

TRD Meeting

Statusreport

TRD Straw-Modules



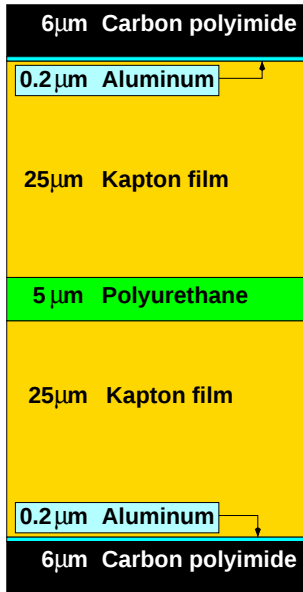
Th. Kirn
I. Phys. Institute B

RWTH
Physics AC-I

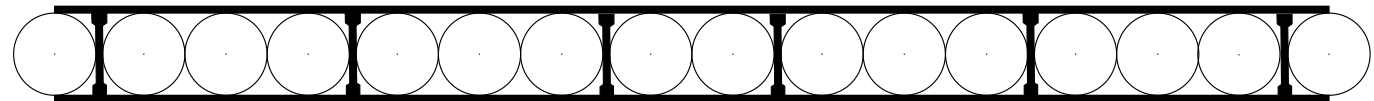
CERN, 16th July 2002

(Once upon a time:) A Straw-Module

Straw-Wall:



Module: 16 Straws at $\varnothing$ 6 mm
30 μ m W-Au wire (tension weight 100 g)
Xe/CO₂ (80/20)
(p = 1250 mbar, flow = 1 l/h)

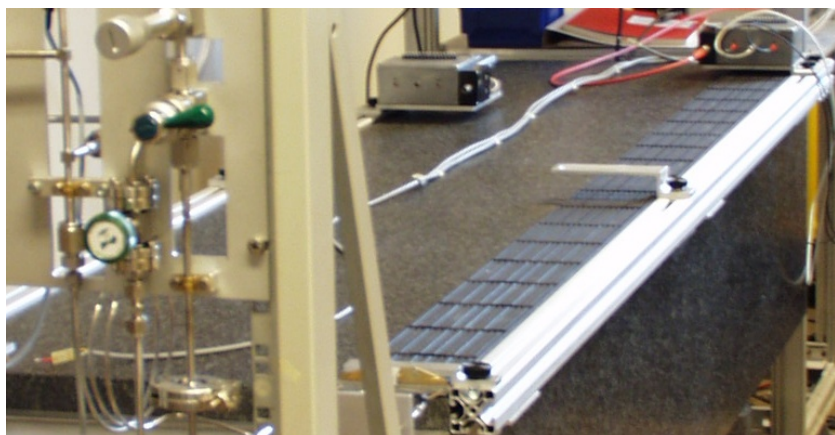
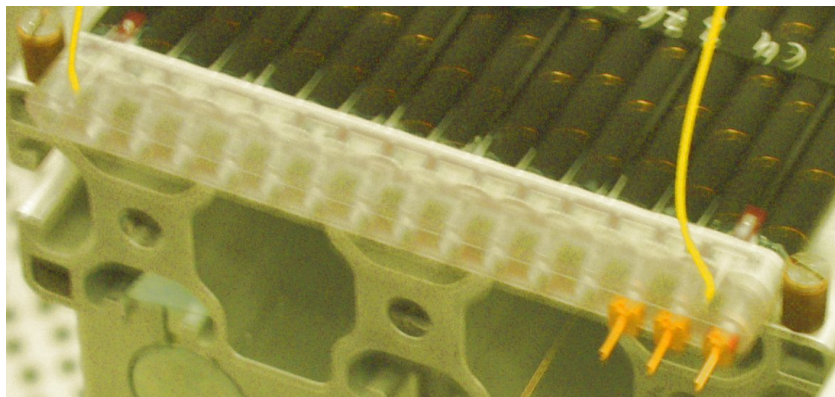


6 longitudinal stiffeners

Strips across every 10 cm



Straw Module Production and Quality Control



Chamberbody glueing at FVT Company
Endpieces O₂ plasma treated at TC-Kleben

At RWTH:

Endpiece glueing

Wire stringing and crimping

HV board mounting / final potting

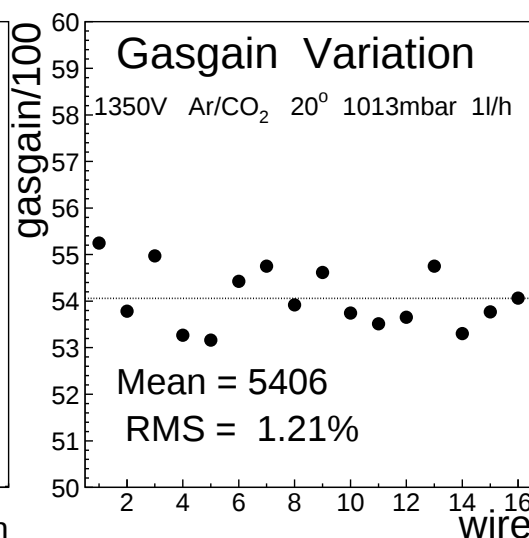
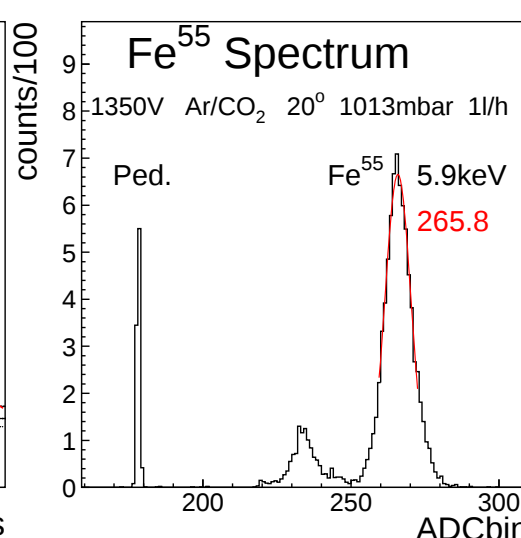
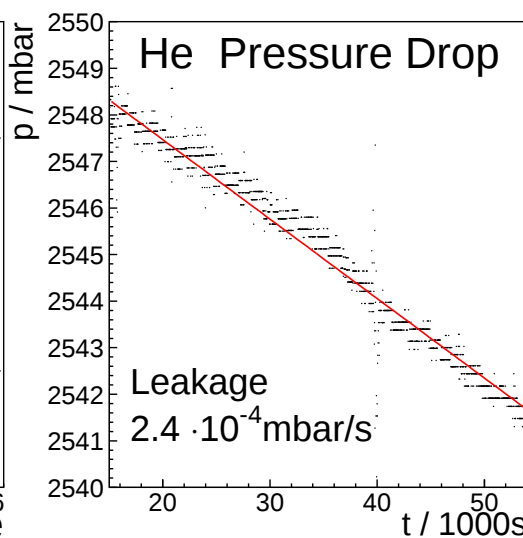
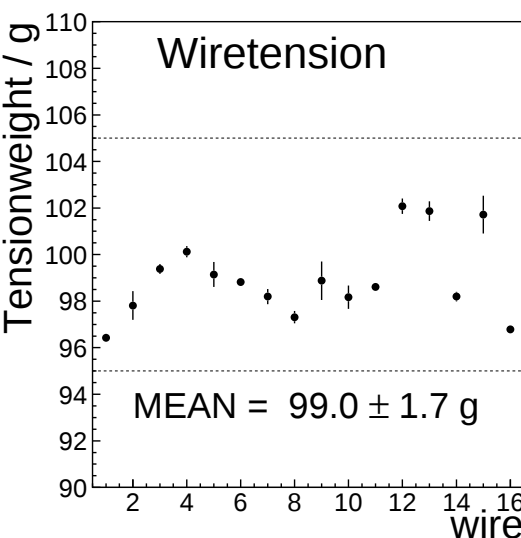
Wiretension measurement 100 ± 5 g

Pressure burst test $\Delta P = 2.5$ bar

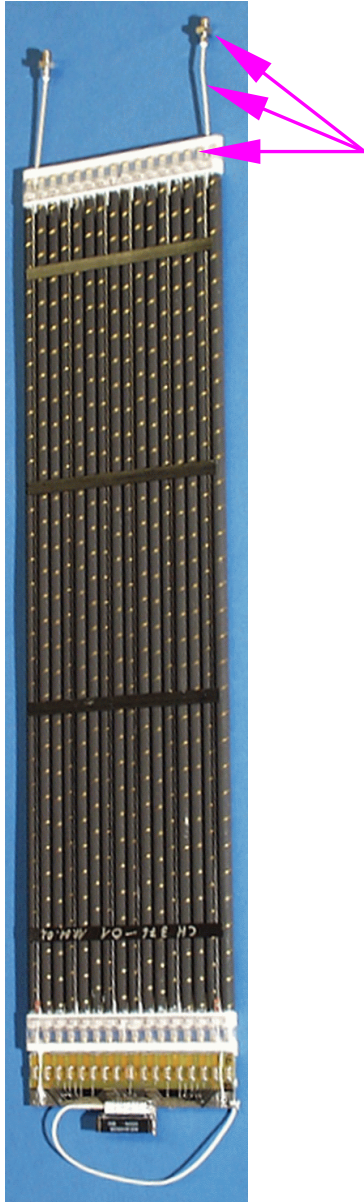
Gastightness (He) $< 3 \cdot 10^{-4}$ mbar/s

Leakage currents < 1 nA

Gasgain precalibration with Ar/CO₂



Straw Module Production Problem History I



- Bad adhesive joint between Polycarbonate Endpiece, PEEK tube and gas connector

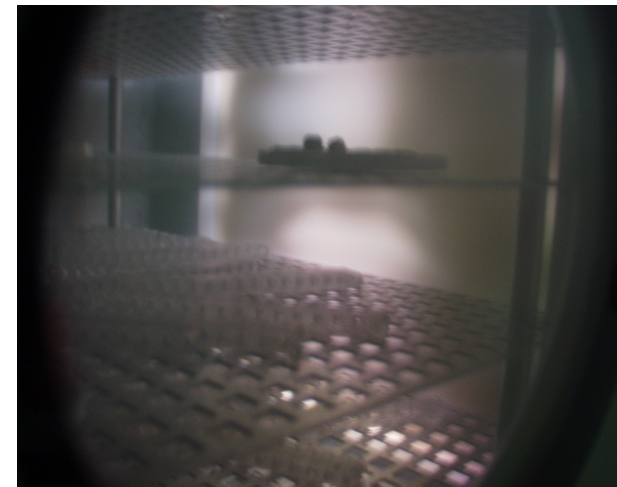


Solution:

Institute für Klebtechnik RWTH Aachen + Fa. TC-Kleben:

O_2 -low-pressure-plasma-surface treatment

⇒ Increase of surface-tension ($45 \text{ mN/m} \rightarrow 60\text{-}65 \text{ mN/m}$)



Space Qualification I

4 Straw Modules:

L=376; 400; 424; 448mm

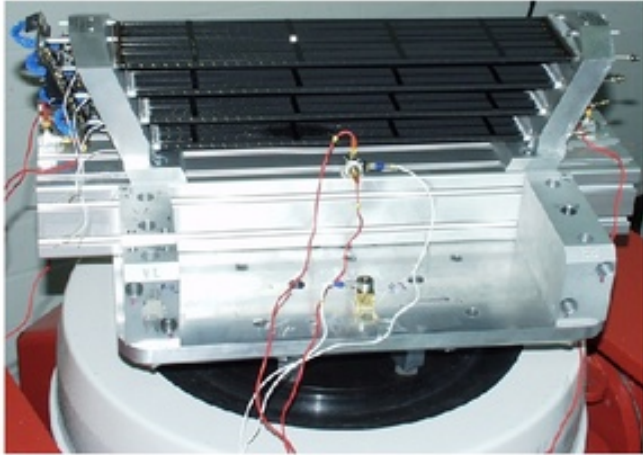
- **Module 376 - 424:**
Glue: Araldit AW134
- **Module 448:**
Glue: EPO-TEK 353ND
- **Module 376:** Straw defect
repaired with EPO-TEK 353ND

Test programm:

- Eigenfrequencies, leak rate, gas gain
- Vibration test I
- Eigenfrequencies, leak rate, gas gain
- Thermo vacuum test
- Eigenfrequencies, leak rate, gas gain
- Vibration test II
- Eigenfrequencies, leak rate, gas gain

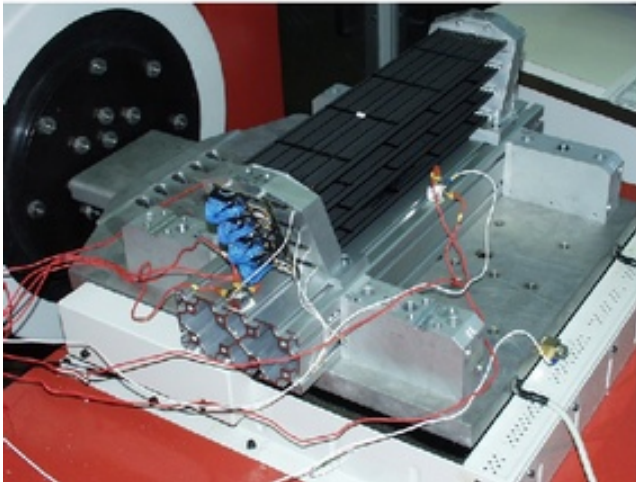
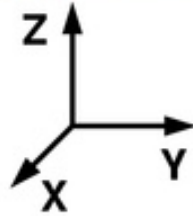


Vibration Test

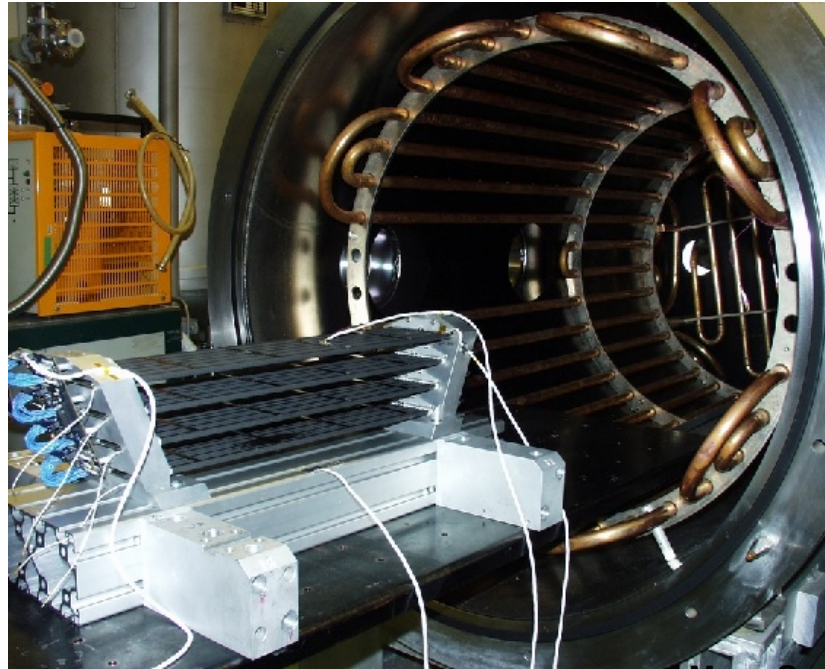


Vibration-Test-Cycle:

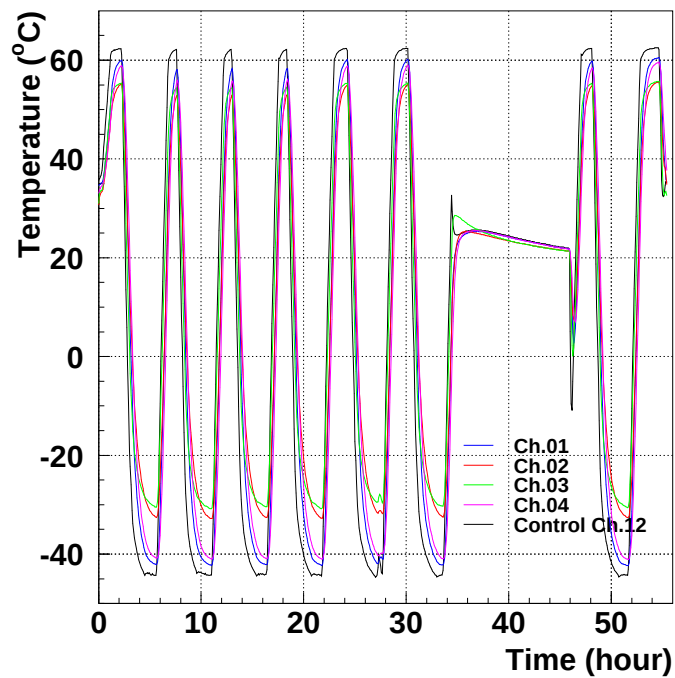
- Sine Sweep 0.5g (10-2000Hz)
- Random Spectrum $a_{\text{RMS}} = 6.8\text{g}$
- Sine Sweep 0.5g (10-2000Hz)



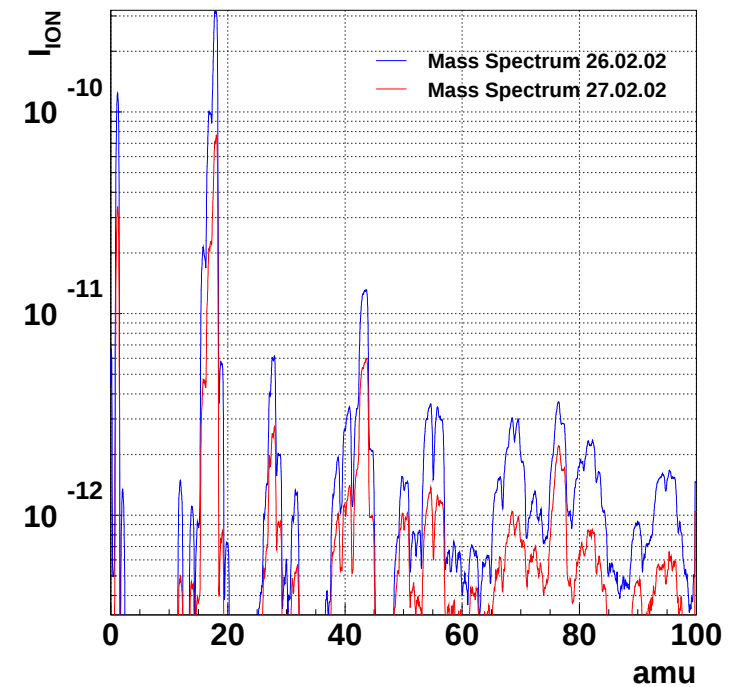
Thermo Vacuum Test @ MPE-Garching



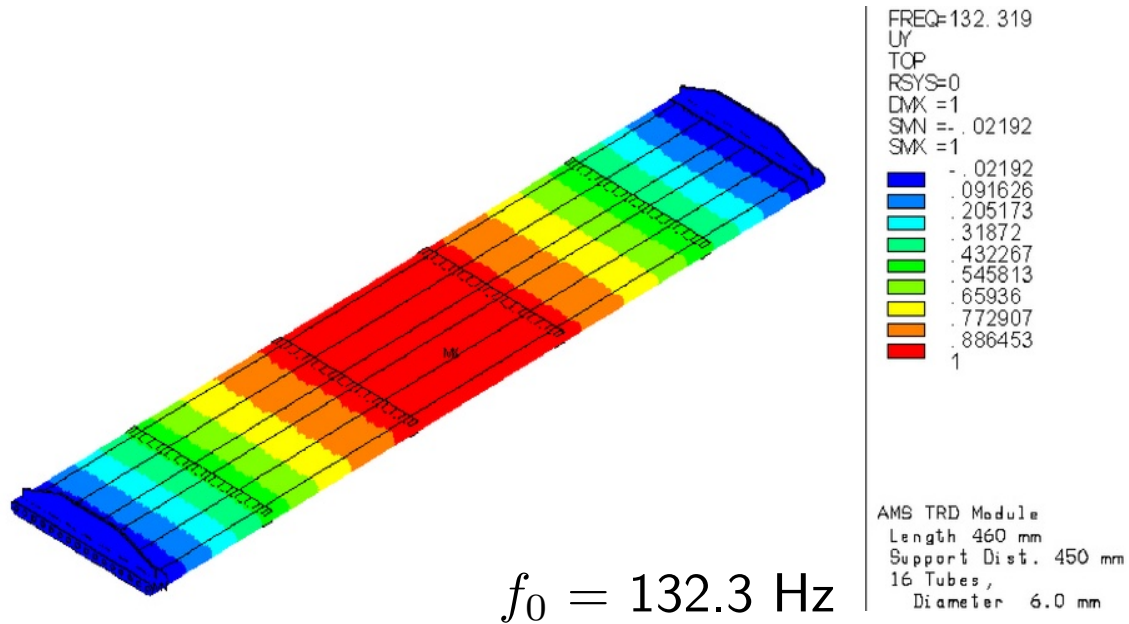
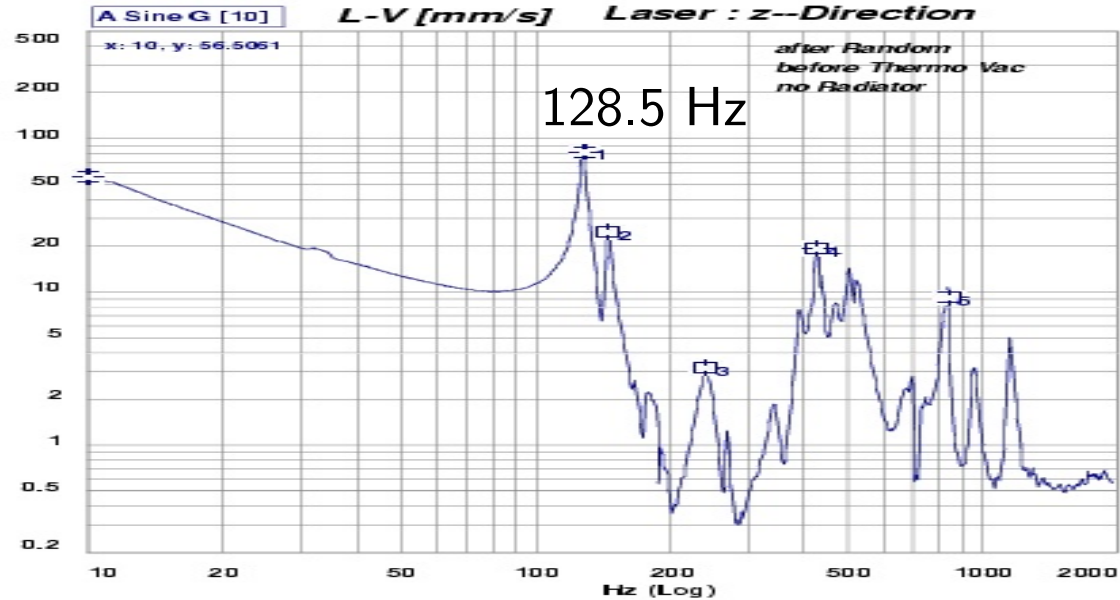
Thermovacuum-Test Start 25.02.2002 10:37:11



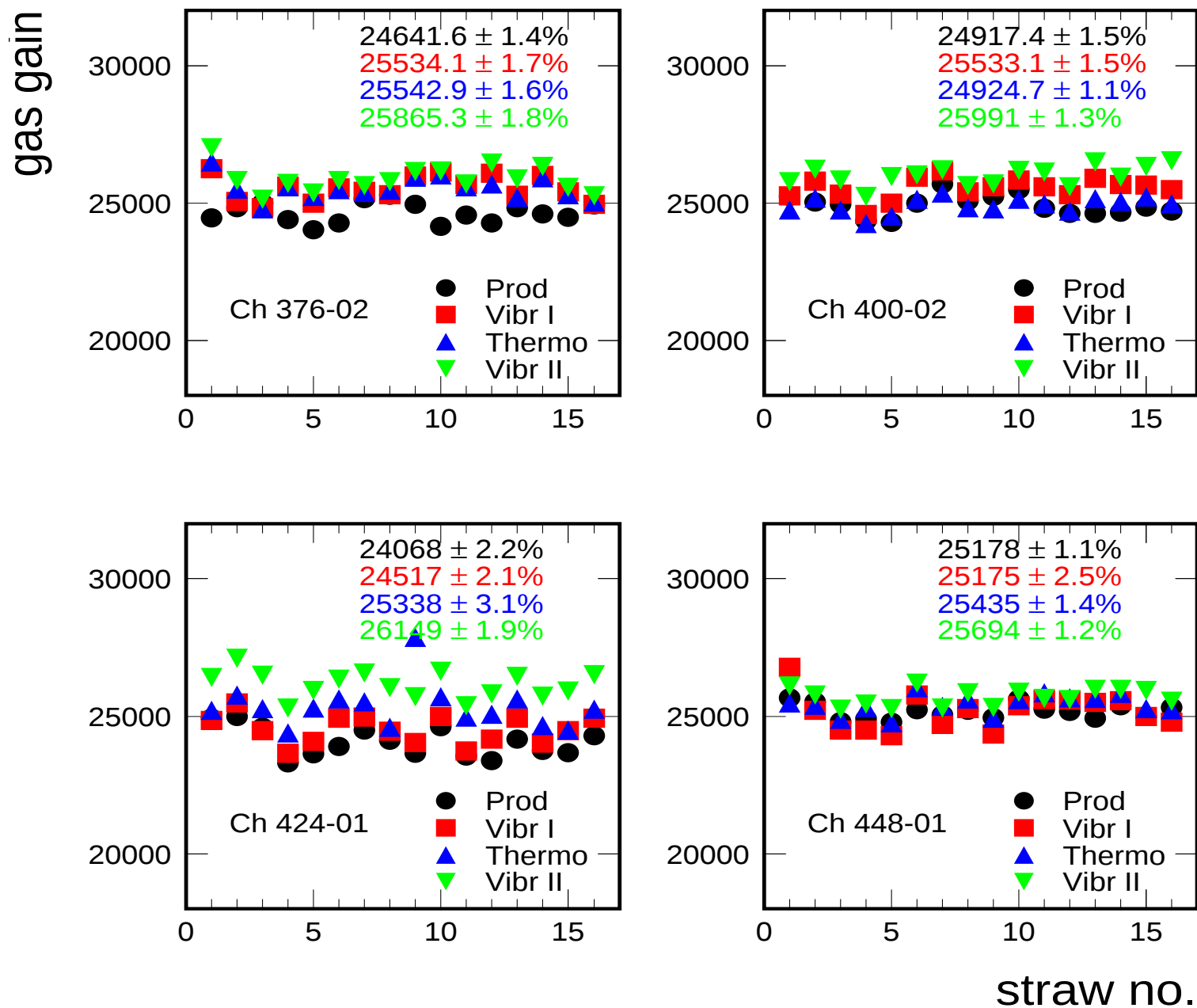
Mass-Spectrum 2 cycles at 60°C



Eigenfrequencies - No Changes



Gasgain (Ar/CO₂) - No Changes



Gastightness - Leak Rate

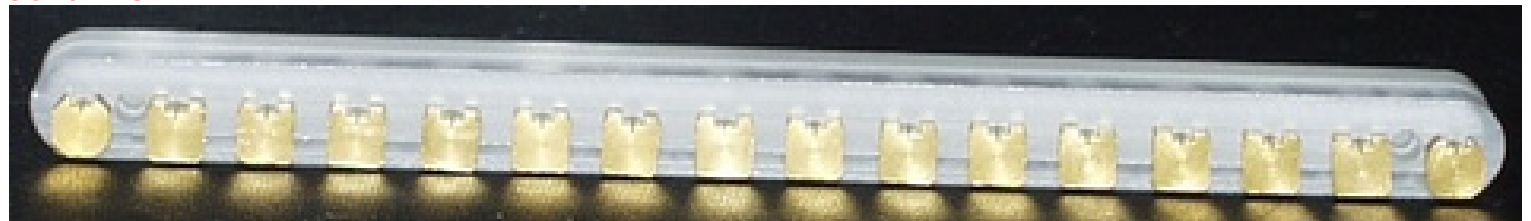
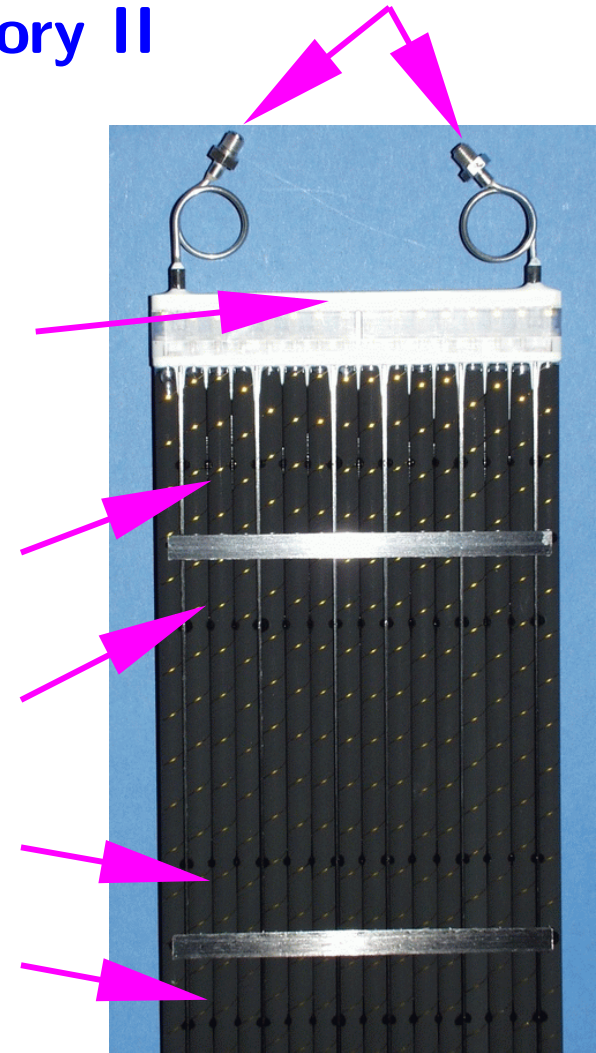
Module	Production	Vibration I	Thermo Vacuum	Vibration II
Straw Length L [mm]	Leak Rate q (He) [$\cdot 10^{-4} \frac{\text{mbar}}{\text{s}}$]	Leak Rate q (He) [$\cdot 10^{-4} \frac{\text{mbar}}{\text{s}}$]	Leak Rate q (He) [$\cdot 10^{-4} \frac{\text{mbar}}{\text{s}}$]	Leak Rate q (He) [$\cdot 10^{-4} \frac{\text{mbar}}{\text{s}}$]
448	2.2	2.7	39.6	20.0
424	1.8	3.1	3.8	3.8
400	1.9	2.8	2.4	2.6
376	1.7	12.1	2.0	11.9

- **Module 448mm:**
sealing with EPO-TEK 353ND broken
⇒ EPO-TEK 353ND not useful for straw modules!
- **Module 376mm:**
(repaired straws) sealing with EPO-TEK 353ND broken
sealing PEEK-Polycarbonate leaky
⇒ PEEK-tube replaced by stainless steel-tubes
+ PC-adapter ⇒



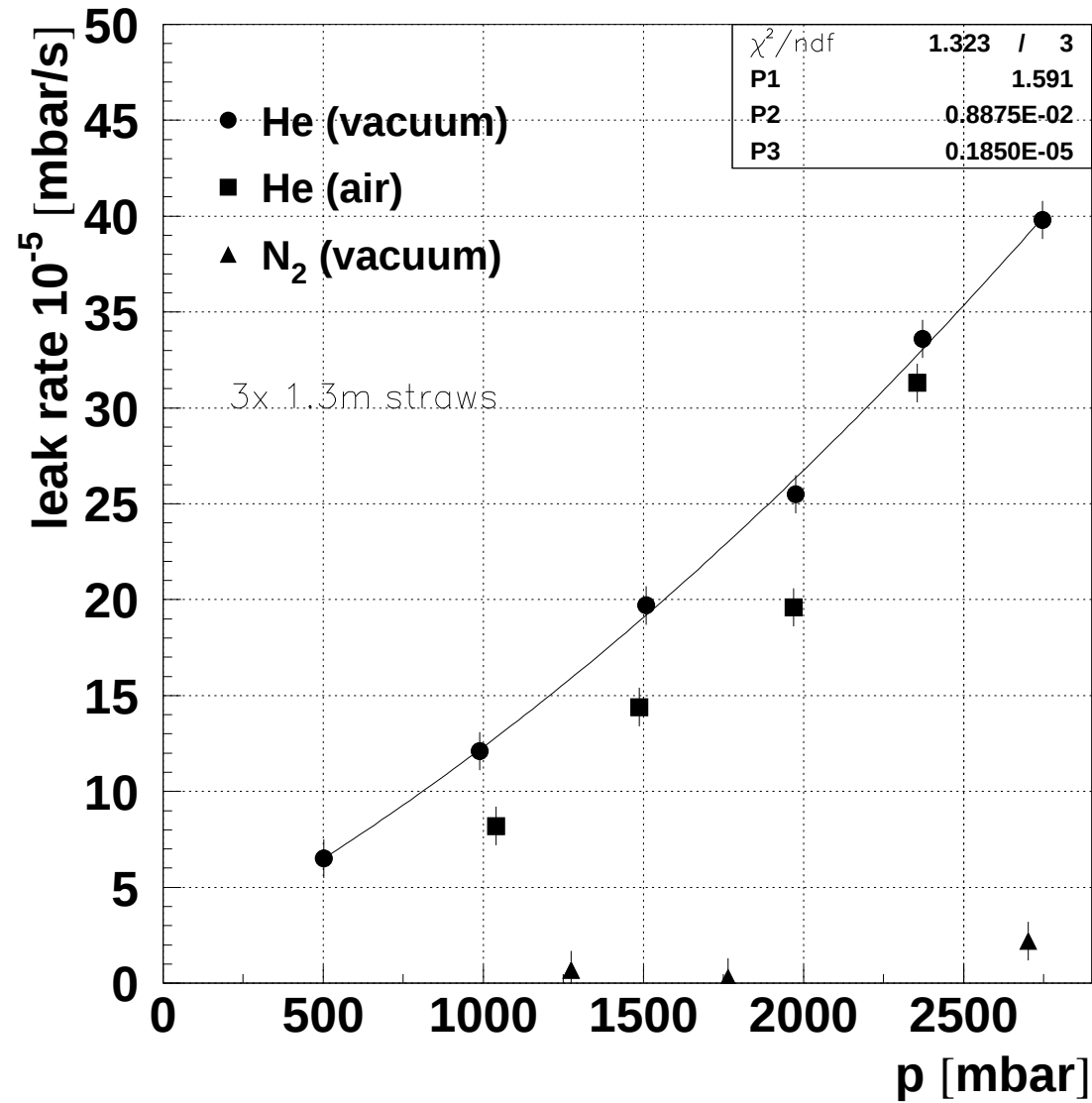
Straw Module Production Problem History II

- 8 Longterm Straw Modules $L=1549$ mm,
 $(q \approx 2 \cdot 10^{-4} \frac{\text{mbar}}{\text{s}} \text{ (He)})$
 - Leaky gas connectors
- 4 Space Qualification Straw Modules
 $L=1258, 1282, 1306, 1330$ mm
 $(q \approx 2 - 5 \cdot 10^{-4} \frac{\text{mbar}}{\text{s}} \text{ (He)})$
 - Leaky gas connectors
 - Leaks at underside of endpieces
 - Leaks along straws
- 3 TRD Flight Straw Modules
 $L=1540, 1564, 1588$ mm
 $(q \approx 1 \cdot 10^{-4} \frac{\text{mbar}}{\text{s}} \text{ (He)} < \text{diffusion rate})$
 - Leaky gas connectors
 - Leaks at underside of endpieces
 - Leaks along straws



Pretests

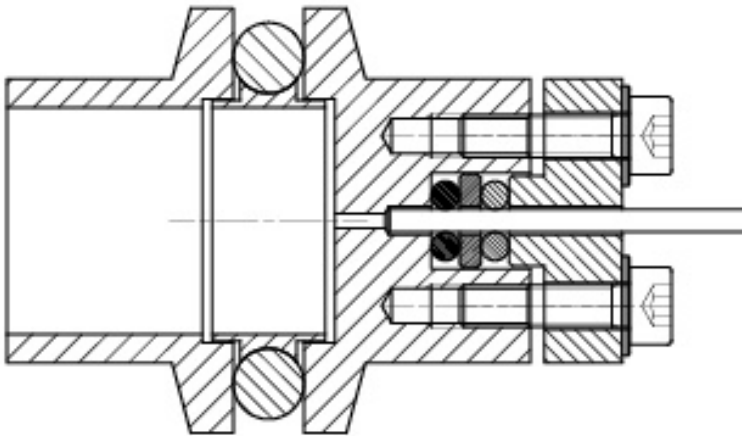
Leak Rate of Straws (He/N₂)



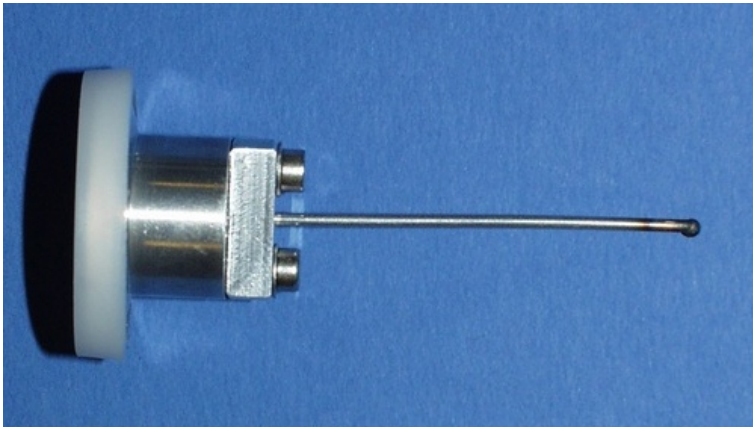
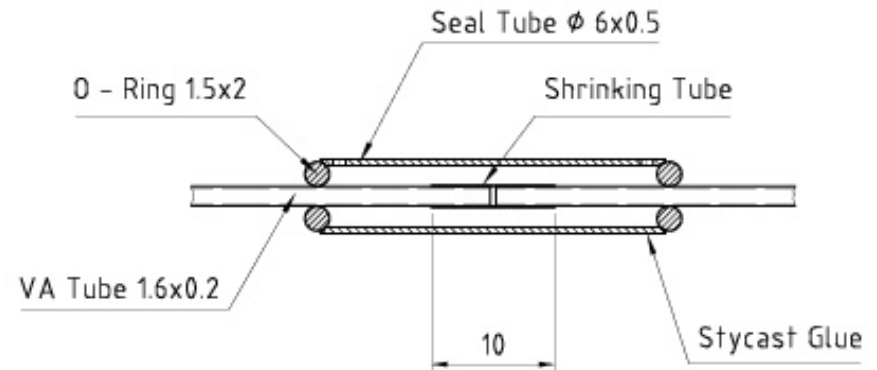
- Leak rate of 3×1.3 m Straws

Pretests

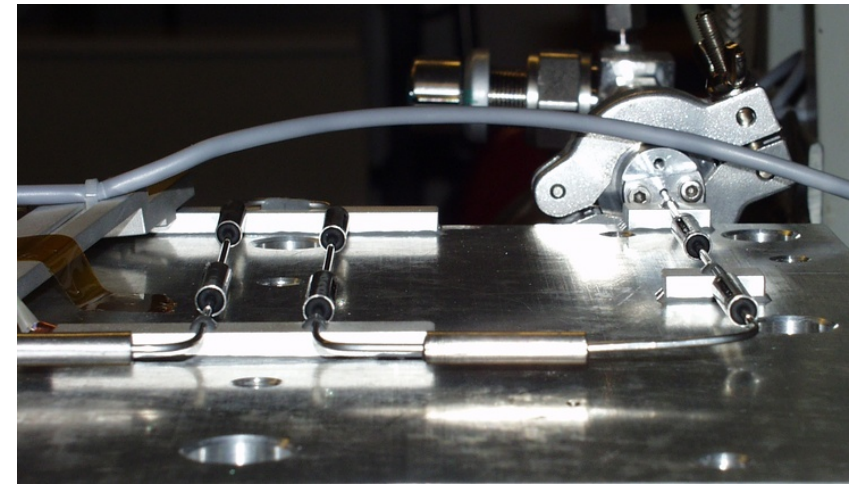
- Leaky gas connectors
- Dobbel-O-Ring connector



Stainless Steel Tube Fitting



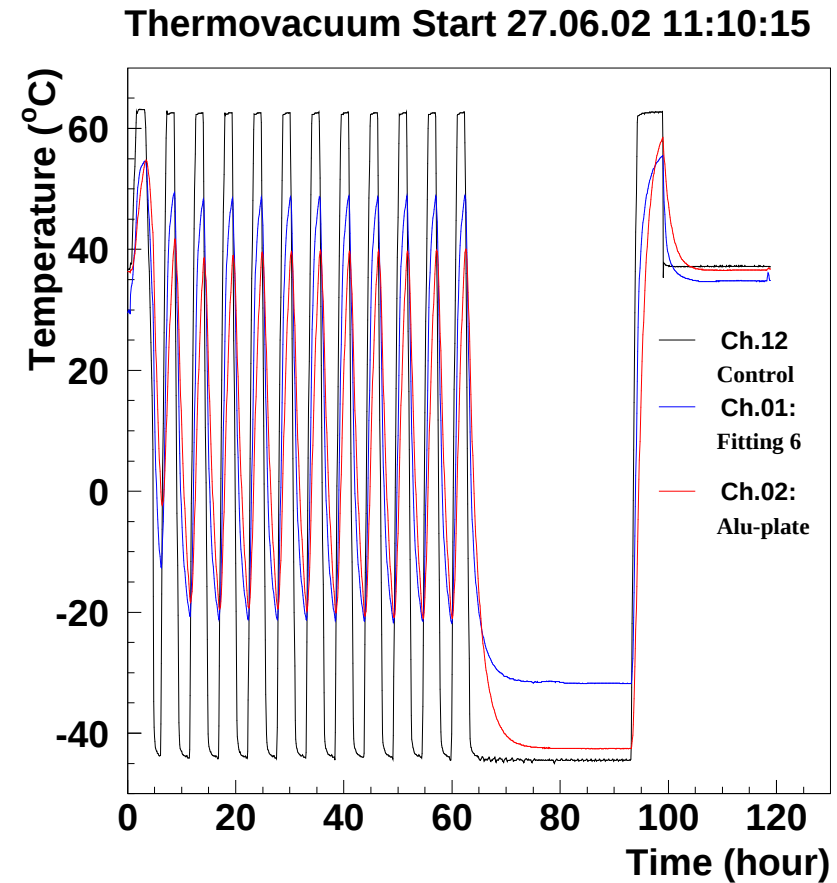
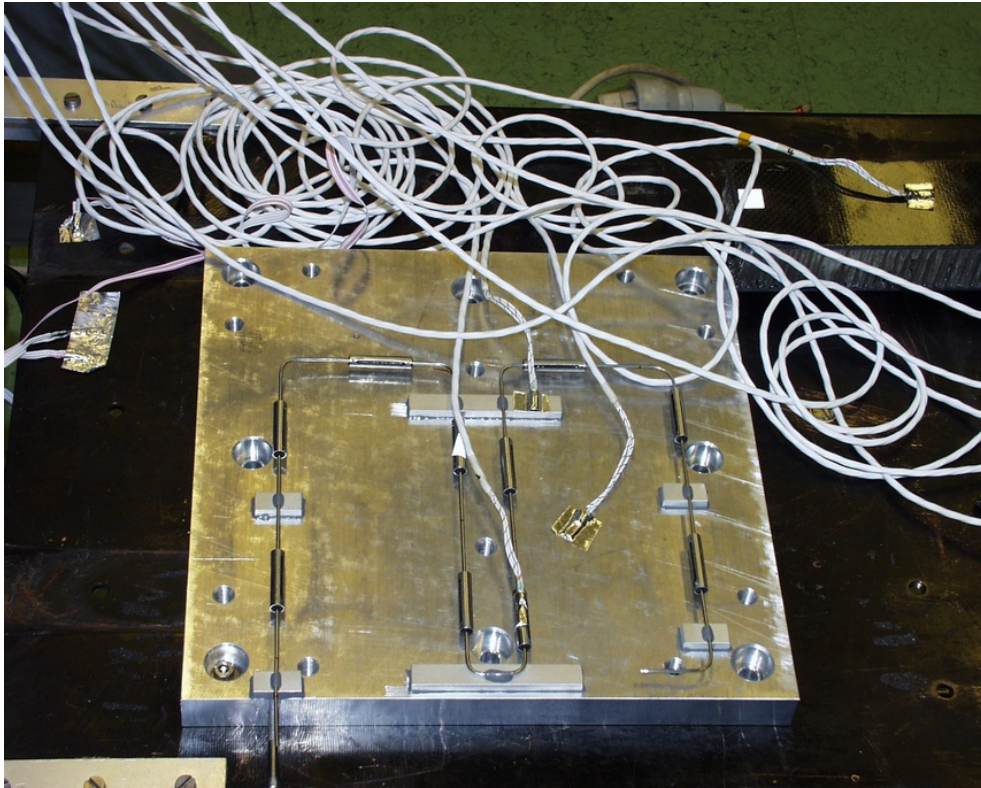
Leak rate: $q = 1 \cdot 10^{-6} \frac{l \cdot mbar}{s}$ (He)



Leak rate: $q = 1 \cdot 10^{-6} \frac{l \cdot mbar}{s}$ (He)

Pretests

Vibration Test I + Thermo Vacuum Test + Vibration Test II

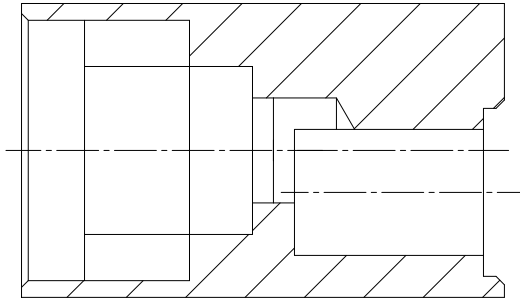


Leak rate before + after: $q = 1 \cdot 10^{-6} \frac{l \cdot mbar}{s}$ (He) $\Rightarrow$ Test with Straw Modules

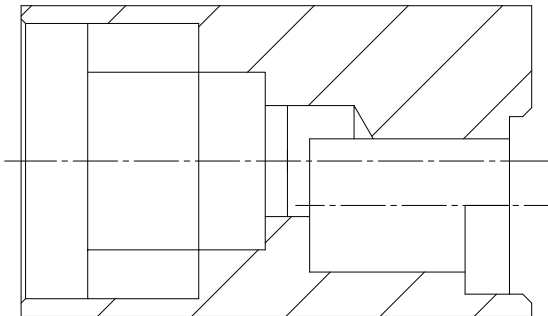
Pretests

- Leaks at underside of endpiece

Old Design:



New Design:

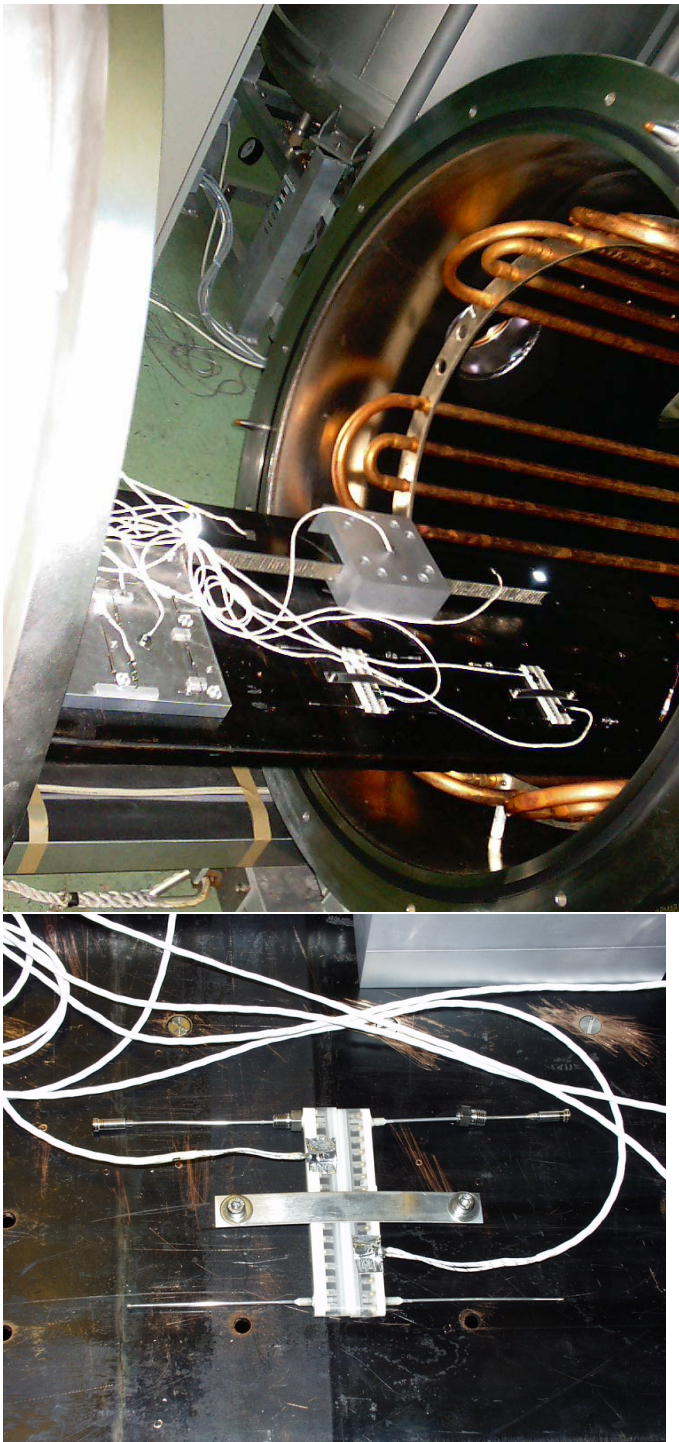


Leak rate: $q = 3 \cdot 10^{-5} \frac{l \cdot mbar}{s}$ (He)
Space qualified? $\Rightarrow$ Thermo Vacuum Test

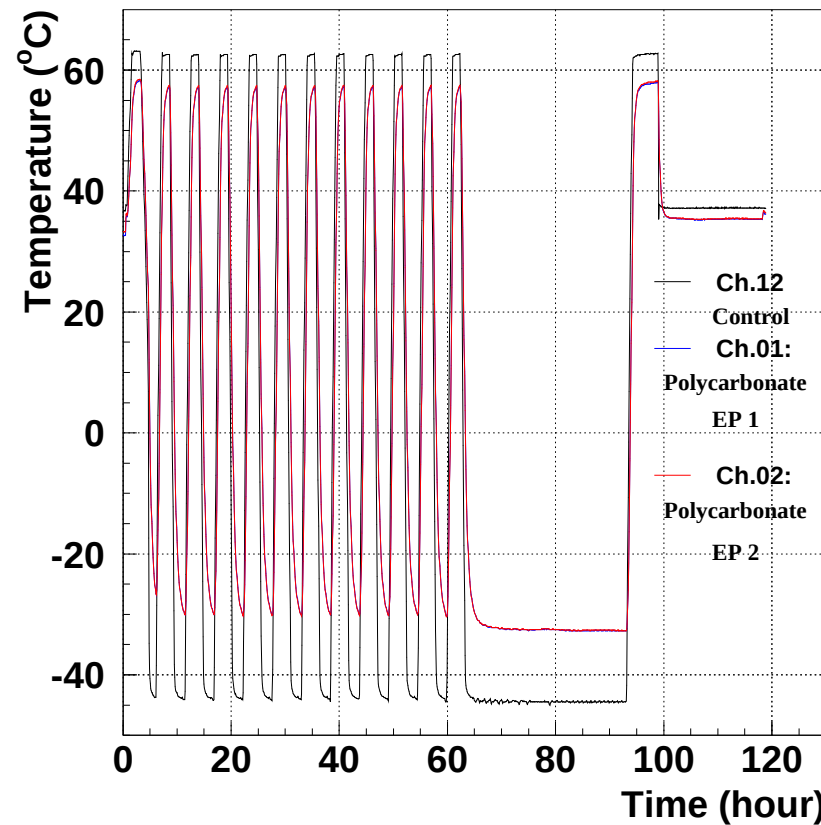


Pretests

Thermo Vacuum Test



Thermovacuum Start 27.06.02 11:10:15

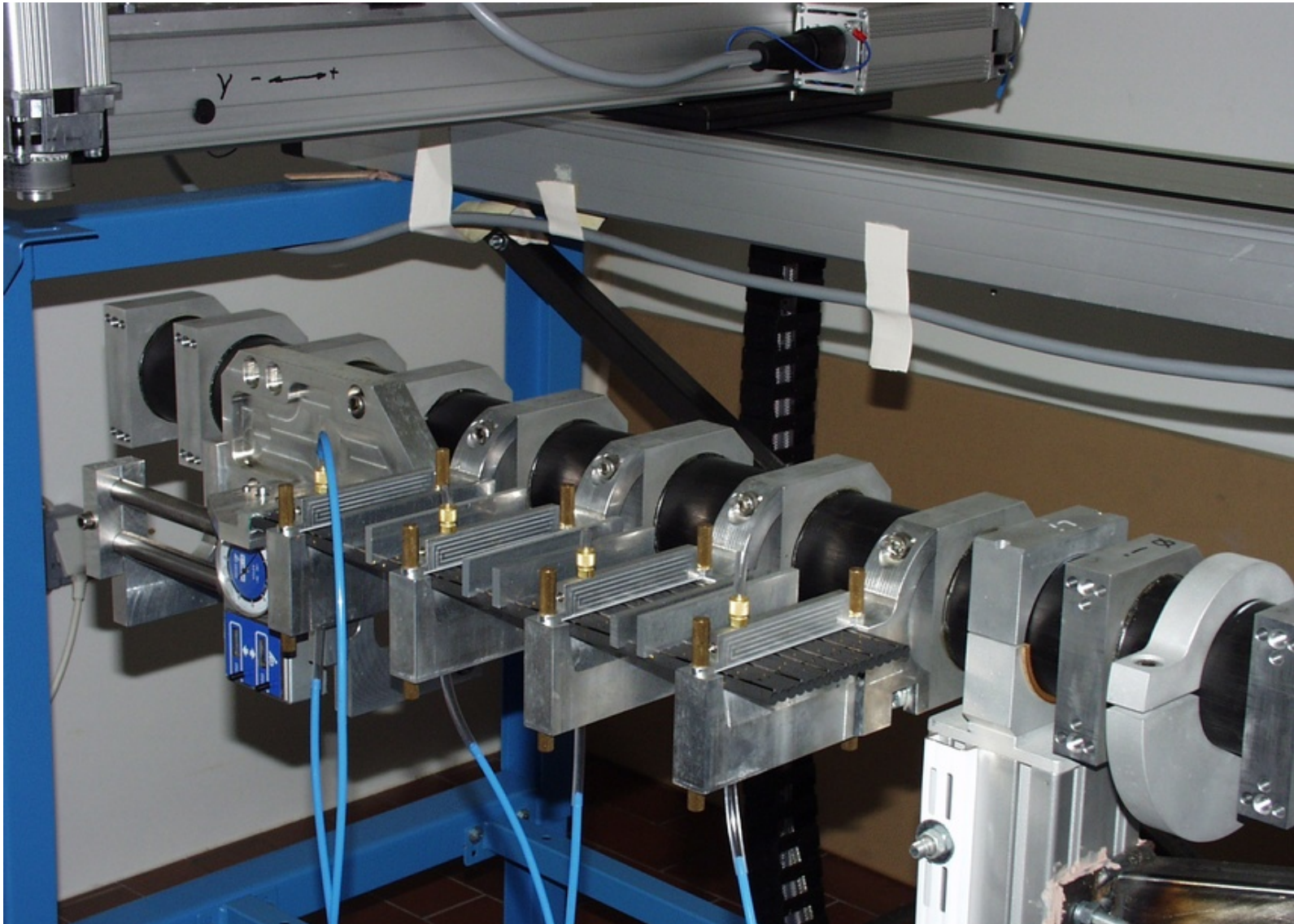


Leak rate before + after: $q = 3 \cdot 10^{-5} \frac{l \cdot mbar}{s}$

⇒ Test Straw Module

Pretests

- Leaks along straws @ glueing points $\Rightarrow$ burr removal $\Leftarrow$ If not?



Time Schedule

- Pretests 24.06.02 → 17.07.02
 - Test 3×1.3 m Straws (Leak Tests He/N₂ vs Air/Vac) → 17.07.02
 - Tube Fittings, DO-Ring Fittings ✓
 - Endpieces AW 134 ✓
 - AW 134 Test-Strips @ 30°, 40°, 50°, 60° (Youngs Modulus) ✓
 - Reparation of Straw Defects (Stycast ?)
- Space Qualification Test 400 mm Modules 26.06.02 → 01.10.02
 - Production of Modules 376, 400, 424, 448 ✓
 - Testmeasurements
 - Vibration Test I + Testmeasurements
 - Thermo Vacuum Test + Testmeasurements
 - Vibration Test II + Testmeasurements
- Longterm Test (Xe/CO₂) 4 × 1549 mm Modules 02.07.02 → 10.10.02
 - Straw Module Body Glueing @ FVT ✓
 - Production + Testmeasurements
 - Assembly Longterm Teststand
 - * Leak Rate, Mass Spectra, Gasgain Xe/CO₂

Time Schedule

- Longterm Recirculating Test MIT 11.10.02 → take off?
 - Mass Spectra, Gasgain Xe/CO₂
- EMI Test 01.07.02 → 30.07.02
 - Old Space Qualification Modules (L=1258, 1282, 1306, 1330 mm) ✓
 - Preparation Jigg ✓
 - EMI-Test @ CAE Electronics
- Production TRD Modules (328 +++) ?
 - Straw Module Body Glueing @ FVT (22/328)
 - Straw Module Production 01.10.02 ? → 01.10.03 ?