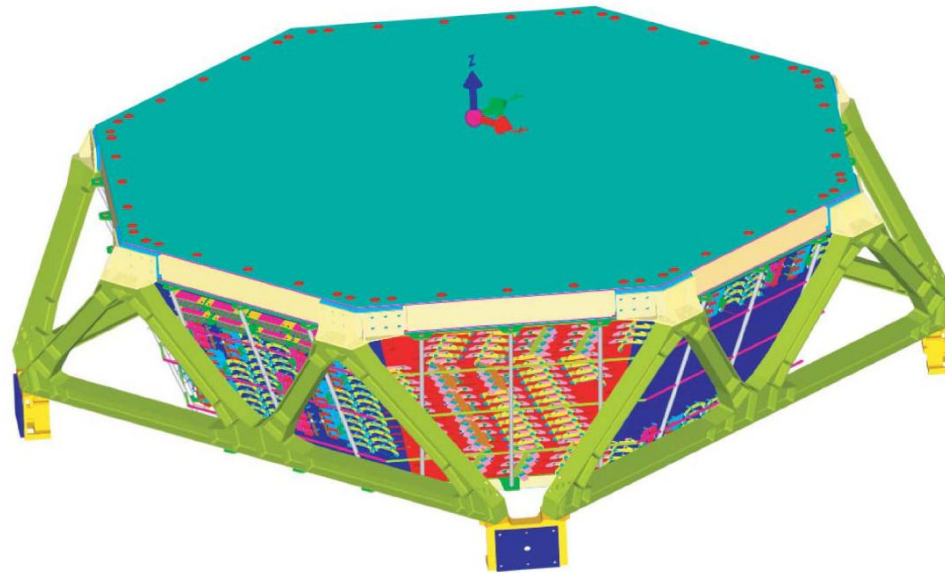


AMS TIM and General Meeting

Status of TRD Straw Module Production



Th. Kirn

C.H. Chung, F. Dömmecke, S. Fopp, K. Lübelmeyer, W. Karpinski, S. Schael,
G. Schwering, Th. Siedenburger, A. Schultz von Dratzig, M. Wlochal

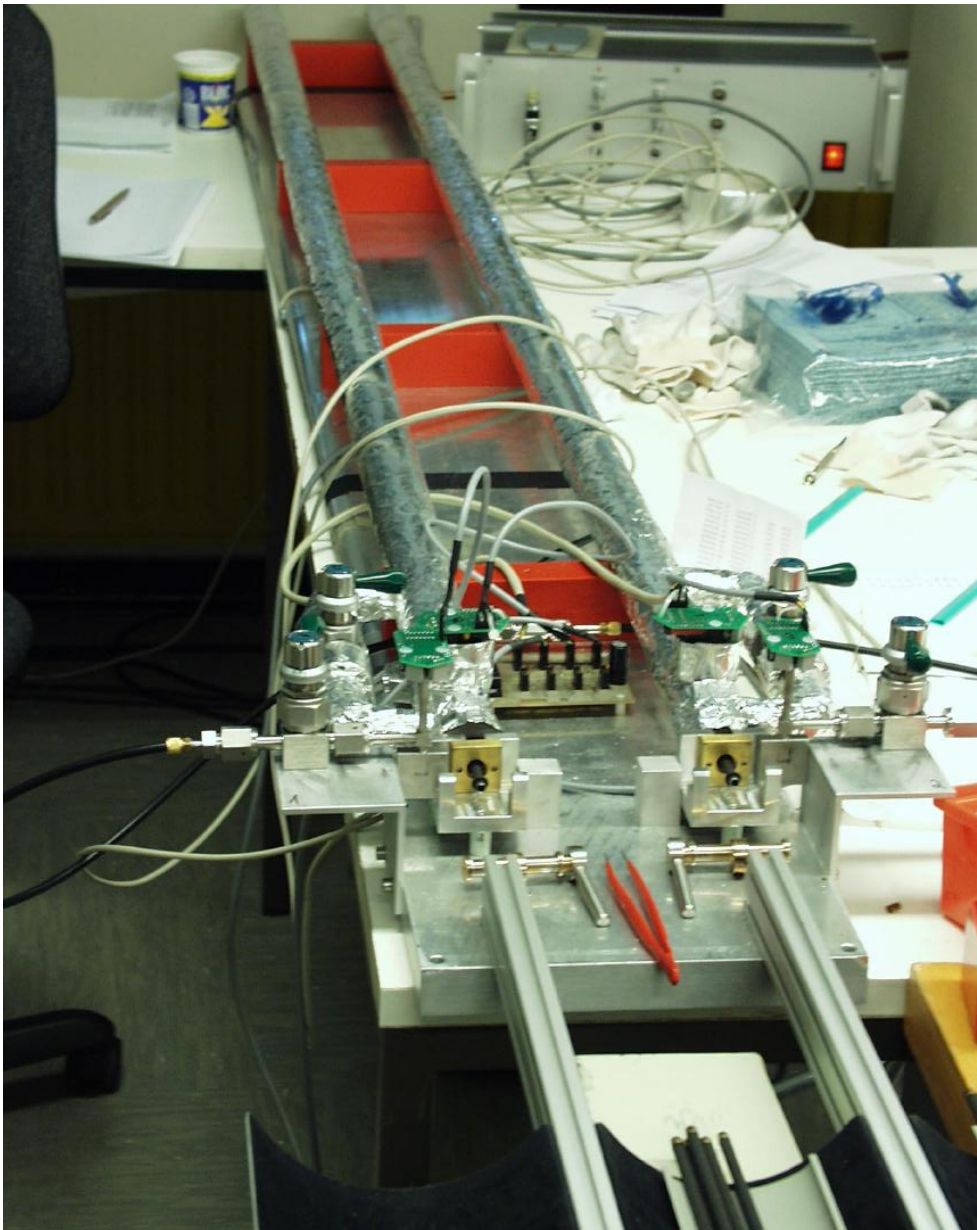
I. Phys. Institute B

RWTH
Physics AC-I

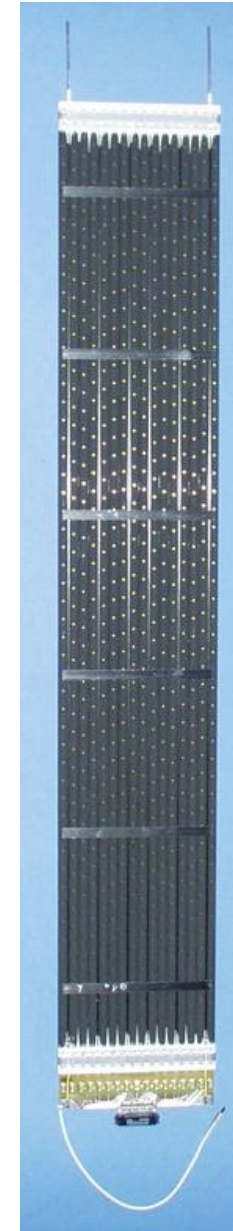
CERN, 19th January 2004

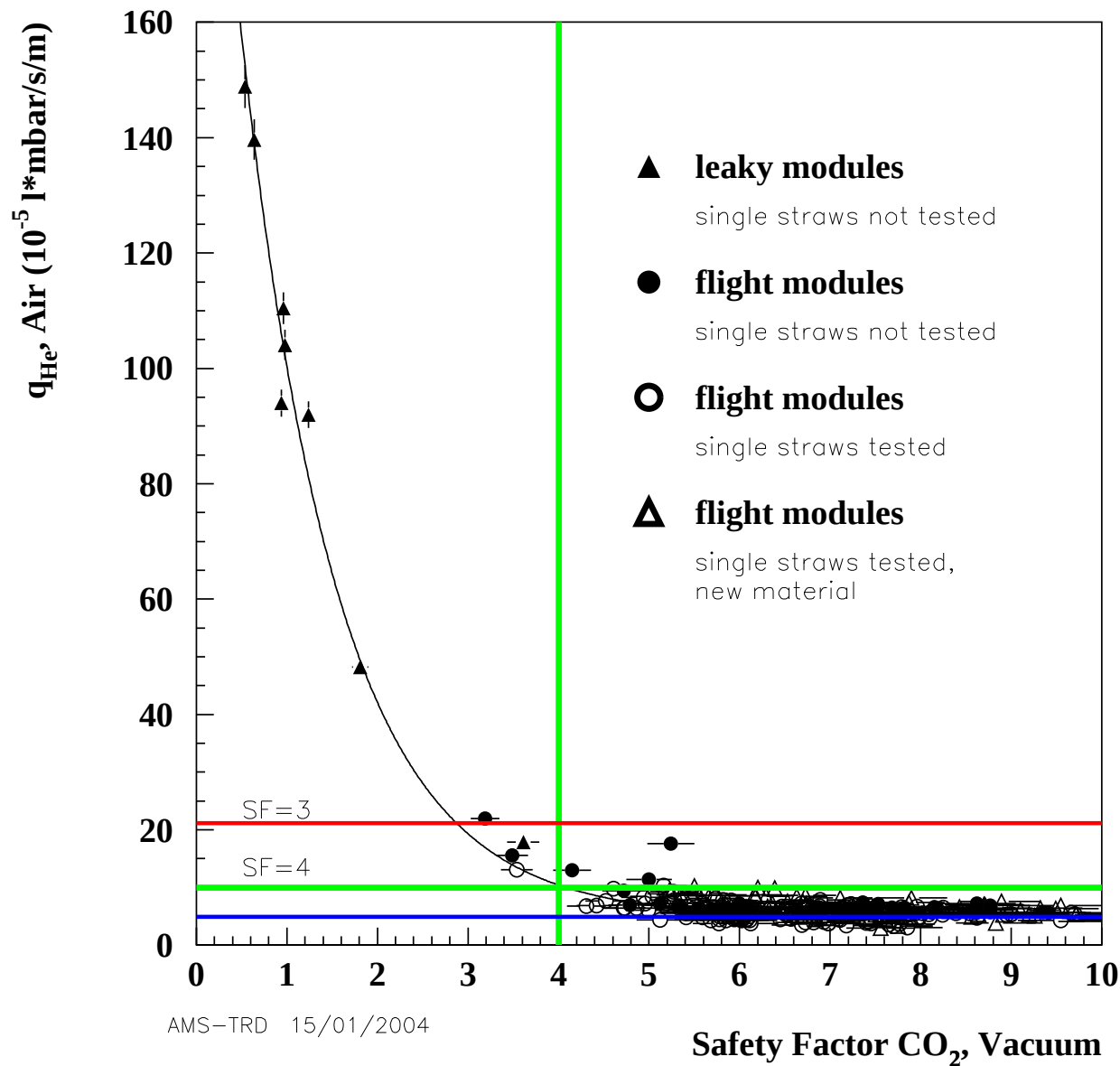
Status TRD Straw Module Production

1.) Single Straw Test



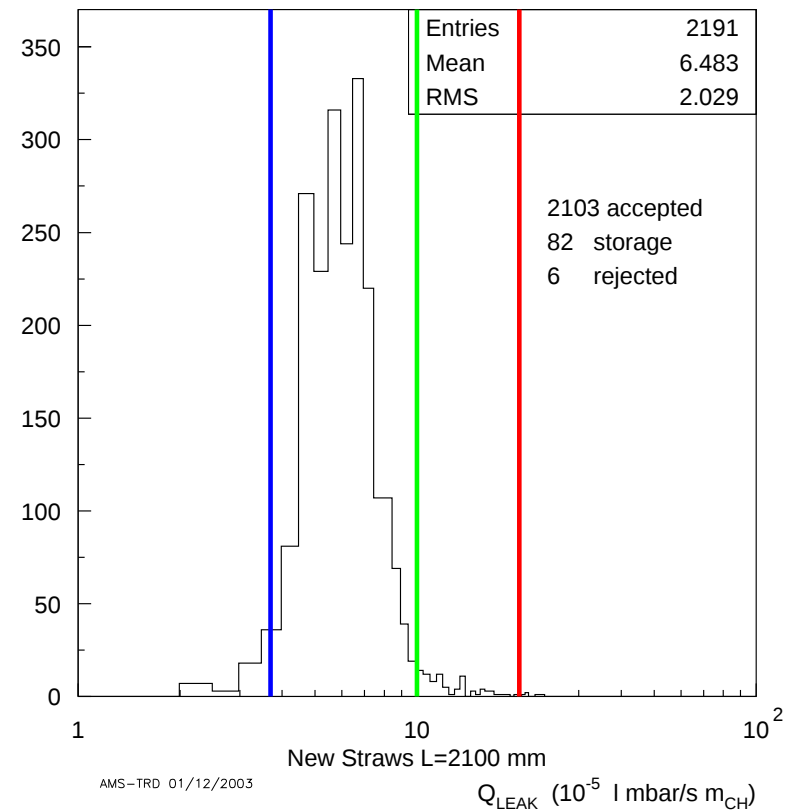
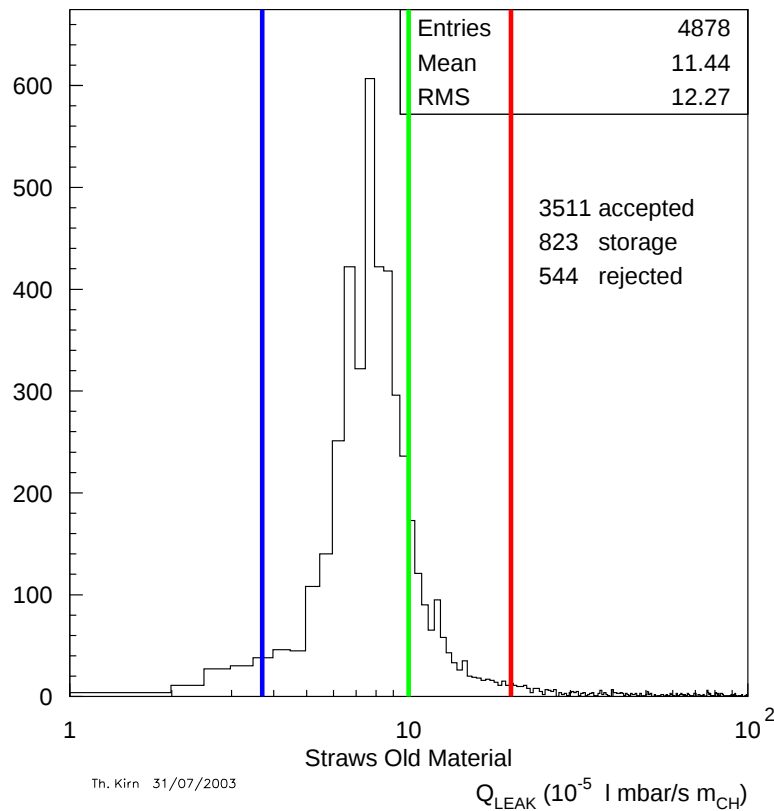
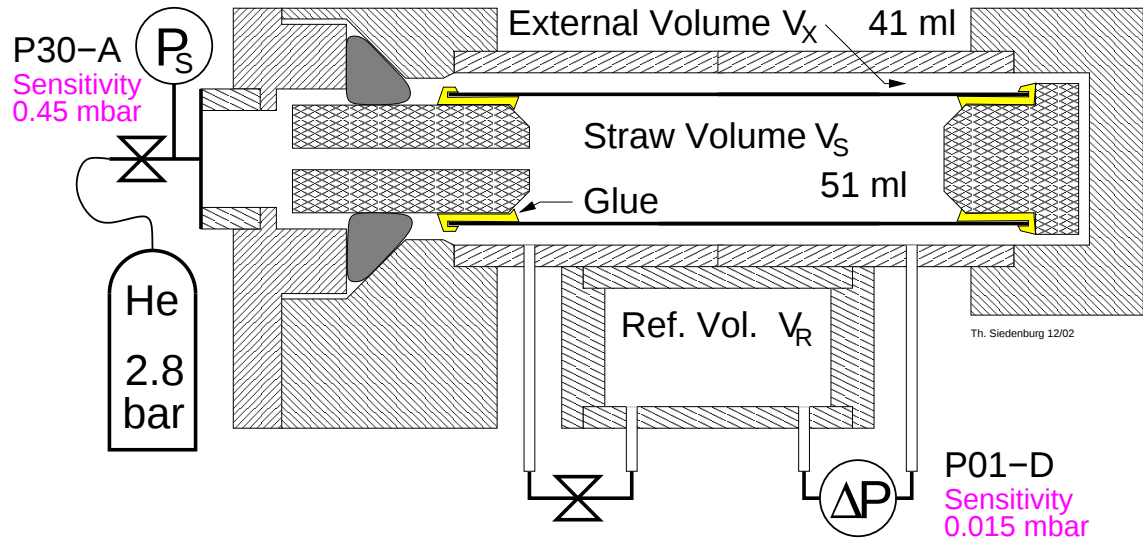
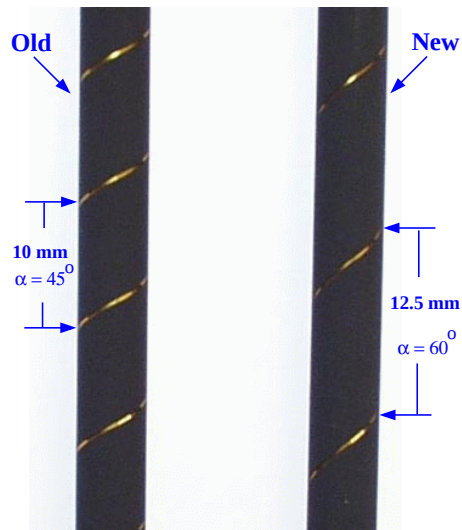
2.) Module Production





- Aim: Safety Factor of $> 4 \Leftrightarrow > 12$ years on ISS $\rightarrow$ He: $10 \cdot 10^{-5} \text{ l} \cdot \text{mbar/s/m}$
 $\Rightarrow$ Need to test each of 5248 straws

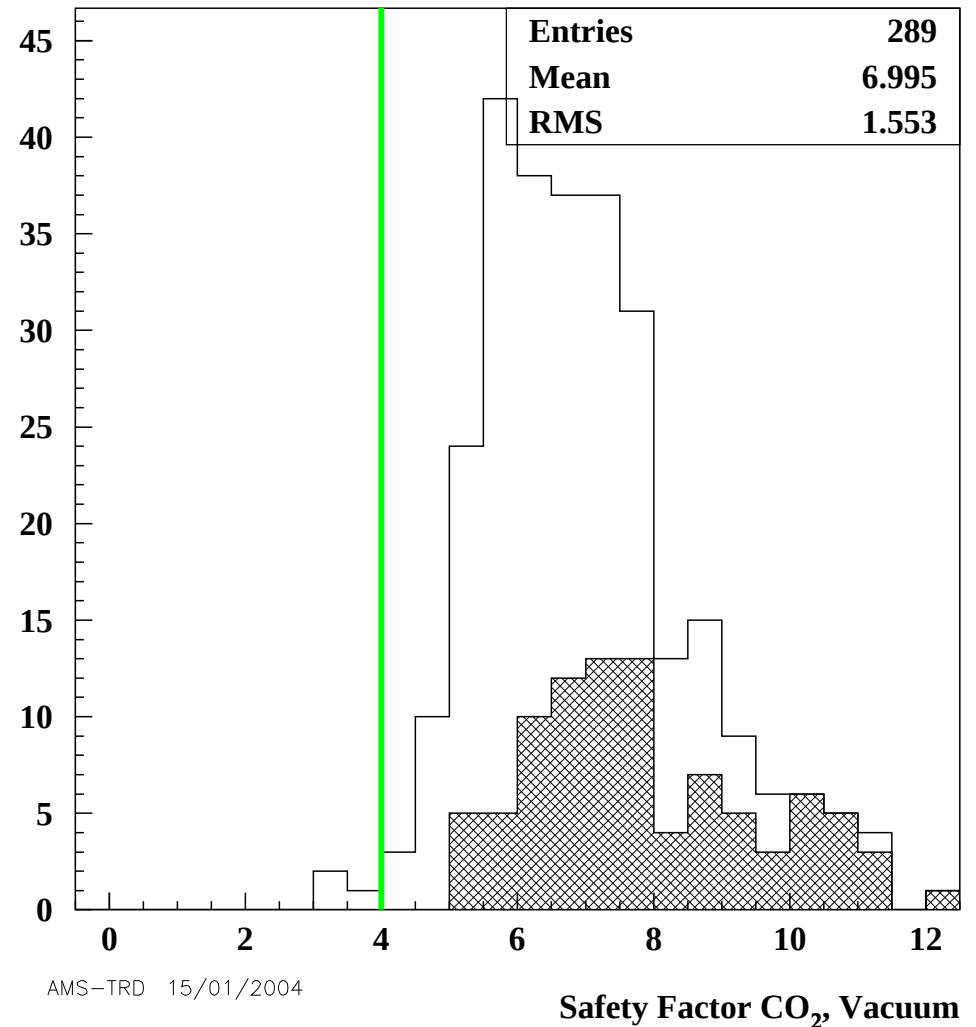
Single Straw Test: 16 Straws/Module $\times$ 328 Modules = 5248 Straws $\checkmark$



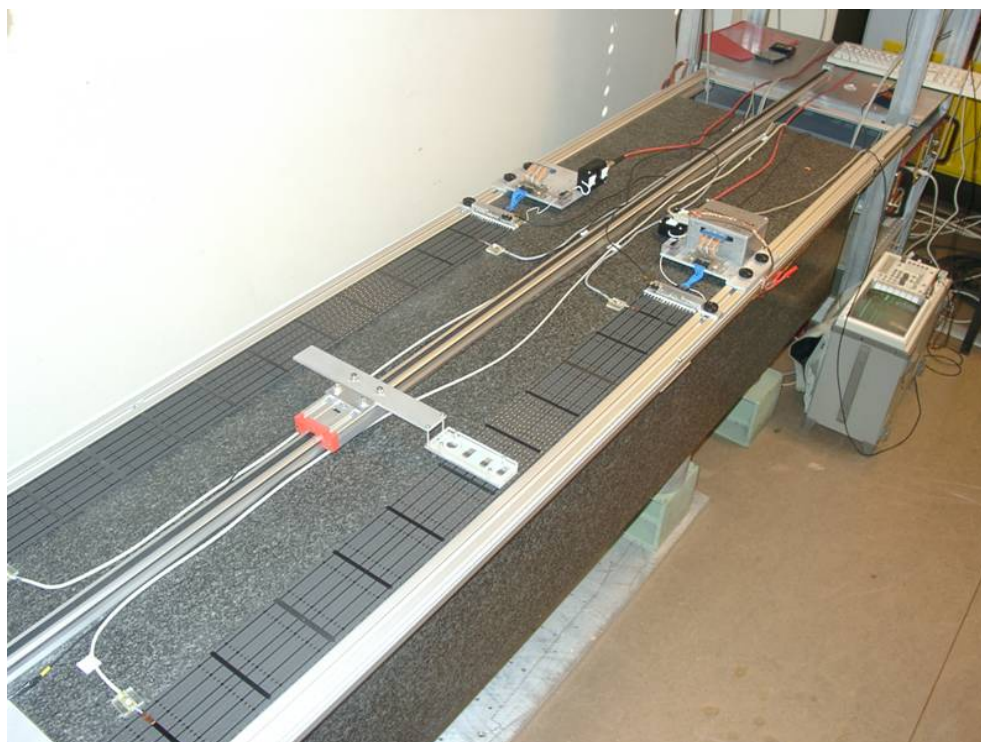
Straw Module Production



289 Straw Modules:
Safety Factor for TRD: ~ 7
 $7 \times 3y \sim 21$ years operation on ISS

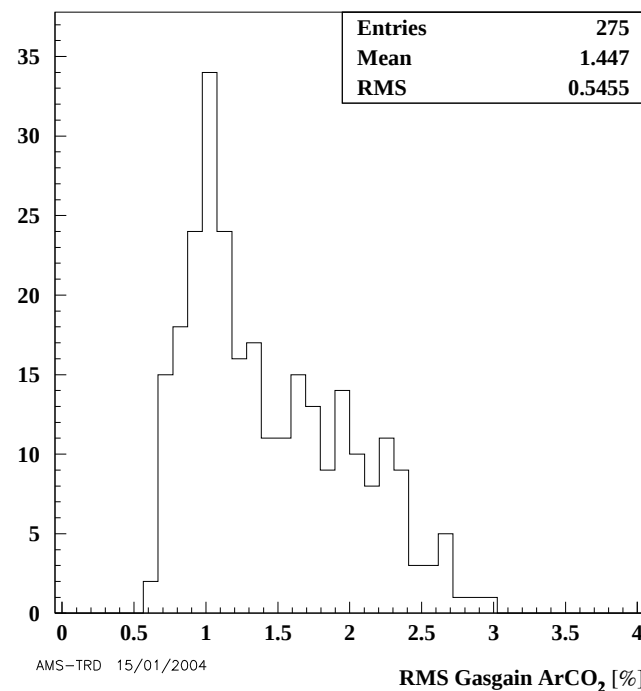
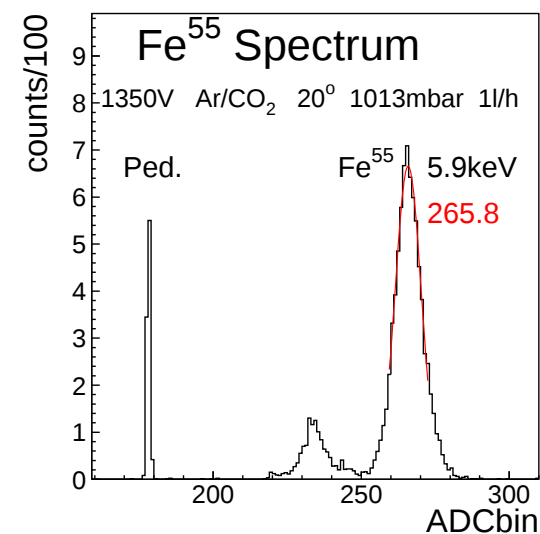


Measurement of Gas Gain with Fe^{55} source



Mean: 5720.69 RMS: 63.90
c:\ggdata\progs\027_3S.pas

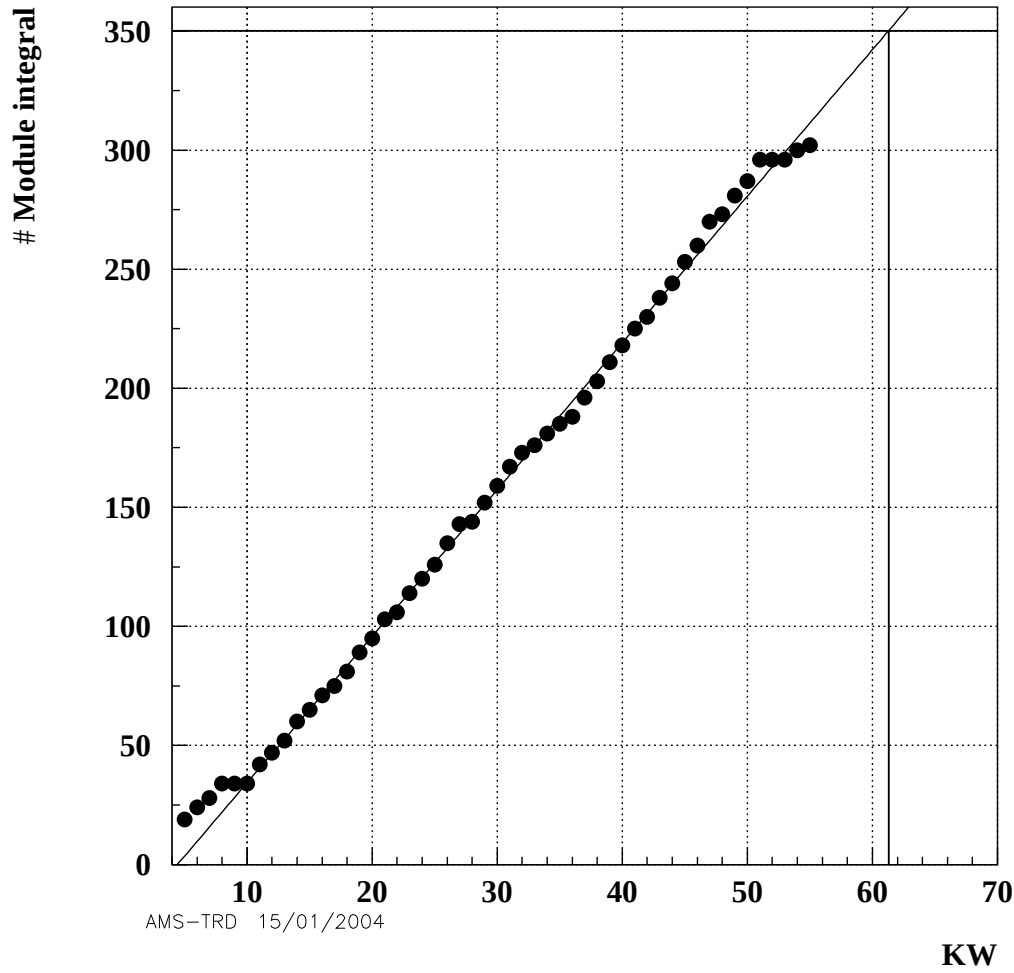
Straw	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
1	2.1	1.6	-2.1	1.0	1.4	1.9	-0.3	0.5	1.6	0.5						
2	-0.8	1.2	0.0	-0.7	1.2	1.0	1.7	-0.2	1.9	1.3						
3	-0.4	-0.5	0.8	-1.3	-0.3	1.6	2.4	0.7	2.9	2.4						
4	-0.4	-1.0	-0.7	-0.5	-1.6	-1.2	0.4	0.5	0.4	0.7						
5	-0.3	0.2	-1.4	0.2	0.3	0.1	0.5	0.8	1.5	0.1						
6	-0.4	0.7	-1.7	-0.1	0.4	-1.3	-0.2	1.4	-0.8	-1.2						
7	-1.1	0.9	-1.9	-1.1	0.3	-0.3	-1.1	1.4	0.6	-0.0						
8	-0.4	-0.1	-1.2	-0.8	-0.0	-2.0	0.4	1.4	-1.4	-1.2						
9	-0.1	-0.3	-0.2	-0.7	-0.8	-1.4	0.2	1.4	-1.2	-0.2						
10	-0.1	0.6	-2.5	-0.3	1.0	0.0	-0.5	0.6	1.2	-1.3						
11	-1.7	-0.6	-1.1	-2.3	0.3	0.1	-0.6	-0.3	0.6	0.3						
12	0.2	-0.9	-2.8	-0.7	-0.9	-0.5	-1.0	-0.5	-0.4	-1.3						
13	-0.3	0.6	-2.3	-0.3	1.4	-0.5	-2.0	0.2	0.5	-1.1						
14	-0.2	0.4	-0.3	0.2	0.3	0.6	-0.1	1.1	0.8	1.4						
15	-2.2	-0.8	0.1	-0.6	-1.0	0.5	0.9	-0.8	2.0	1.9						
16	0.8	1.3	-1.1	2.1	2.4	0.6	0.2	1.7	1.0	-1.2						



Average variation of gas gain: 1.45%

Straw Module Production Status

Module Production 2003 + 2004



End of Module Production: March 2004



Straw Module Production Status

	-9	-8	-7	-6	-5	-4	-3	-2	-1	+1	+2	+3	+4	+5	+6	+7	+8	+9	
20	260	268	276	284	292	300	308	316	324										
19	259	264	272	280	288	296	304	312	320	328									
18	258	263	267	271	279	287	295	299	307	315	323								
17	257	262	266	274	278	282	286	290	294	302	310	318	326						
16	188	196	200	204	208	212	216	220	224	228	236	244	252	256					
15	187	192	195	203	211	219	227	235	243	251	255								
14	186	191	194	198	202	206	210	214	218	222	226	230	234	238	242	246	250	254	
13	185	189	193	197	201	205	209	213	217	221	225	229	233	237	241	245	249	253	
12		124	128	132	136	140	144	148	152	156	160	164	168	172	176	180	184		
11		123	127	131	135	139	143	147	151	155	159	163	167	171	175	179	183		
10		122	126	130	134	138	142	146	150	154	158	162	166	170	174	178	182		
9		121	125	129	133	137	141	145	149	153	157	161	165	169	173	177	181		
8		060	064	068	072	076	080	084	088	092	096	100	104	108	112	116	120		
7		059	063	067	071	075	079	083	087	091	095	099	103	107	111	115	119		
6		058	062	066	070	074	078	082	086	090	094	098	102	106	110	114	118		
5		057	061	065	069	073	077	081	085	089	093	097	101	105	109	113	117		
4			004	008	012	016	020	024	028	032	036	040	044	048	052	056			
3			003	007	011	015	019	023	027	031	035	039	043	047	051	055			
2			002	006	010	014	018	022	026	030	034	038	042	046	050	054			
1			001	005	009	013	017	021	025	029	033	037	041	045	049	053			

BODY

produced

MODULE

under test

ok

Conclusion

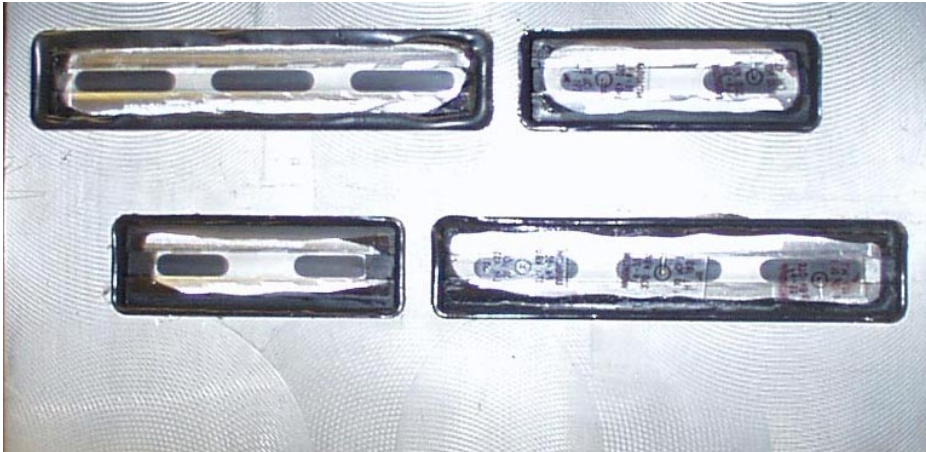
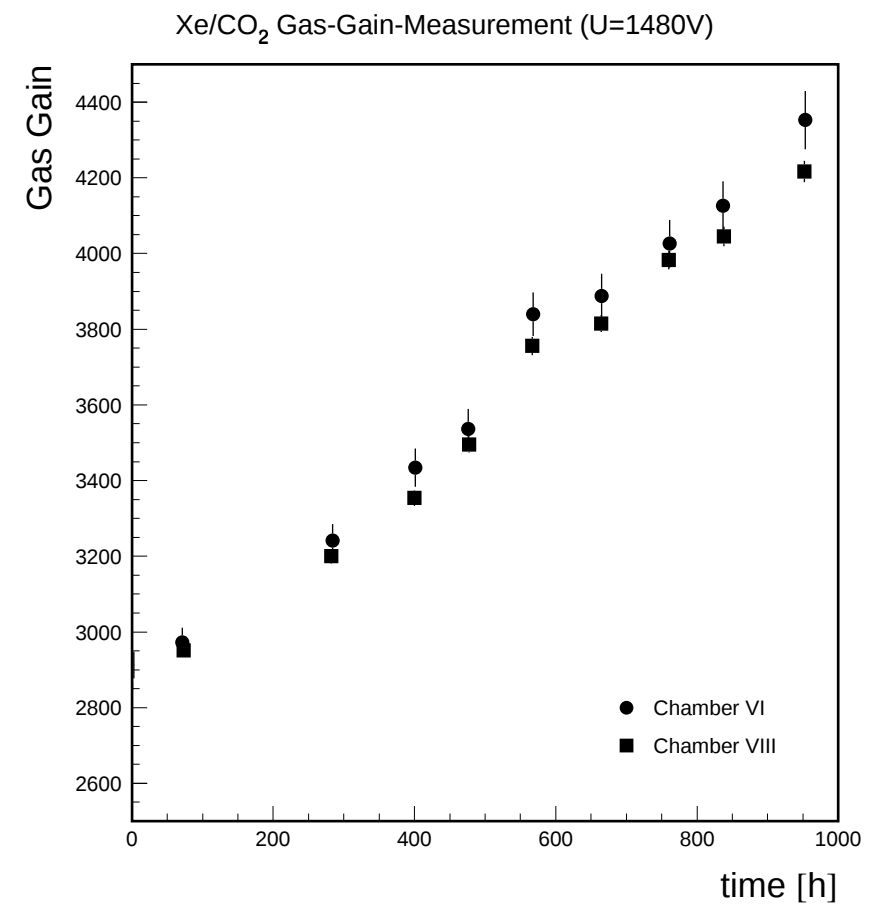
Single Straws:

- 328 Modules $\times$ 16 Straws = 5248 Straws ✓
- Additional 1000 Straws under test

TRD: 328 Flight Modules

- Flight Modules ready for installation: 264
 - Flight Modules under test: 17
 - Flight Modules in production: 14
- $\sum \text{FlightModules} = 295$
- Production ready March 2004





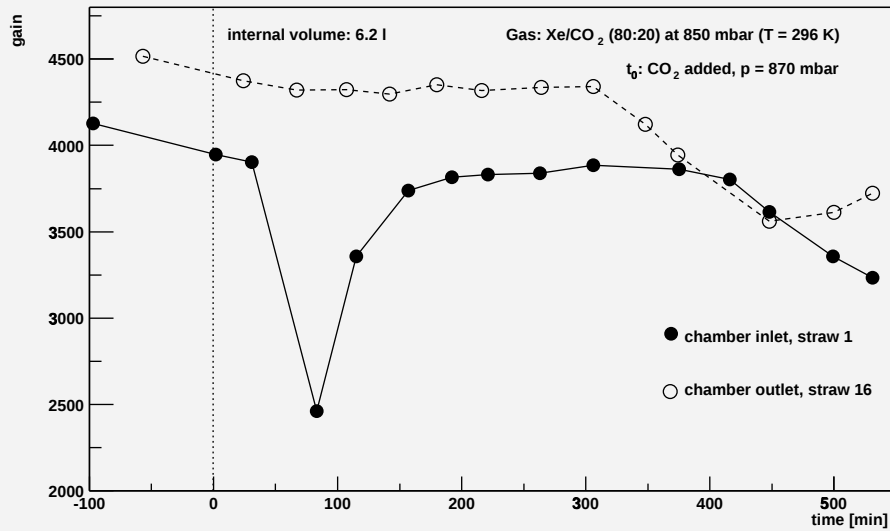
$$\frac{dG}{G} = 53.6\%$$

$$df_{\text{CO}_2} = 7\%$$

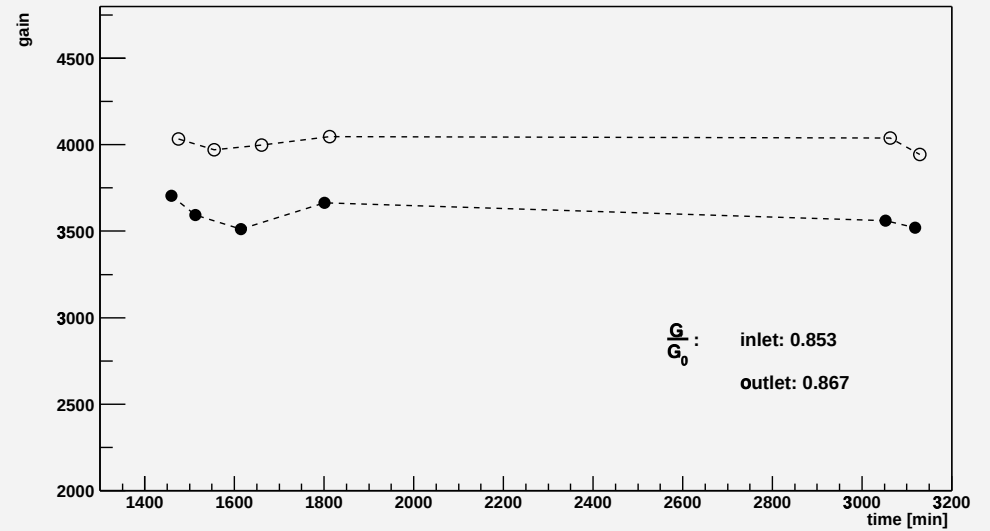
$$\frac{1}{G} \cdot \frac{dG}{df} = \frac{8\%}{1\% f_{\text{CO}_2}}$$

Longterm-Vacuum-Test with Recirculating System:

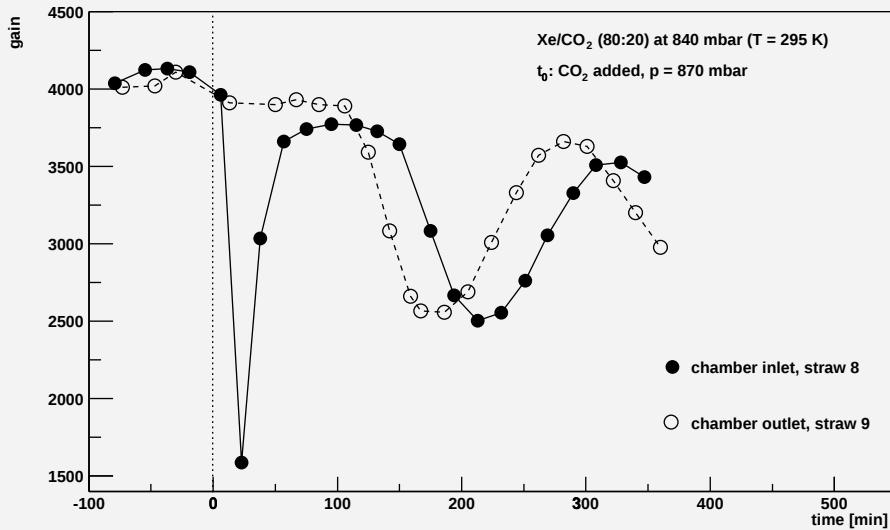
gas flow: 1 l/h



gas flow: 1 l/h



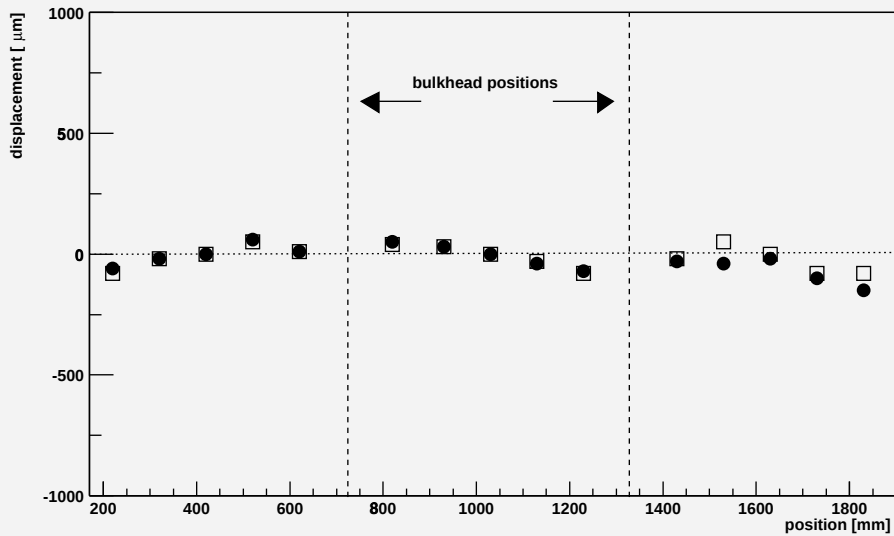
gas flow: 2 l/h



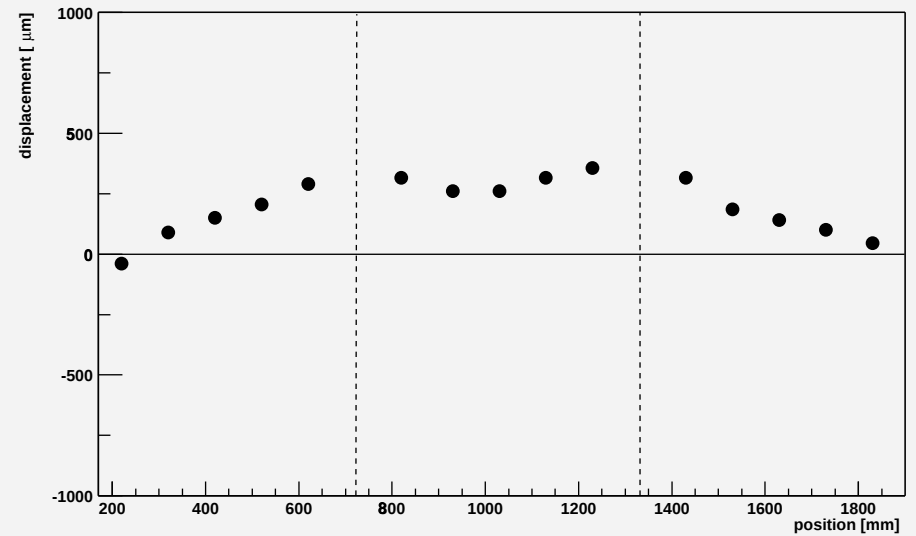
Jan Hattenbach, 01/2004

Preinstallation Gasgain Test:

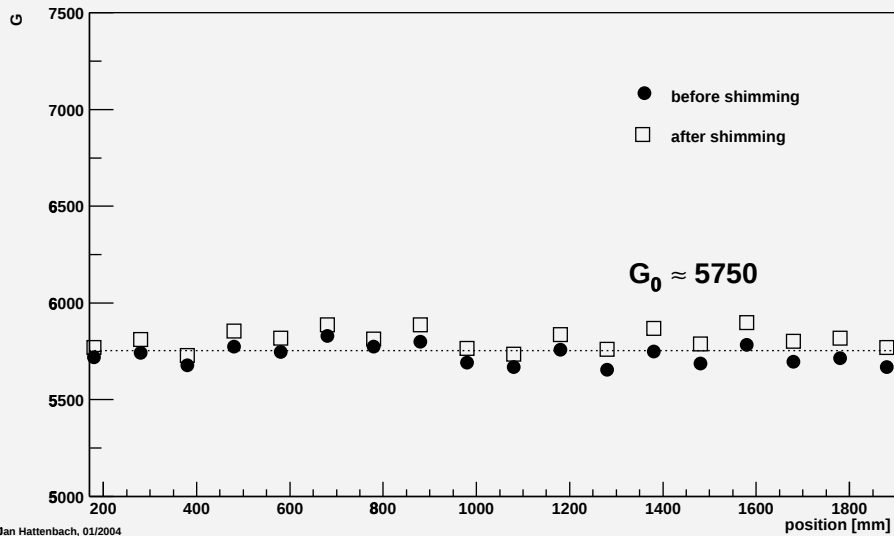
chamber 160: zero position



chamber 160: +300 μm at bulkhead positions

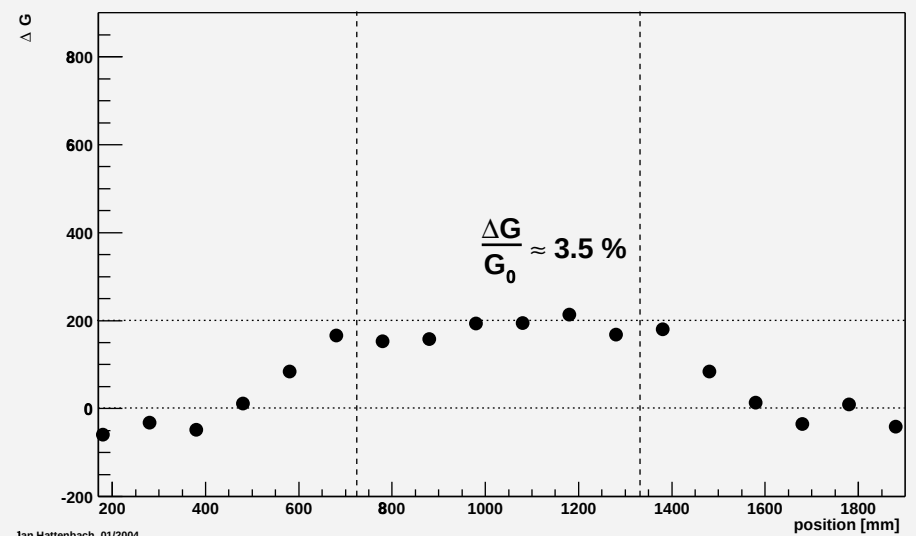


gasgain at zero position



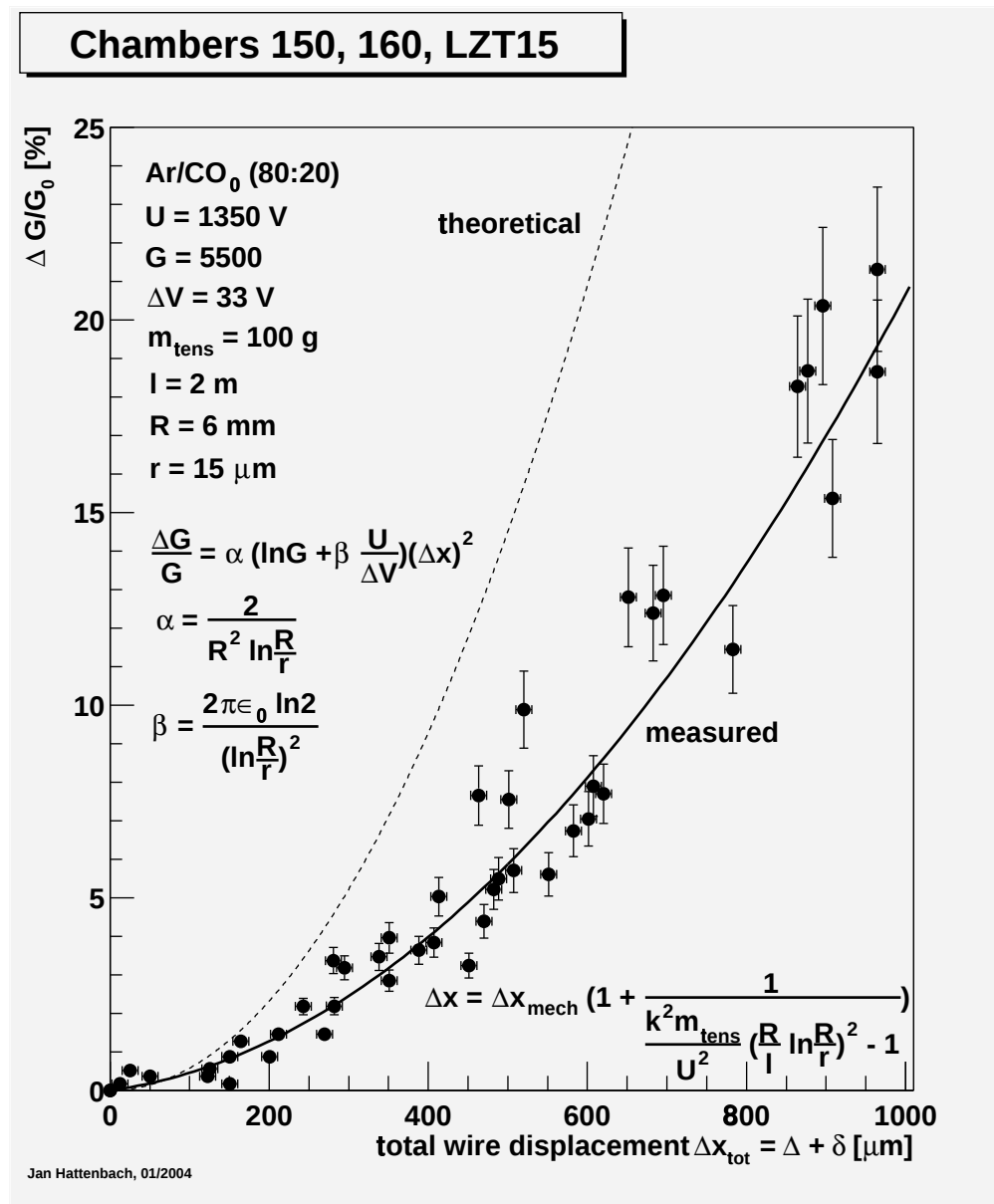
Jan Hattenbach, 01/2004

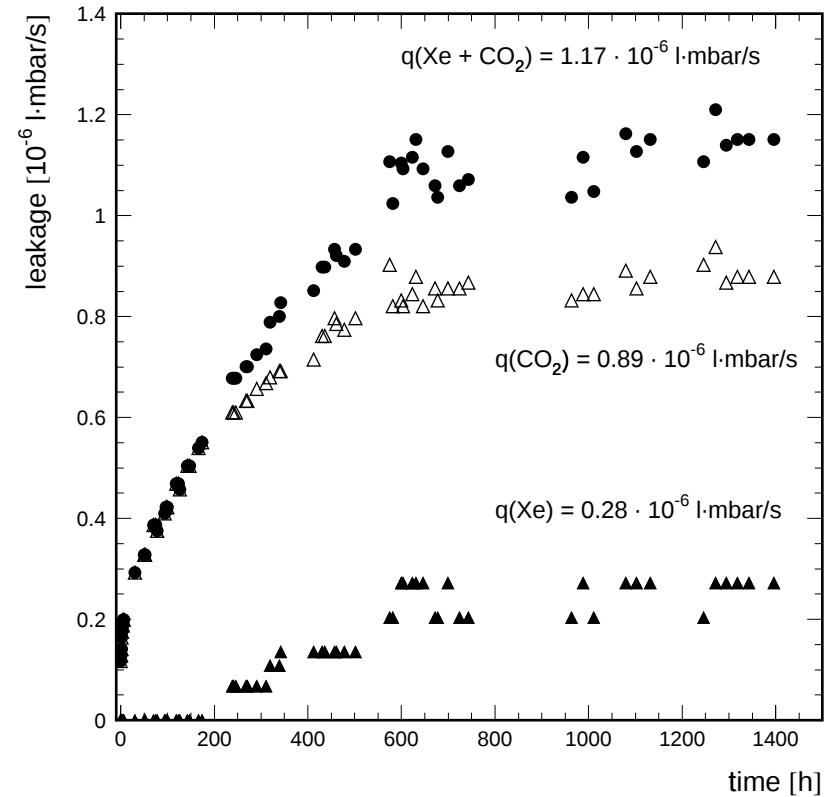
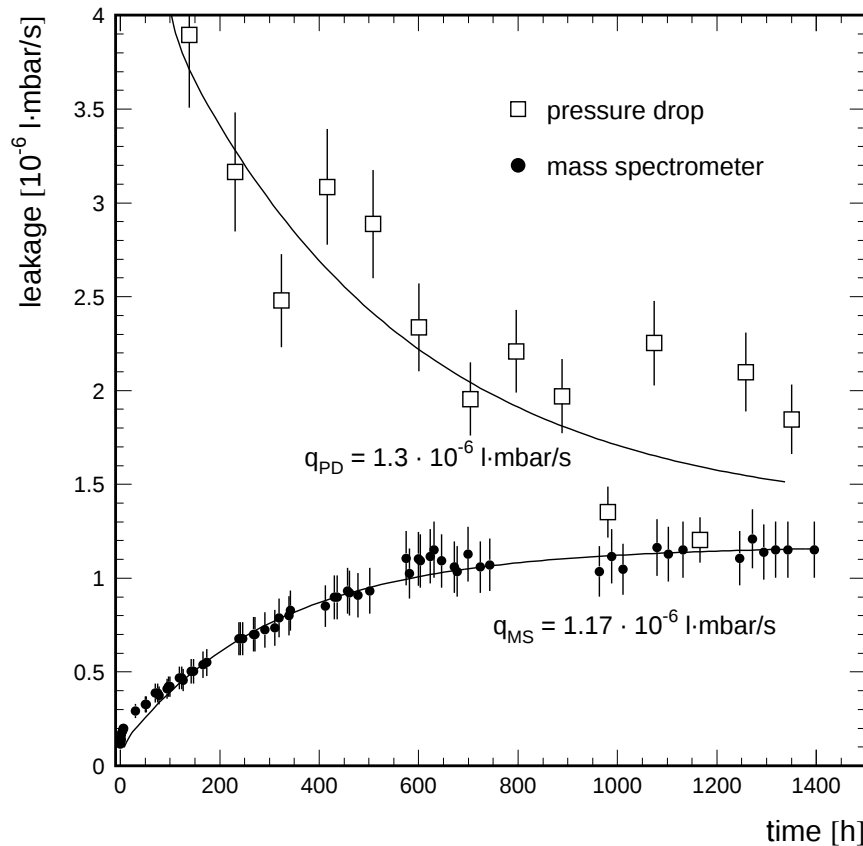
gasgain



Jan Hattenbach, 01/2004

Preinstallation Gasgain Test:





• Xe/CO₂ (80/20) Leak rate 3 single Straw Tubes L=1.3 m

$$q_{Xe}(80\%, 16\text{straws}) = 0.12 \cdot 10^{-5} \frac{\text{l·mbar}}{\text{s·m}_{\text{Module}}},$$

$$q_{Xe,max} = \frac{8100 \text{ l·1013 mbar}}{1000 \cdot 86400 \text{ s}} \cdot \frac{1}{500 \text{ m}} = 19 \cdot 10^{-5} \frac{\text{l·mbar}}{\text{s·m}_{\text{Module}}} \rightarrow \text{Safety factor :158}$$

$$q_{CO_2}(20\%, 16\text{straws}) = 0.37 \cdot 10^{-5} \frac{\text{l·mbar}}{\text{s·m}_{\text{Module}}},$$

$$q_{CO_2,max} = \frac{2000 \text{ l·1013 mbar}}{1000 \cdot 86400 \text{ s}} \cdot \frac{1}{500 \text{ m}} = 4.7 \cdot 10^{-5} \frac{\text{l·mbar}}{\text{s·m}_{\text{Module}}} \rightarrow \text{Safety factor :12.7}$$

AIM: CO₂ Safety Faktor: 4