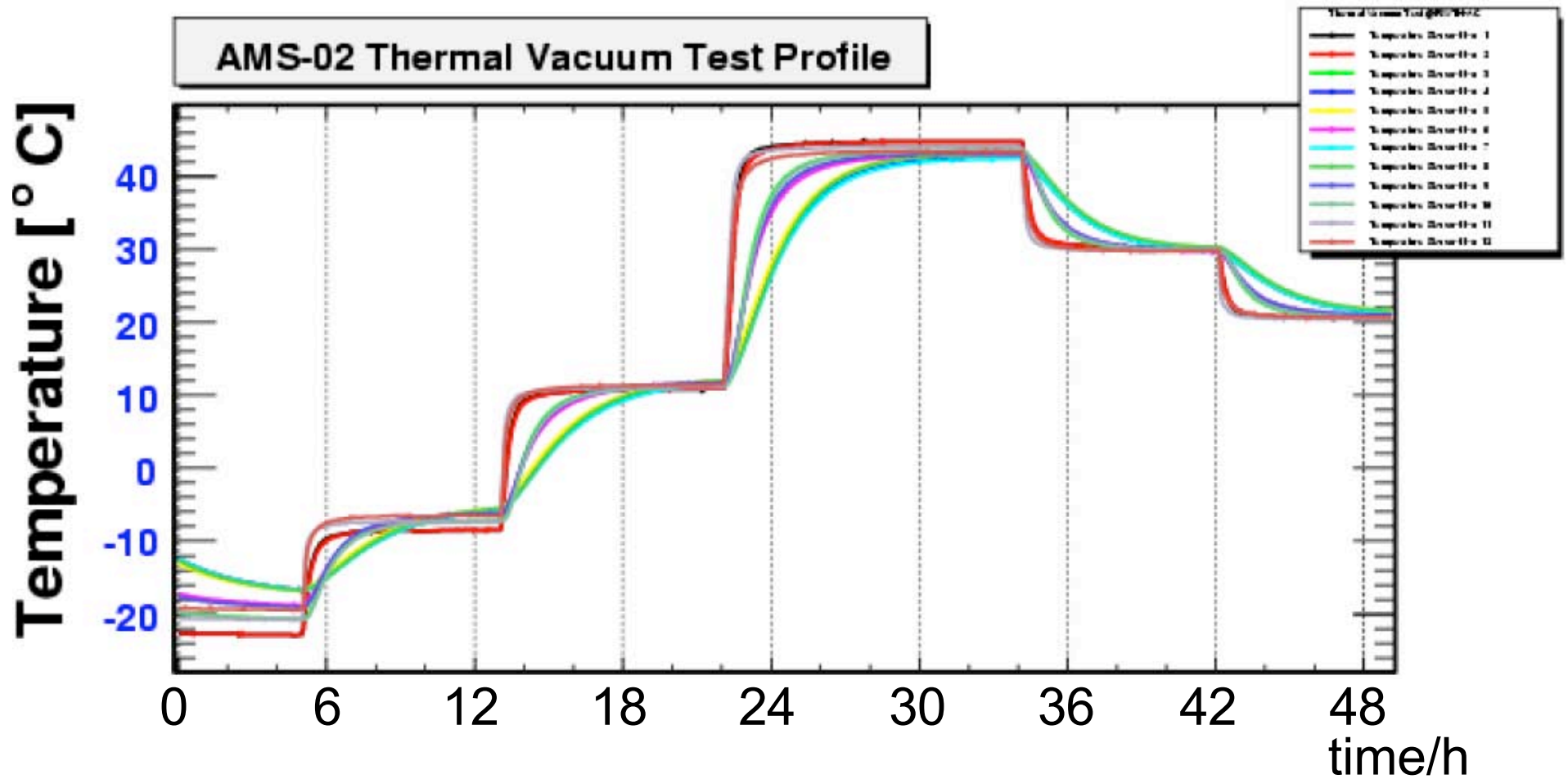
# TRD Gasgroup TVT Oct.05



16  $\mu$ -cycles (equiv. 1000 d on ISS)  
Module Temp.  $-15^{\circ}\text{C} \dots +35^{\circ}\text{C}$   
Test Module Gastightness  
Test UFE Gain/Calibration Stability  
Test Gasdensity/Gasgain Correction

Stack of four TRD Modules  
Serial flow of  $\text{Ar}/\text{CO}_2$  @ 1l/h  
UFE with UDR/UHVG DAQ  
 $^{55}\text{Fe}$  Source inside TVT  
Random Trigger Readout

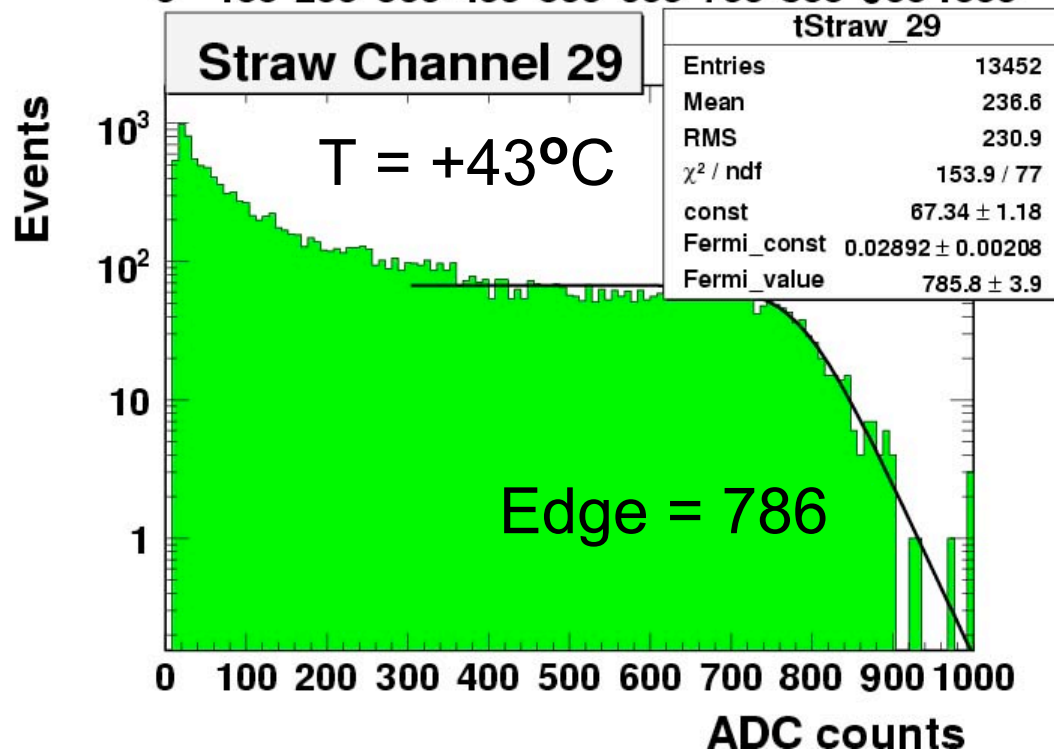
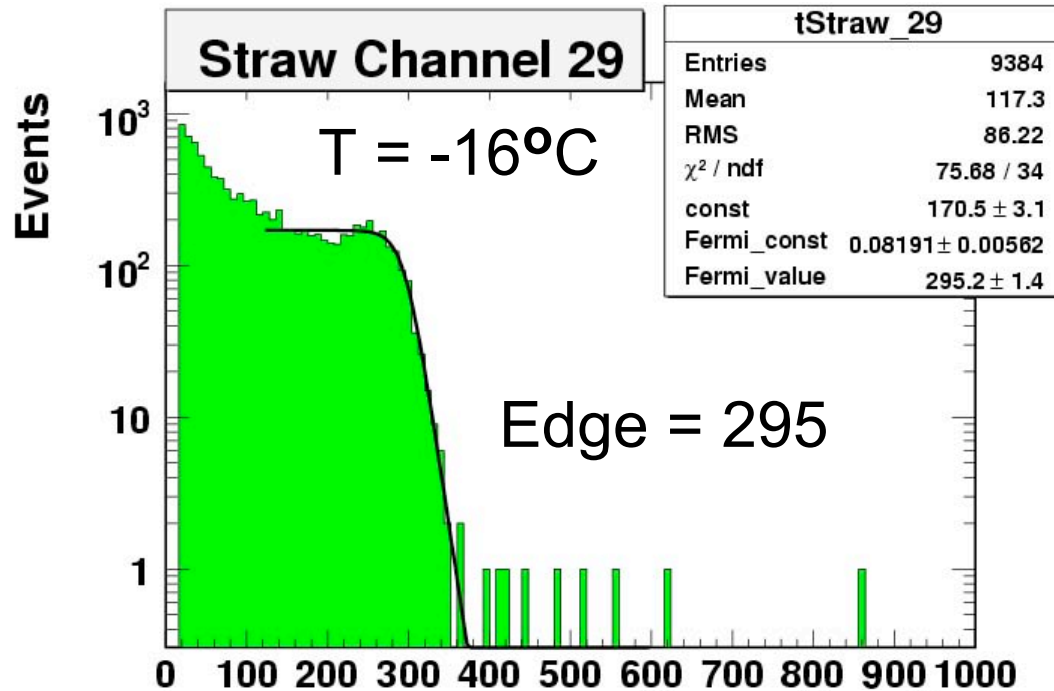
# TRD Gasgroup TVT Profile



# Temperature / Pulseheight

$^{55}\text{Fe}$  Sources in TVT

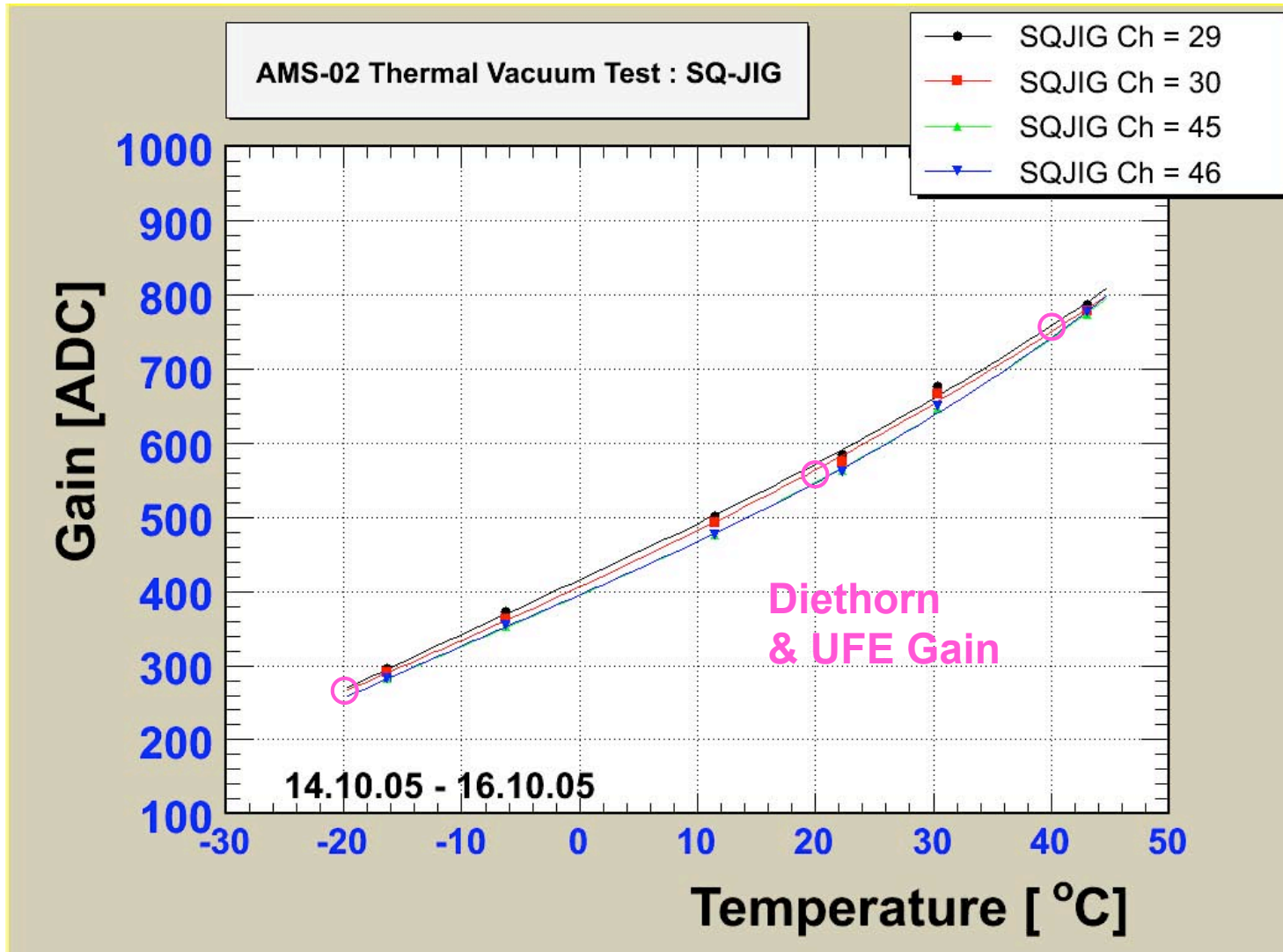
Random Trig. UFE/UDR DAQ



# Pulseheight – Density Correlation

GasGain (Diethorn):  $G = G_0 (T/T_0)^\alpha$  with  $\alpha \approx 6$

UFE Gain drops at higher Temperatures  $\approx -0.4\%$  per  $^\circ\text{C}$



# TRD Integration Tasks

Required Components to be installed on TRD Octagon

Required Hardware for Component Qualification

Required Setups / Procedures during Component Installation

Required Setups and Studies to assure TRD Operation



Other Items required for TRD Operation

Crucial Item:        Octagon Manifolds


                         Rosengitter Installation after Manifold Mounting TBD



# Octagon Integration Schedule

Nr.		Vorgangname	% geschlossen	Dauer	Anfang	2004	Ende	Vorgänger	Ressourcen
110		<b>TRD Integration in Aachen</b>	<b>44%</b>	<b>444 Tage?</b>	<b>Fre 01.10.04</b>		<b>Die 25.07.06</b>		
111		<b>Integrate TRD Modules and UI</b>	<b>100%</b>	<b>256 Tage</b>	<b>Fre 01.10.04</b>		<b>Fre 14.10.05</b>		
123		Tower gas tubeing (interconnection	0%	8 Wochen	Mon 17.10.05		Fre 09.12.05	122	
124		Integrate UFE	0%	4 Wochen	Die 13.12.05		Fre 27.01.06	123;72	
125		Mount 16 Manifolds	0%	3 Tage	Mon 30.01.06		Mit 01.02.06	124;18	
126		Mount Rosengitter	0%	1 Woche	Don 02.02.06		Mit 08.02.06	125	
127		Mount Upper Cover	0%	1 Tag	Don 09.02.06		Don 09.02.06	126;6	
128		Gas Tubeing tower <=> manifolds	0%	4 Wochen	Fre 10.02.06		Don 09.03.06	127	MIT/Aachen
129		HV + Signal Cabeling	0%	2 Wochen	Mon 20.03.06		Fre 31.03.06	128;77	
130		Temperatur Cables	0%	3 Tage	Mon 03.04.06		Mit 05.04.06	129	
131		Manifold cabeling	0%	3 Tage	Don 06.04.06		Mon 10.04.06	130	
132		Manifold Control (UG Crate)	0%	1 Tag?	Die 11.04.06		Die 11.04.06	131	
133		TRD Test 0, Ar/CO2,	0%	4 Wochen	Mit 12.04.06		Die 09.05.06	132	
134									
135		Move TRD to transport Jig	0%	1 Woche	Mit 10.05.06		Die 16.05.06	133;57	
136									
137		Mount U-Crate, UG-Crate	0%	1 Woche	Mit 17.05.06		Die 23.05.06	135	
138		Mount EM BOX S+C	0%	1 Woche	Mit 24.05.06		Die 30.05.06	137	
139		Mount MLI	0%	1 Woche	Mit 31.05.06		Die 06.06.06	138	
140		TRD System Test 1, Xe/CO2	0%	4 Wochen	Mit 07.06.06		Die 04.07.06	139	
141		EMI/EMC Test Munich	0%	2 Wochen	Mit 05.07.06		Die 18.07.06	140	
142		Ship TRD/Upper ToF CERN	0%	1 Woche	Mit 19.07.06		Die 25.07.06	141	

# Manifold Production Schedule

Nr.		Vorgangsname	% geschlossen	Dauer	Anfang 2004	Ende	Vorgänger	Ressourcenna
8		<b>Manifolds</b>	<b>13%</b>	<b>277 Tage</b>	<b>Fre 26.11.04</b>	<b>Fre 27.01.06</b>		
9		Test 2 EM with Flightsimulator with U	100%	2 Wochen	Mit 03.08.05	Die 16.08.05		Gast
10		Send 4 QM from CERN => Aachen	0%	0 Tage	Fre 28.10.05	Fre 28.10.05		Berges
11		Test 4 QM with Flightsimulator with L	0%	2 Wochen	Fre 04.11.05	Don 17.11.05	10EA+5 Tage	Gast
12		4 QM Space Qualification	0%	2 Wochen	Fre 18.11.05	Don 01.12.05	11	
13		Test 4 QM Flightsimulator	0%	1 Woche	Fre 02.12.05	Don 08.12.05	12	
14		Send 2 QM from Aachen => Rome	0%	0 Tage	Fre 26.11.04	Fre 26.11.04		
15		16 FM Modules in Aachen with UGPS	0%	0 Tage	Die 01.11.05	Die 01.11.05		
16		Test with Flightsimulator	0%	4 Wochen	Die 01.11.05	Mon 28.11.05	15	
17		Space Qualification	0%	4 Wochen	Die 13.12.05	Fre 27.01.06	16EA+10 Tag	
18		Ready to mount on Octagon	0%	0 Tage	Fre 27.01.06	Fre 27.01.06	17	

# Rosengitter Tubing Schedule

Nr.		Vorgangsname	% geschlossen	Dauer	Anfang 2004	Ende	Vorgänger	Ressourcenna
20		<b>Gas Tubeing Tower&lt;=&gt; Manifolds</b>	<b>0%</b>	<b>1 Tag?</b>	<b>Fre 26.11.04</b>	<b>Fre 26.11.04</b>		<b>MIT/CERN</b>
21		Order Material	0%	1 Tag?	Fre 26.11.04	Fre 26.11.04		
22		Soldering double O-connectors on on	0%	1 Tag?	Fre 26.11.04	Fre 26.11.04		
23		cleaning	0%	1 Tag?	Fre 26.11.04	Fre 26.11.04		
24		ship to Aachen	0%	1 Tag?	Fre 26.11.04	Fre 26.11.04		

# TRD Cables / Tubes

UG-Crate cable support design (Balcony)

Manifold-Control cable-lengths and FM procurement

UG-Crate to BOX-C/S routing / length / procurement

Gas-Manifold at M-Corner Bracket / Tubing through MLI

# Manifolds / UGPS

4 EM Manifolds with prototype patch-panel for Aachen until Oct.TIM

EM Manifold Tests Nov.05

O-Ring Flipper-Valve mounting prototype test in Aachen

2 EM Manifolds to Rome in Nov.05 for Test-Setup

QM Manifold Space Qualification Test-Sequence

Patch-Panel (blue board) flight design

UGPS Space-Qualification ( variable resistors -> fixed )

FM Manifolds production - Mar.06

FM Manifolds flight-qualification Apr.06 with UGFV  
Manifold Box-C side is Mission Critical TVT & Vibr.Test-Sequence

FM Manifold Octagon Installation May.06

# Manifold Control with UGSCM

Flipper Valve Operation

dP Sensor Monitoring

Flow-Restrictor / UGPS PreAmp calibration

Leak Detection Scheme

# DALLAS Ports on UGSCM

Box-C/S DALLAS Sensors (44) connected to port 8 via Backplane

Octagon DALLAS chains connected to front panel

# Box-C/S Operation

SETUP: QM Box-S (1% Ar+CO<sub>2</sub> Stor.Vess, Dummy TRD) QM-Box-C QM-UGBP  
Circulation Flow of 41 l/h with P, T and Flow Monitoring

SETUP: Spirometer and Gasgain Monitor tubes (available and working QM+FM )  
Gas Mixing and Refreshment

SETUP: Inlet/Outlet Manifold, TRD Module Stack (SQjig+EM-UFE in Nov.05)  
Correlate with <sup>55</sup>Fe gain measurements  
Study Leak-Detection in circulating system

# USCM / JMDC Programming

TRD Status Monitoring (which Sensors, how often):

Box-C/S P,T Sensors

Gasgain Monitor Tubes

Spirometer

Manifold dP Sensors

Octagon DALLAS Chains

UFE Signal Subsample (DSP histogram option)

Slowrate Datalink Fraction for TRD

Integration into AMS slow control Database

Standard Command Sequences

Alarm Actions: Box-S/C Problems, TRD Leaks, ... ?  
JMDC Action ?

# Availability of Hardware

QM Manifolds

Oct.05 from Cern to Aachen

TRD Modules  
with UDR Readout

Nov.05 from Aachen to Rome

Manifold Control  
UG-Crate BackPlane with UGFV Card

FM Manifolds  
with Flight Manifold Control Cables

Box-C EM + FM (+ QM ?)  
with UG-Crate Control  
and HV for Gasgain Monitor Tubes

Box-S E/QM + FM  
with UG-Crate Control