Summary of Tritium Evolution from Various Experiments

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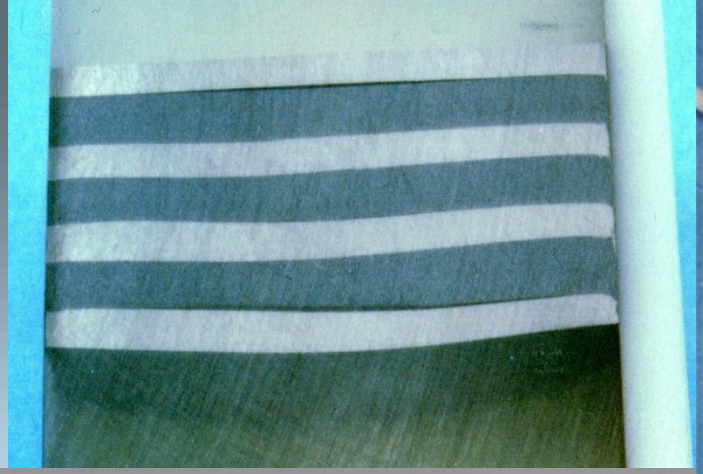
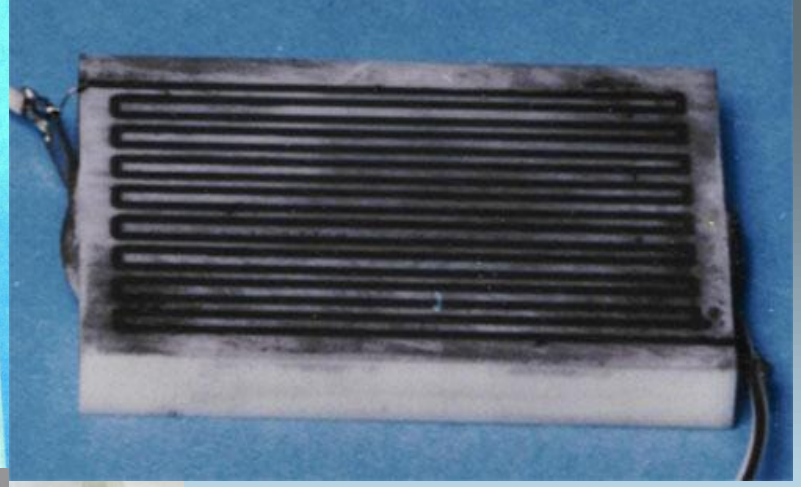
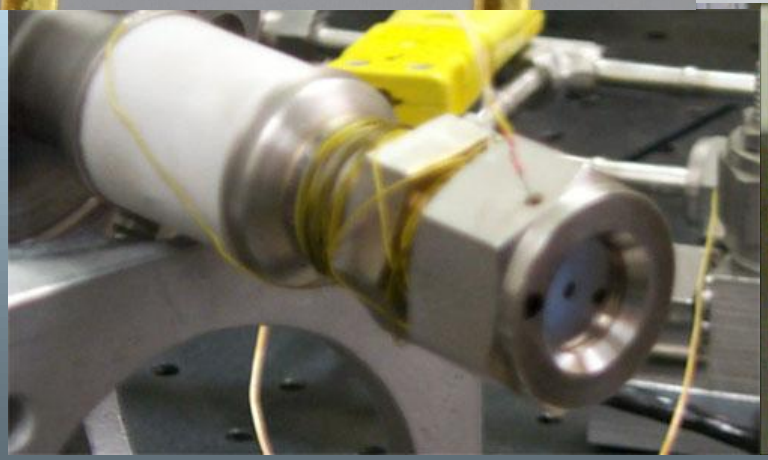
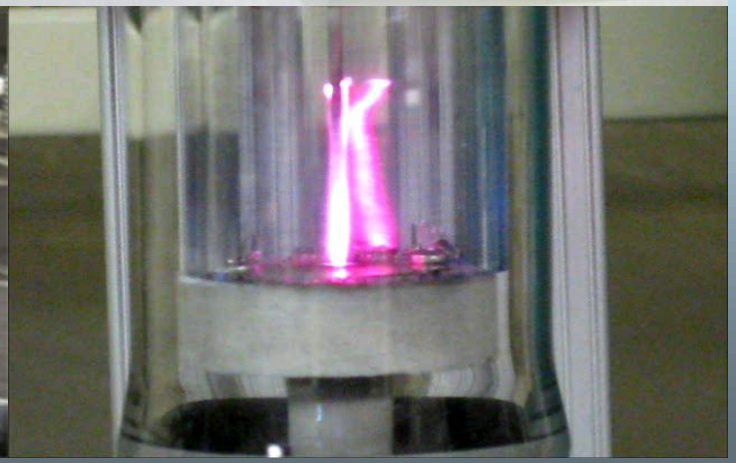
Presentation fatigue





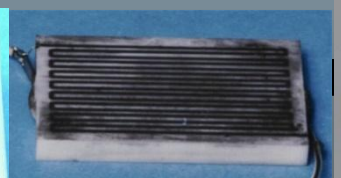




What we have done and where are we going:

	Pd-Si powder solid state cells	Pd powder tracks	Pd wire cells	Pd diffusion disk	Plasma cells	G75 cells
Pd load	20 g	2 g	250 mg	1.5 g	150mg	2 g
Tritium pCi/hr-g	Up to 50	to 30	to 44	200	to 530	15
Excitation	Fast, short, high power pulse			Heating discharge	FSHPP	Heat
n/t ratio	3×10^{-8}					

3% ?



Stated Alloy Composition	Highest Tritium Rate pCi/h
PdRhCoB (5%,5%,0.045)	80
PdRhCoB (5%,5%,0.18)	6.2
PdCu (10%)	6.2
PdRhCoB (5%,5%,0.26)	5.1
PdRh (0.1%)	4.8
PdRhCoB (5%,1.1%,0.11)	4.5
PdHg (0.1%)	3.8
PdB (5%)	2.0
PdCu (1%)	1.4
PdB (0.06%)	1.1
PdAl (0.1%)	1.0
PdFe (10%)	0.62
PdNi (4.6%)	0.53
PdLi (0.3%)	0.45
PdW (0.1%)	0.28
PdCo (1.1%)	0.25
PdRhCrB(5%,5%, ?%)	0.21
PdB (0.03%)	0.10
PdRh (0.5%)	-0.17
PdCr (2.1%)	-0.52
PdRhB(10%,1.0)	-0.73
PdNi (1.1%)	-2.3
PdRhB(5%,0.49)	-2.4
PdBe (0.4%)	-2.8
PdBe (0.1%)	-5.4
PdHf (0.1%)	-6.7

Alloy composition All rolled foil	Tritium rate pCi/h
Hf	+10.0
W	7.0
Ta	5.0
Ti	5.0
Pt	4.6
V	2.5
Ni alloy 1: Ni 79.3, Fe 15.6,Cr 3.0, Mn 0.94	2.1
Ni	1.8
Ni alloy 2: Ni 80.4, Fe 14.9, Mo 4.1, Mn 0.53	1.5
Nb	0.0
Zr	0.0
Fe	0.0
Fe-Ni	0.0
Ag	0.0

Various Metal “Shielding” Factors (Raiola et al 2006)

Metals with Highest Uo

Pd	**800ev**
Sb	**720ev**
Pt	**670ev**
Co	**640ev**
Tl	**550ev**
Ni	**380ev**
Rh	**230ev**

Metals showing little or no Effect

Transition Metals

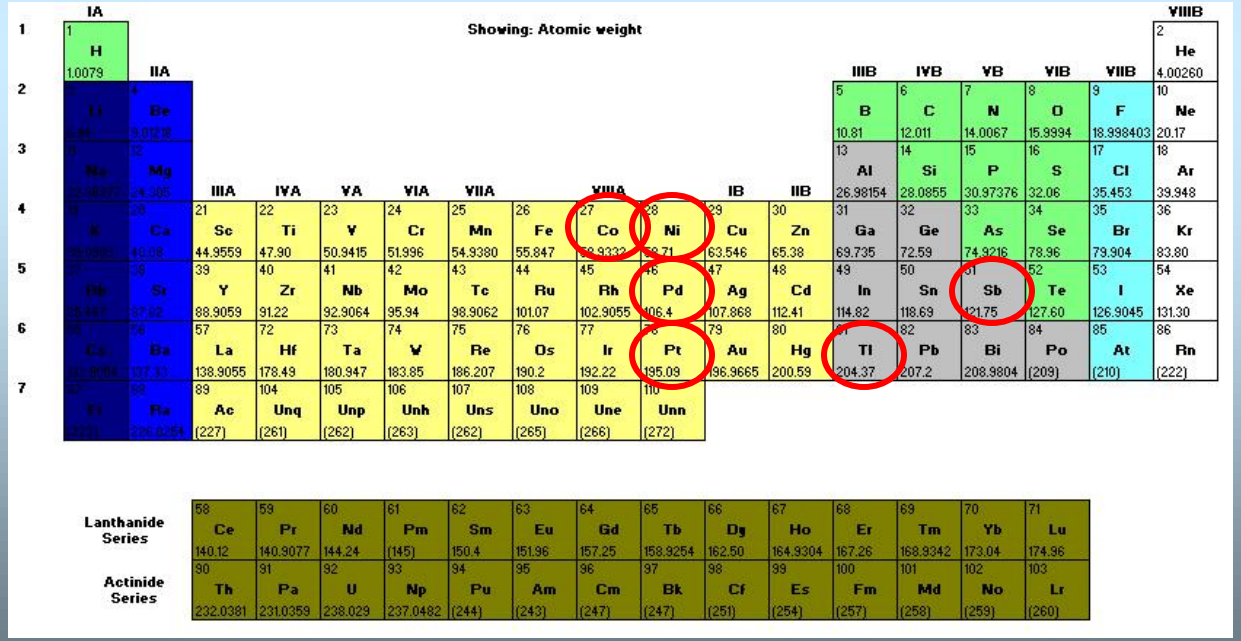
Ti	<30
Sc	<30
Hf	<30
Zr	<40

Lanthanides

Nd	<30
Sm	<30
Ce	<30

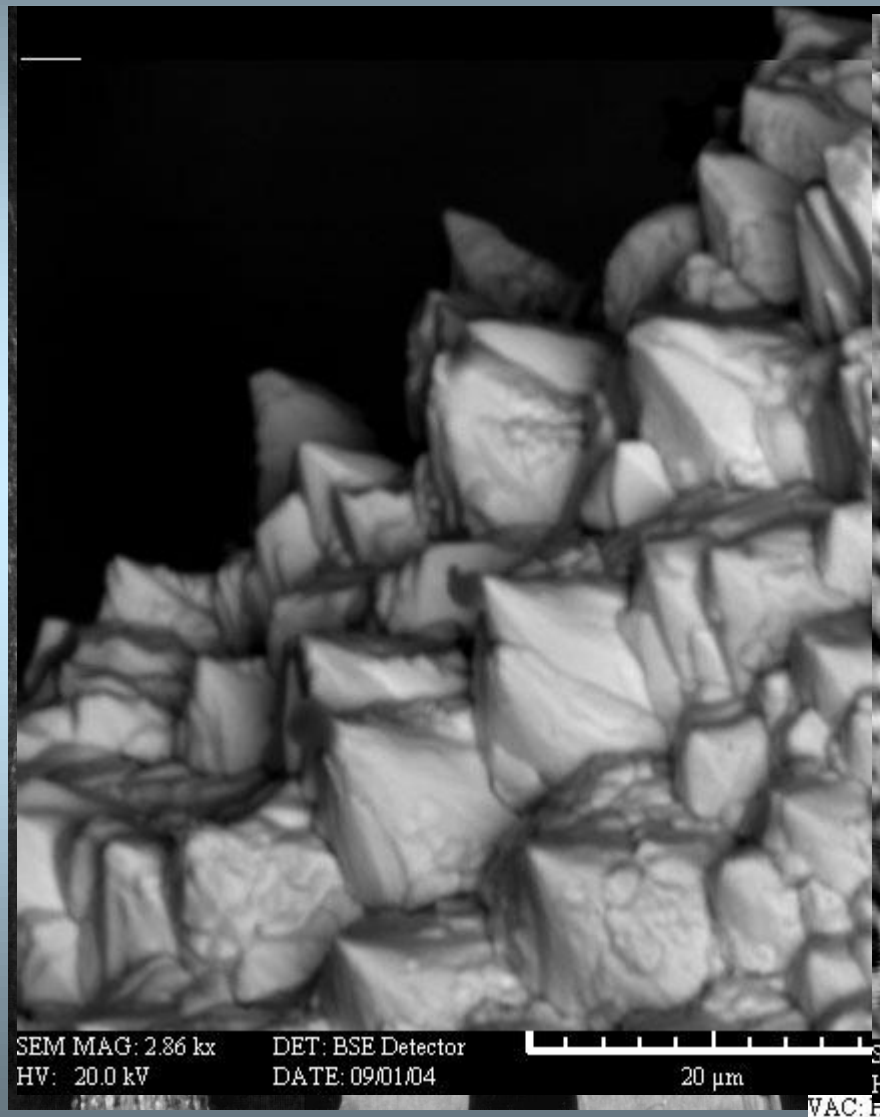
Rare Earths

Dy	<30
Tb	<30
Gd	<30

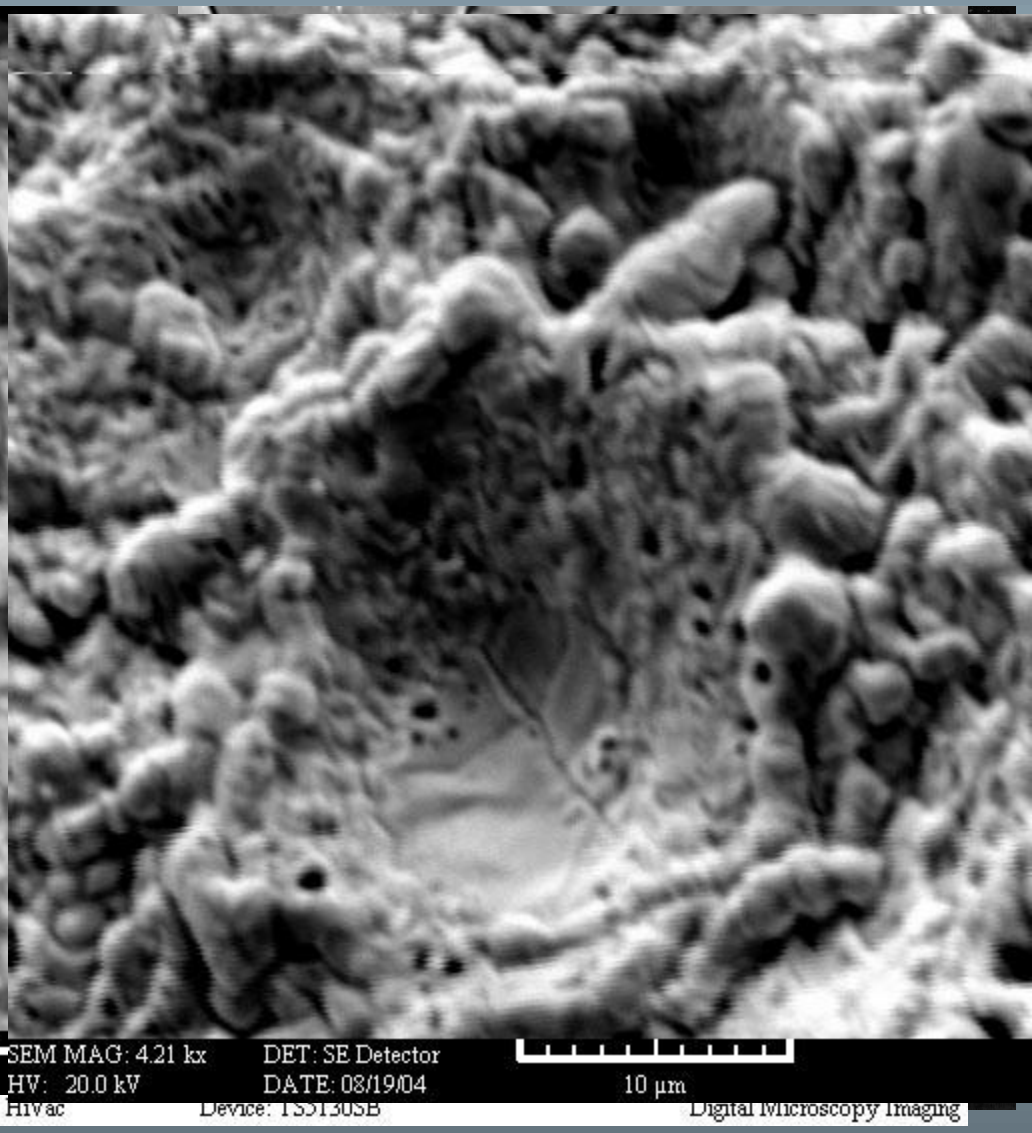


Some Samples of Interest:

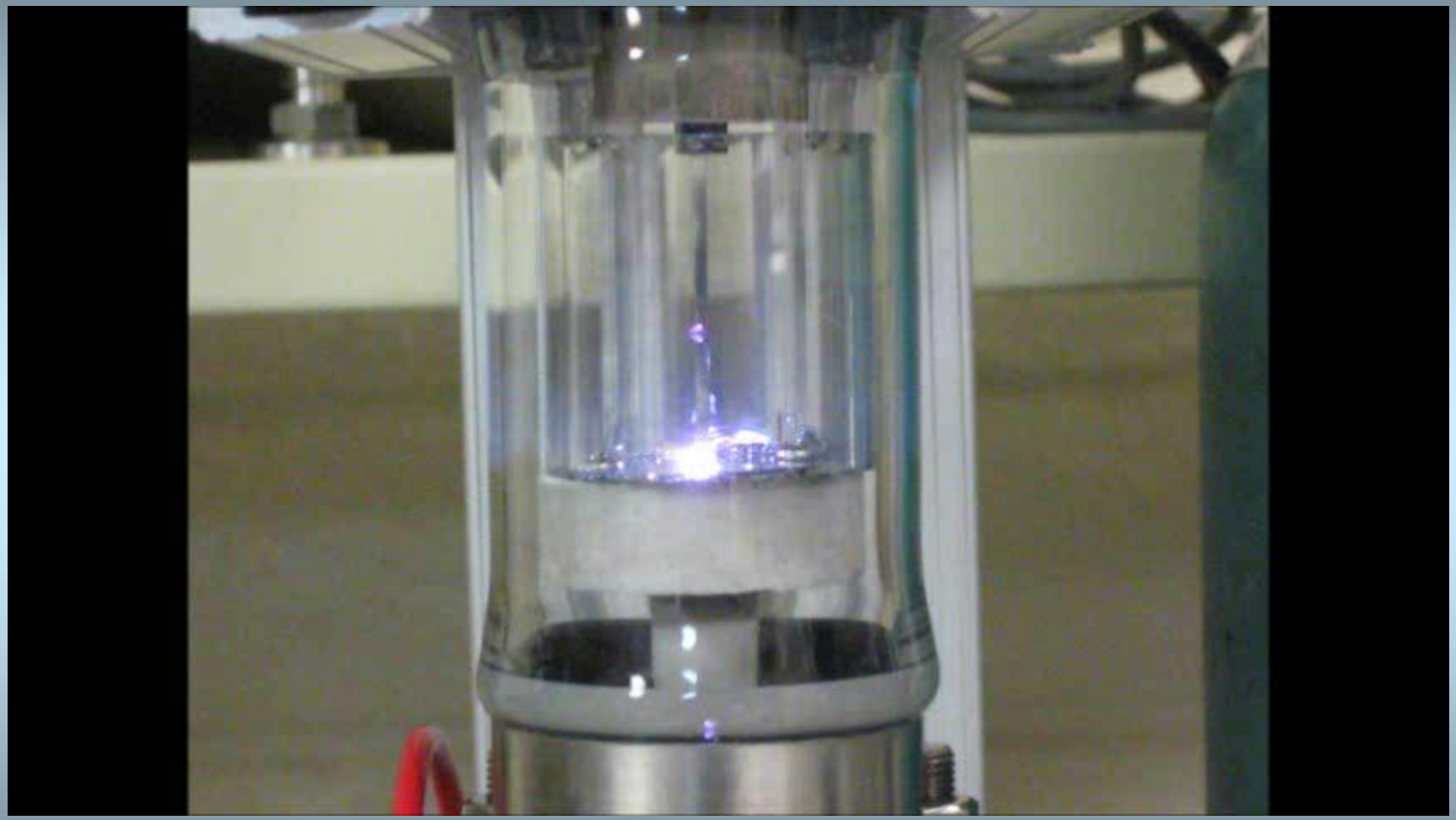
cathode



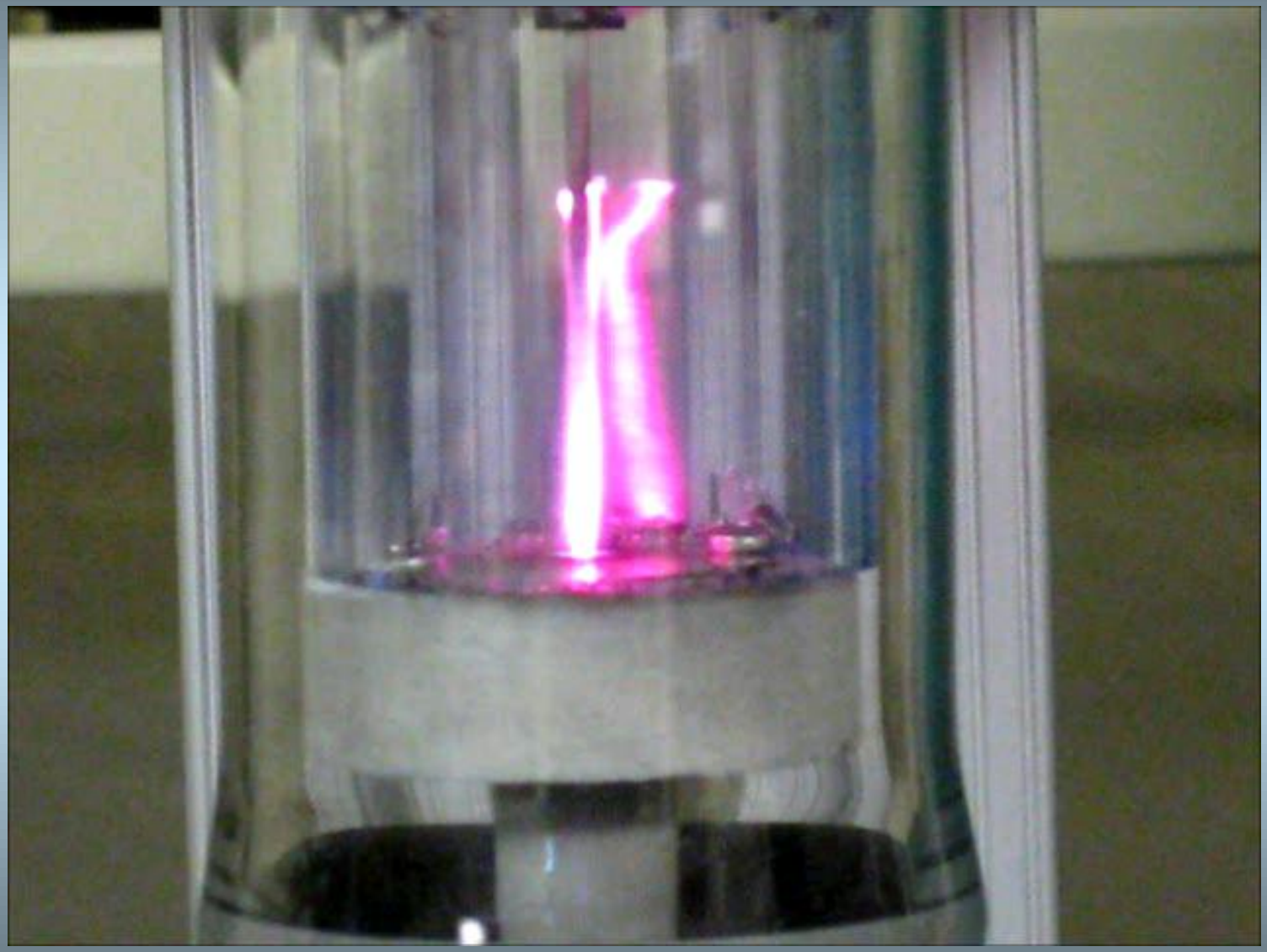
anode



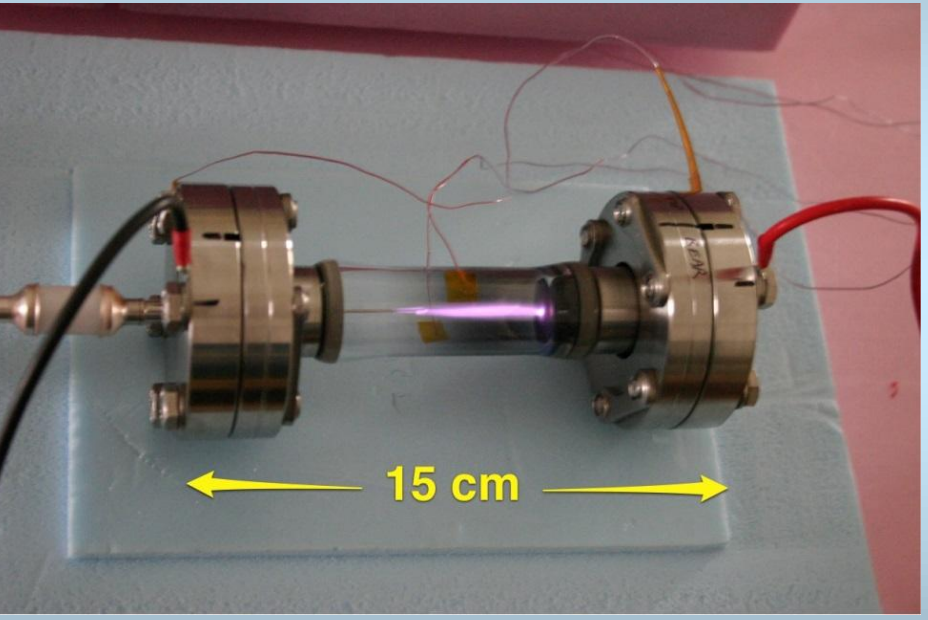
Modes of Operation: Arcing



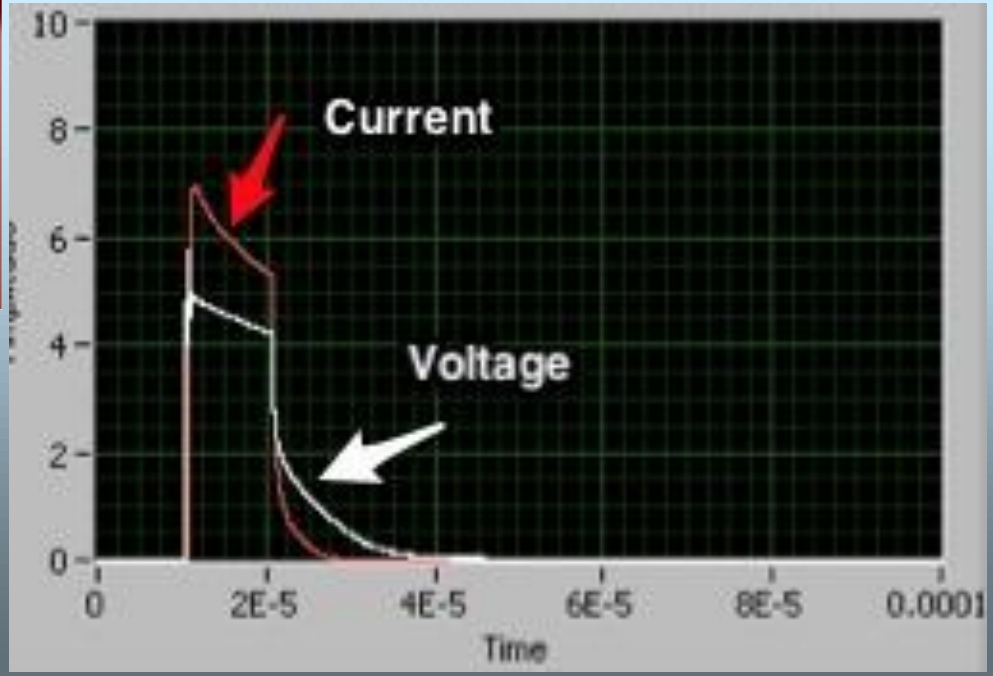
Modes of operation: ion channel and attachment



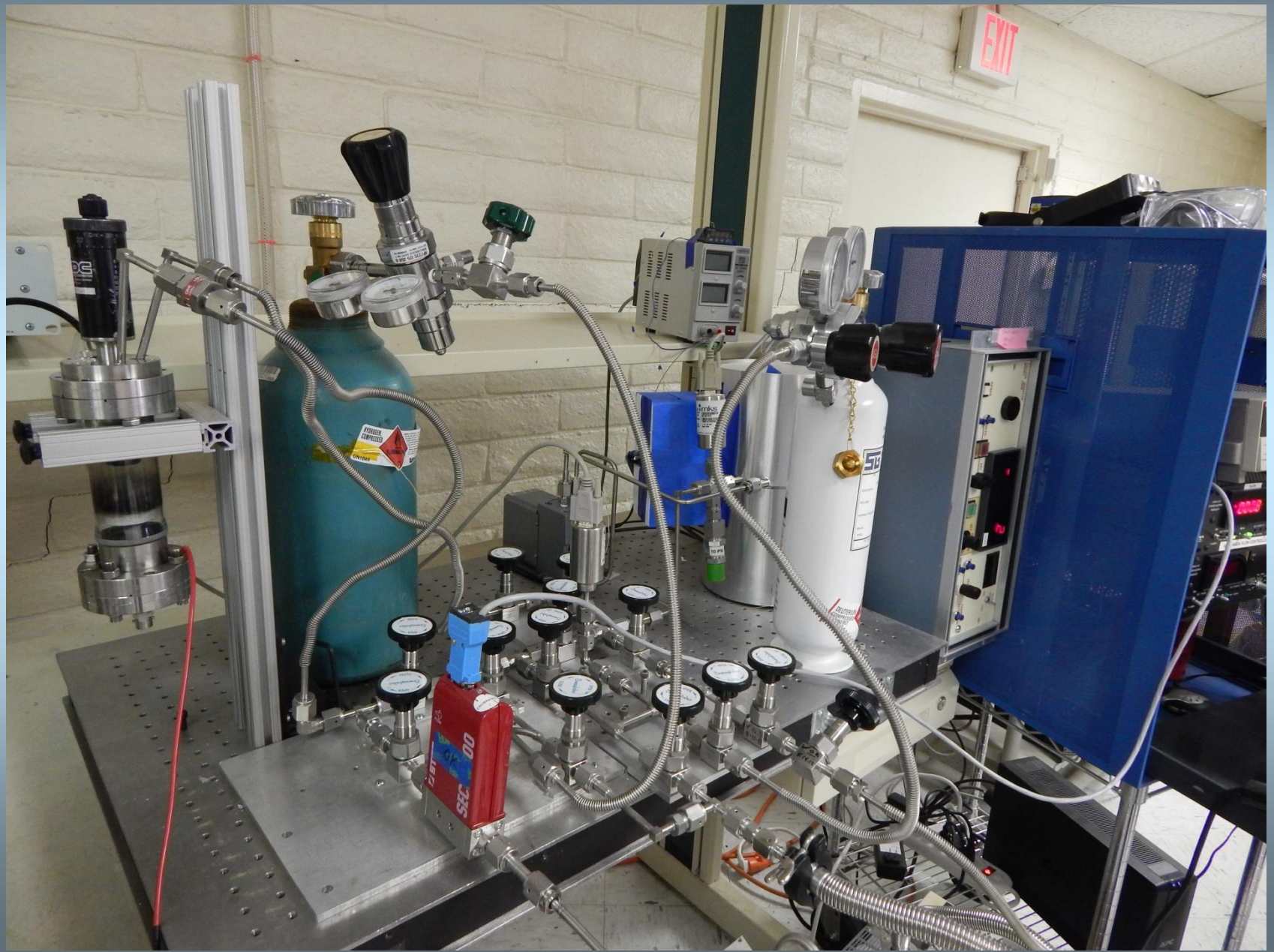
Plasma characteristics (Not a glow discharge)



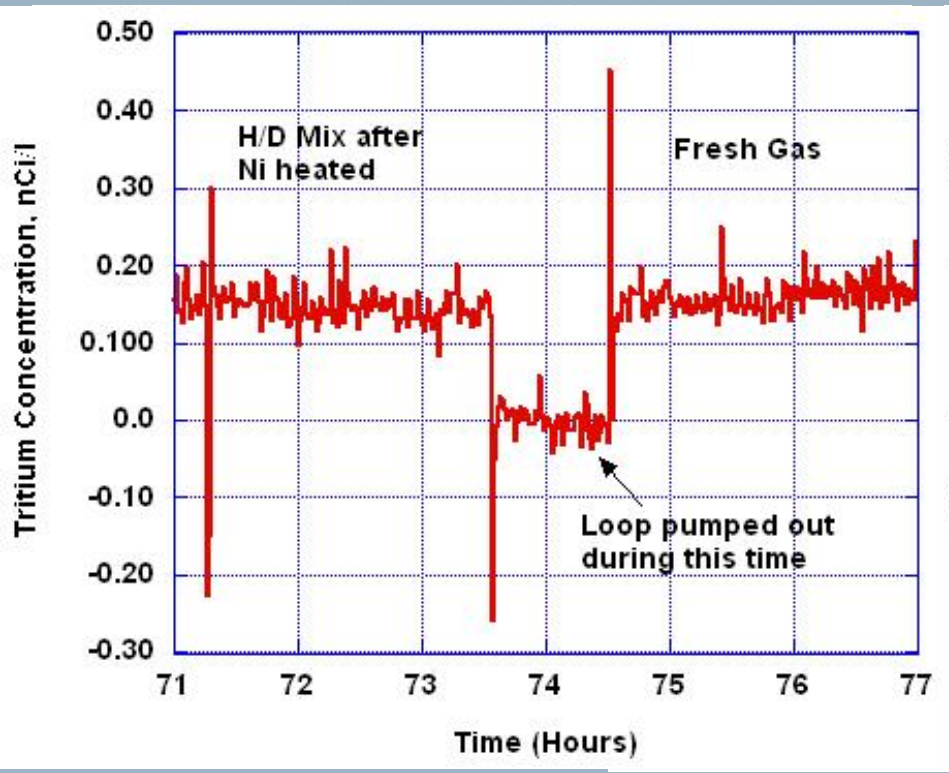
- 150-450 torr
- 900-1300 volts, 5-12 amps
- 5-20 µs pulse @ 50-100 Hz
- Peak Power up to 15000 W
- Constant power operation
- Sample V &I @ 14-bit, 100 M-sample/sec

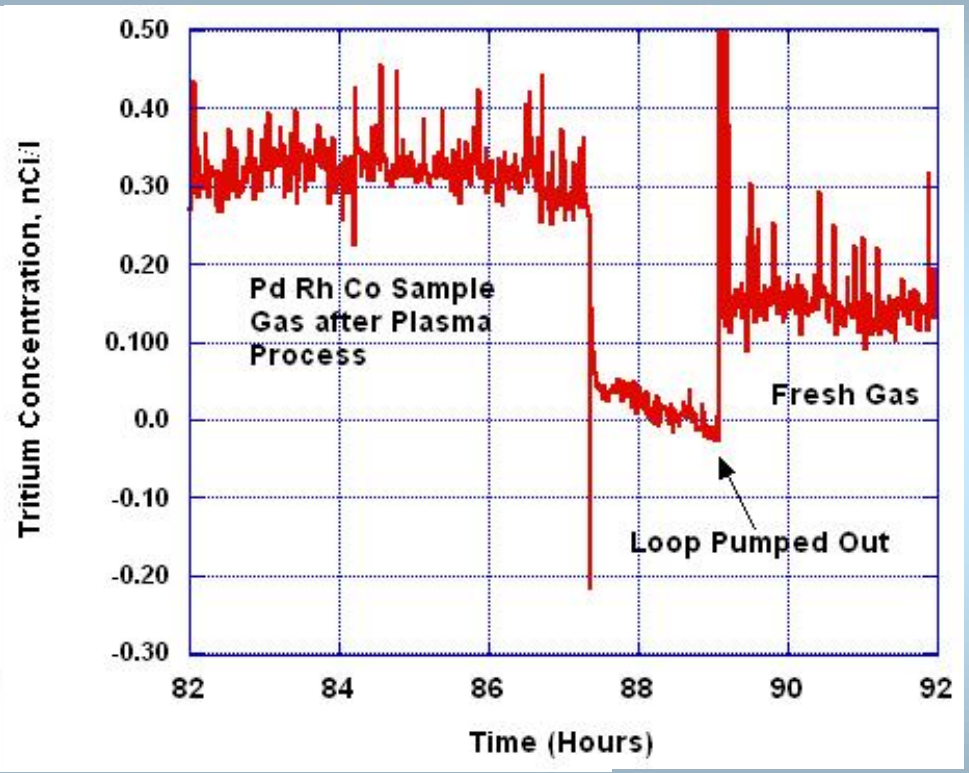


Femtotech Gas Analysis System



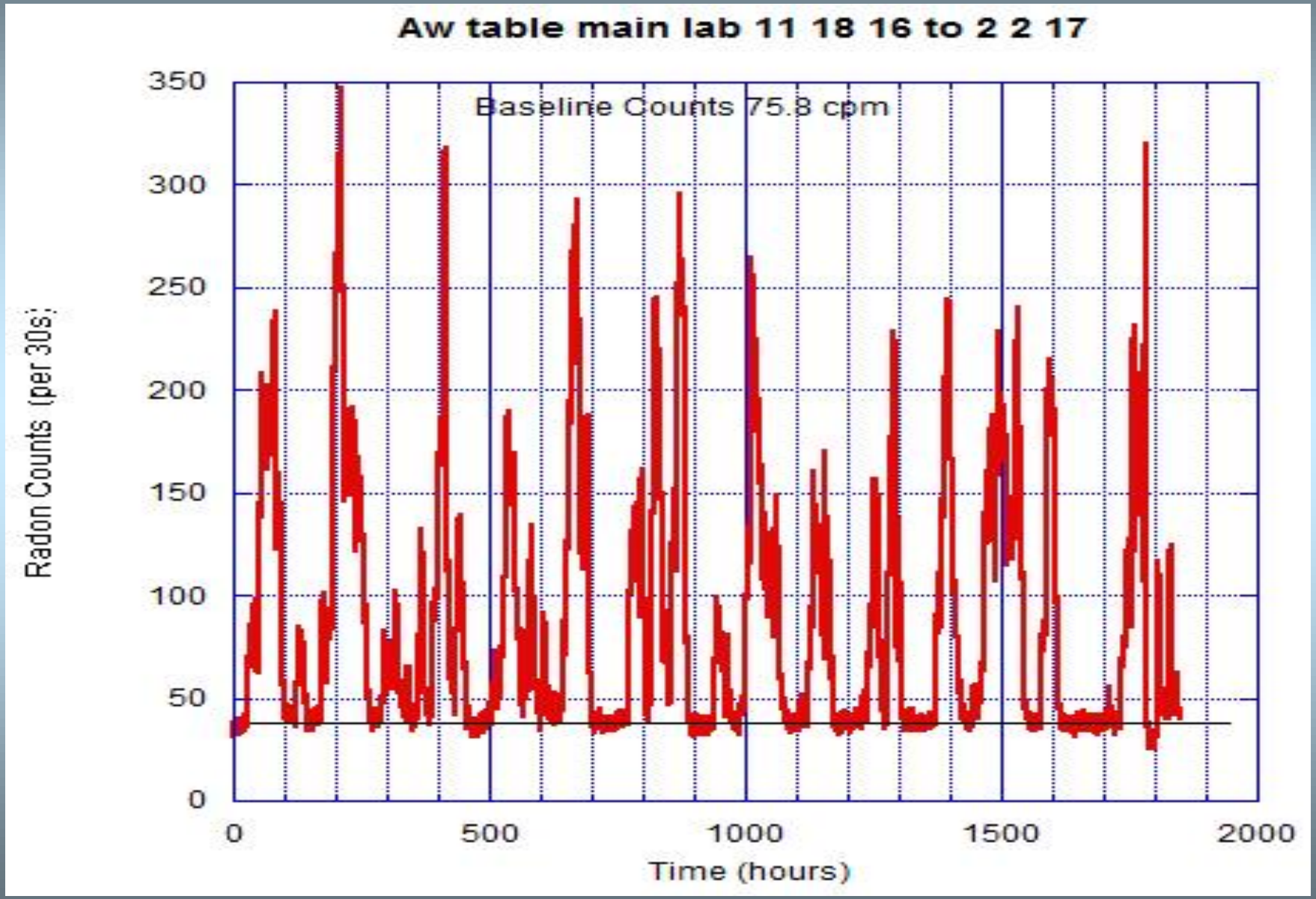
Tritium Femtotech Data



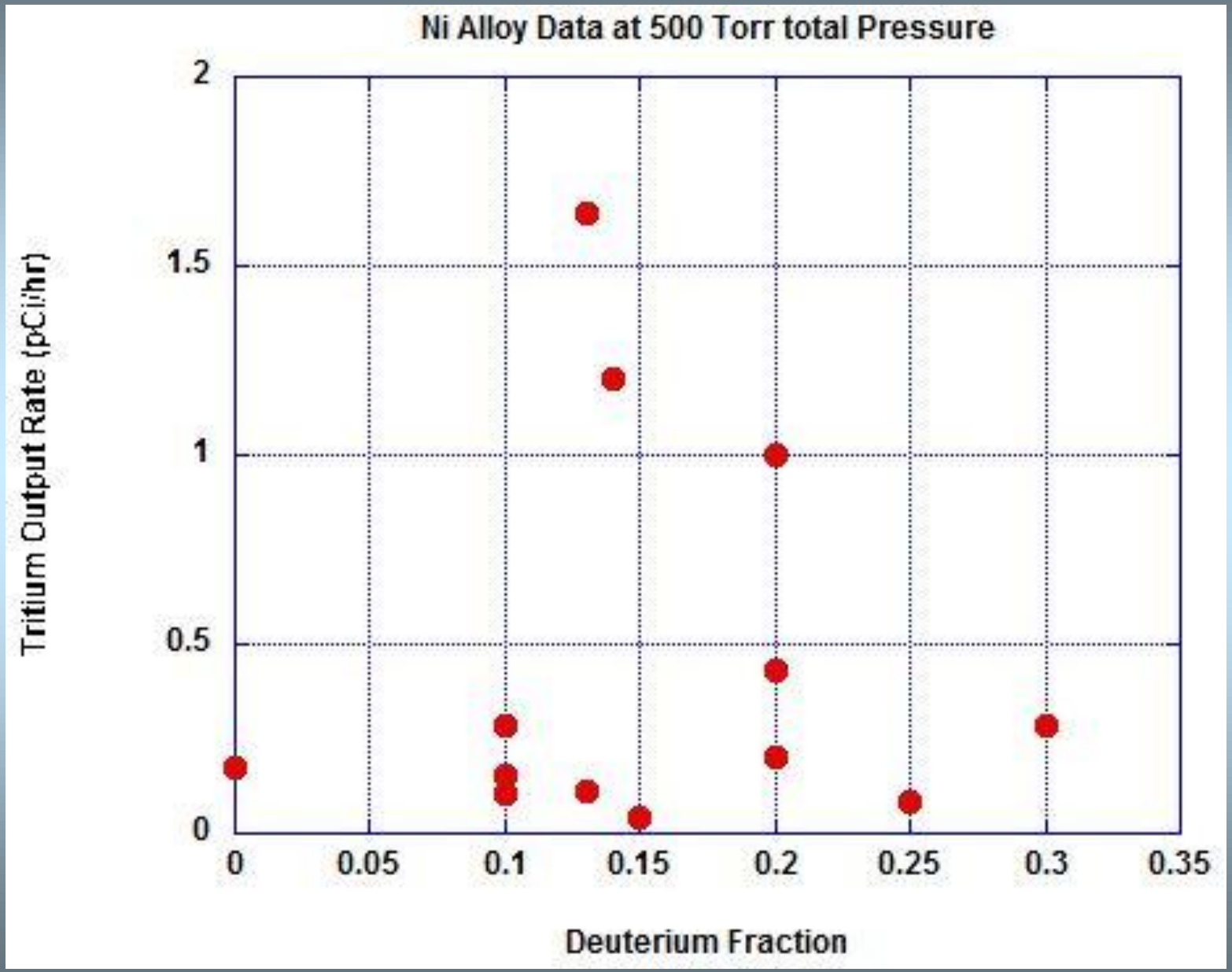


Beckman LSC 6500 1cc water sample in 10cc Ultima Gold Fluid

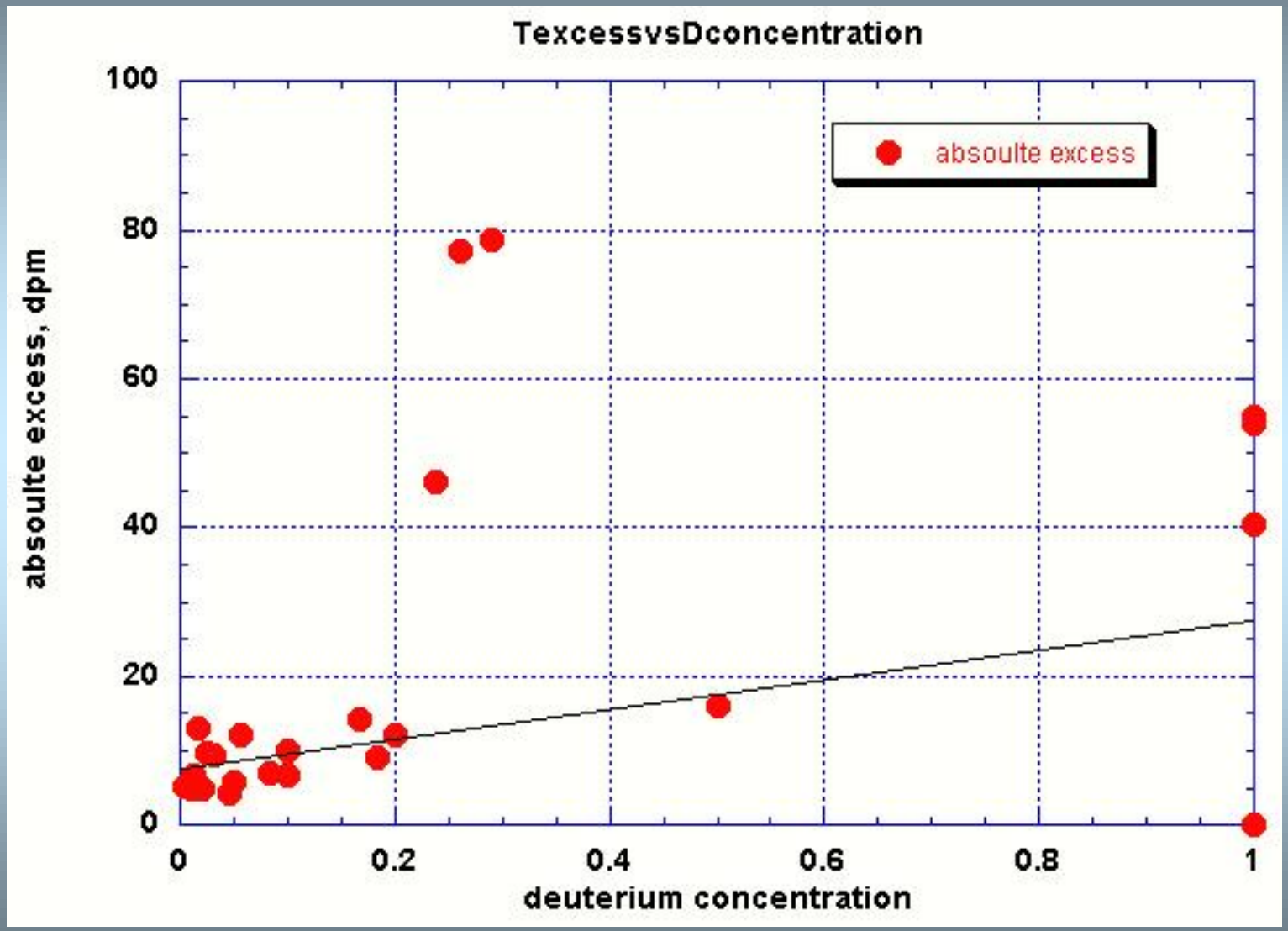
Radon and Daughters can be a Problem for the Beckman



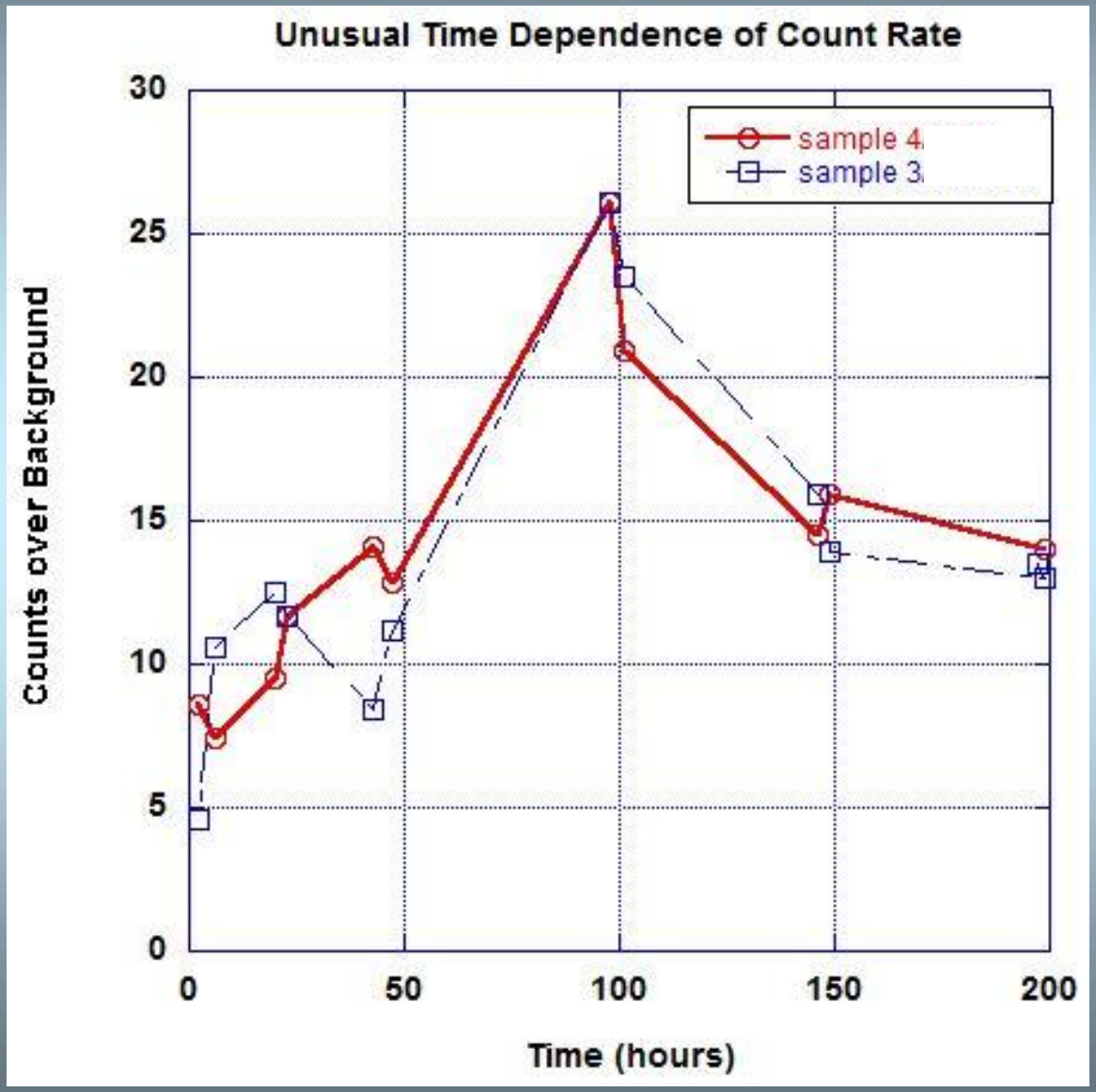
Tritium output as a function of D_2 in H_2



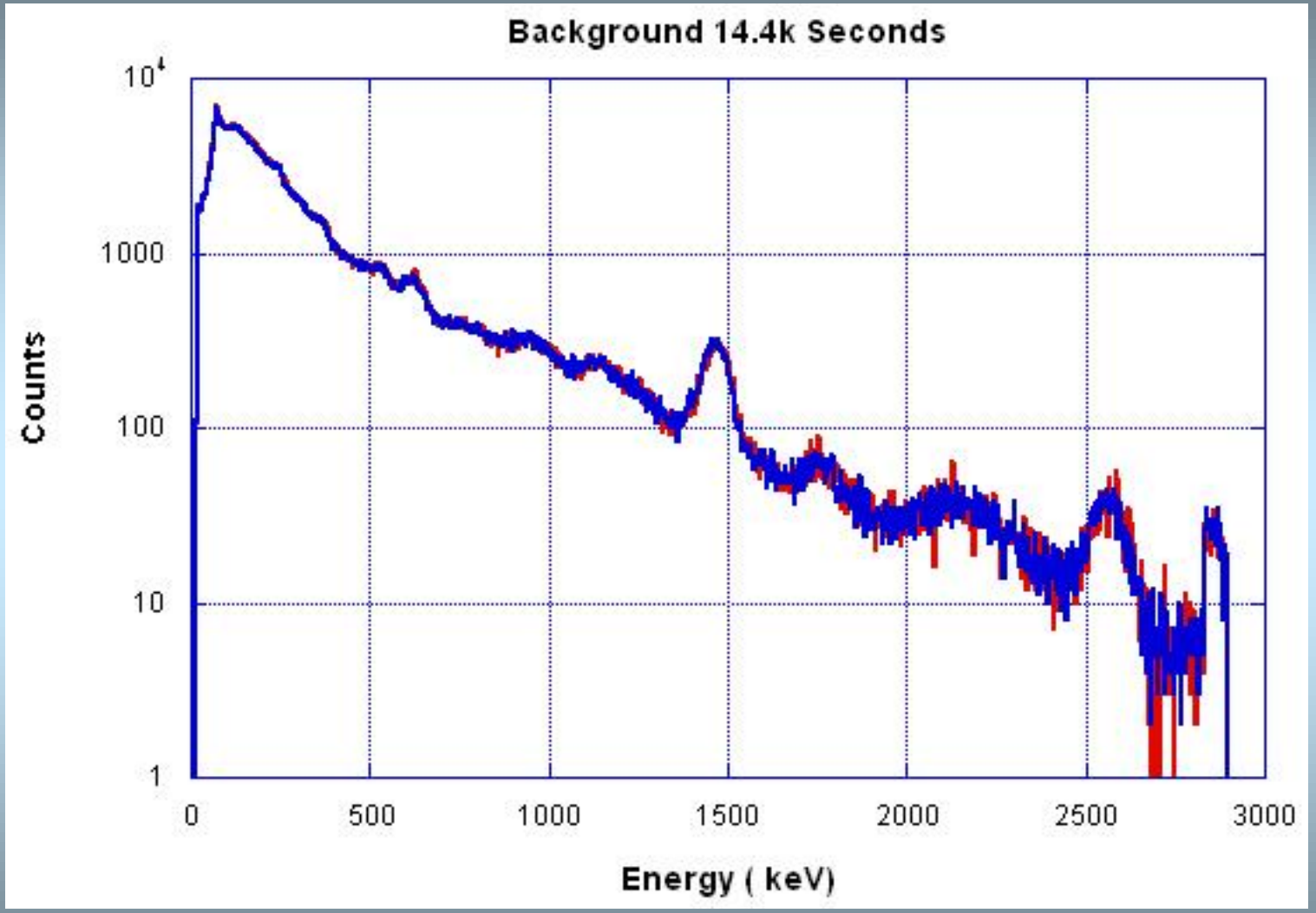
G75 tritium output as a function of D_2 fraction



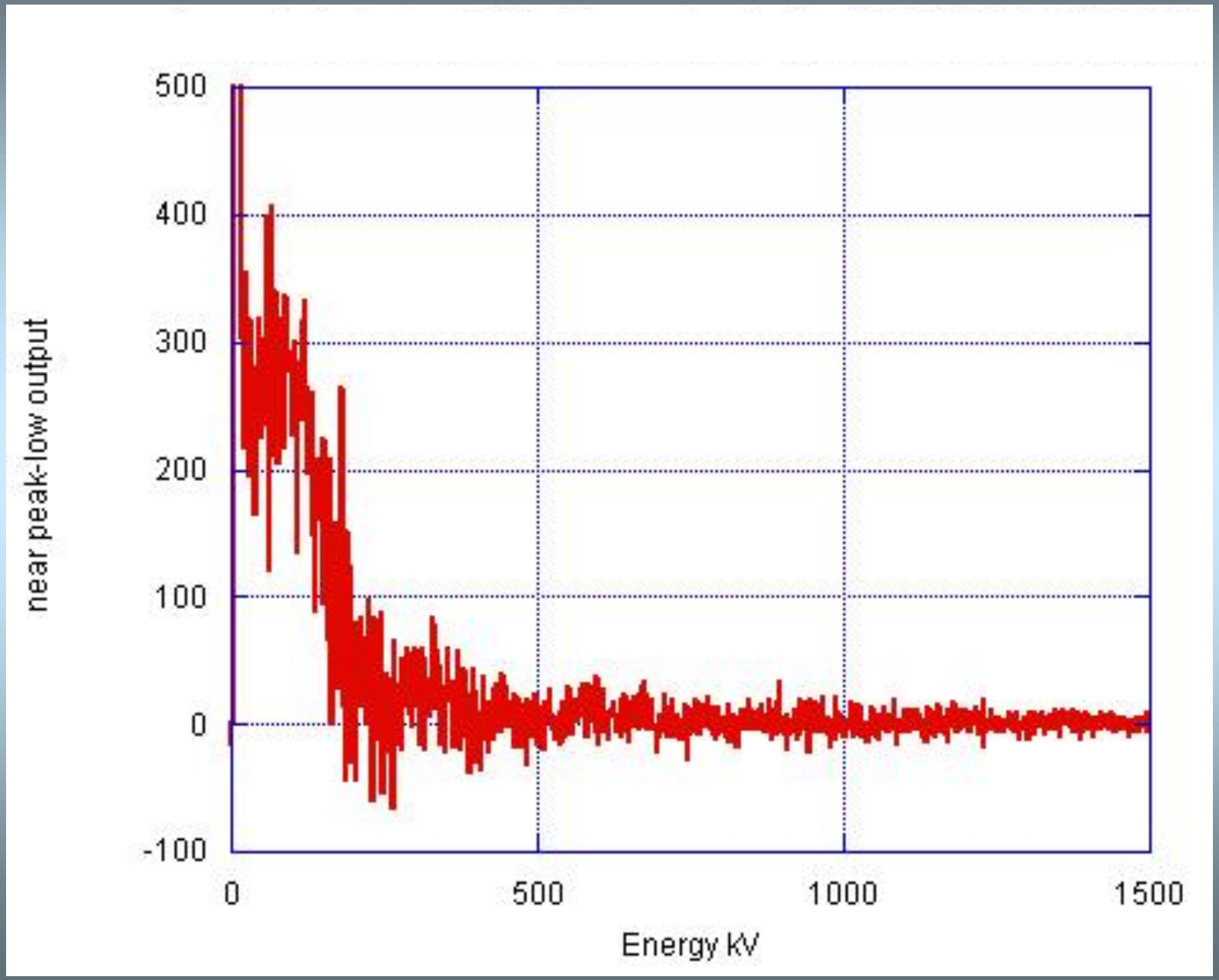
Scintillation counting as a function of time:



NaI Detector Data

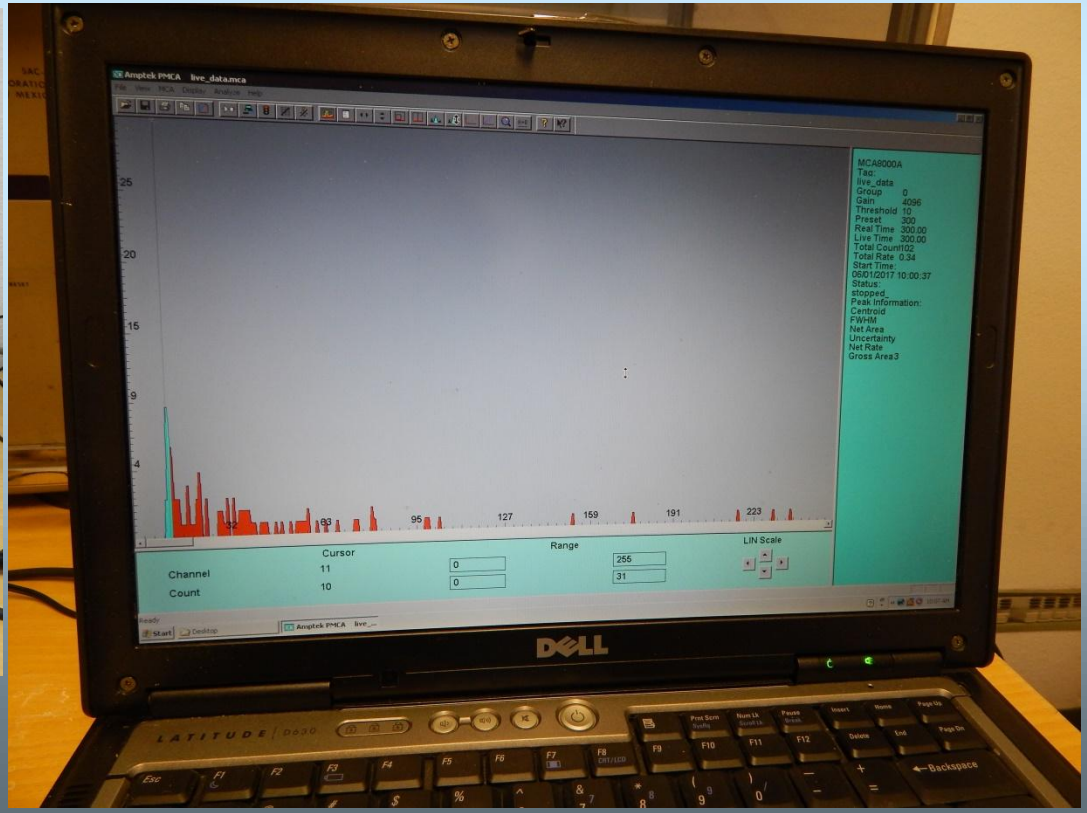


Spectral Difference Between Cell Operation and Background

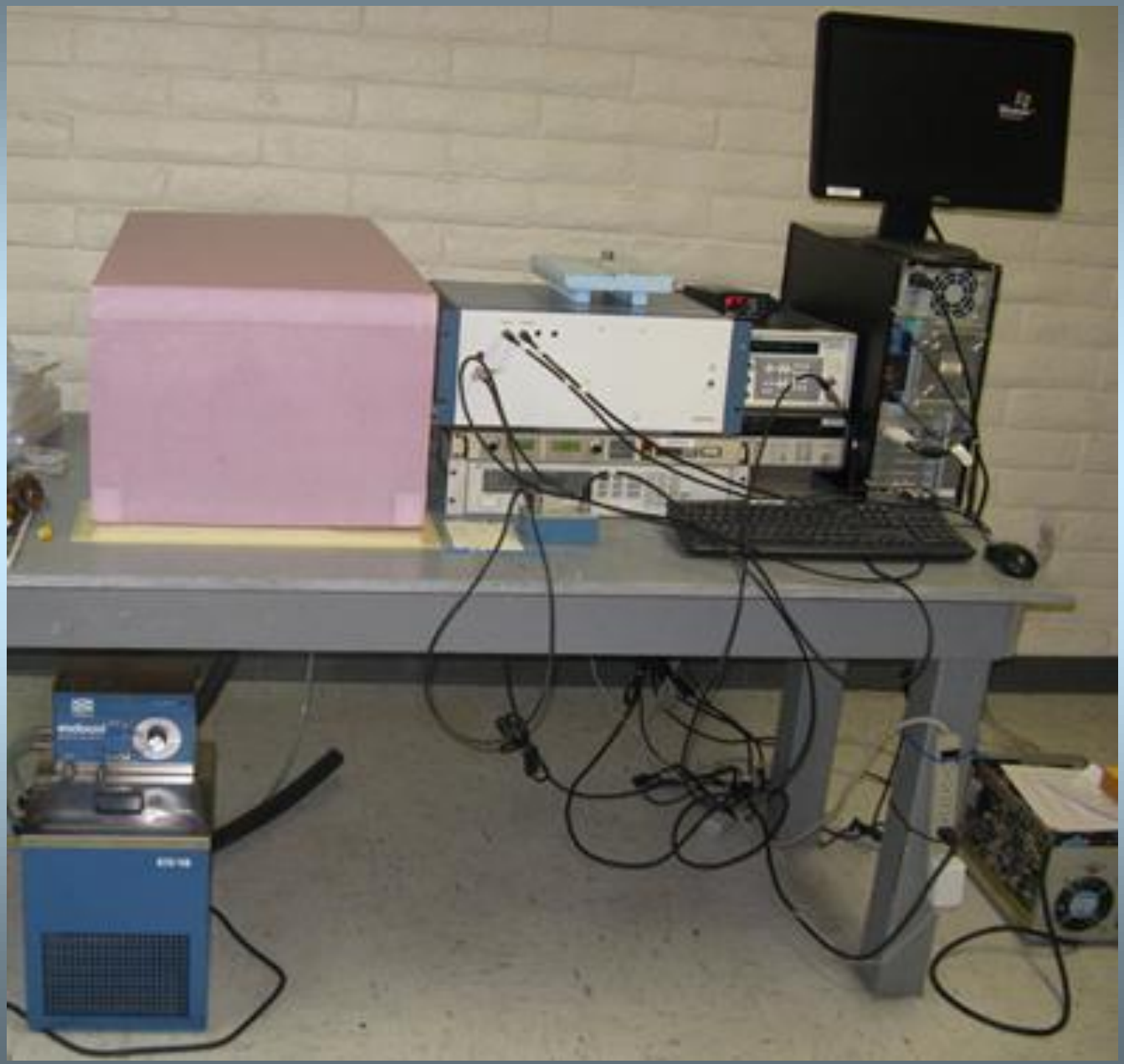


SSD Detector for Post Run Activity

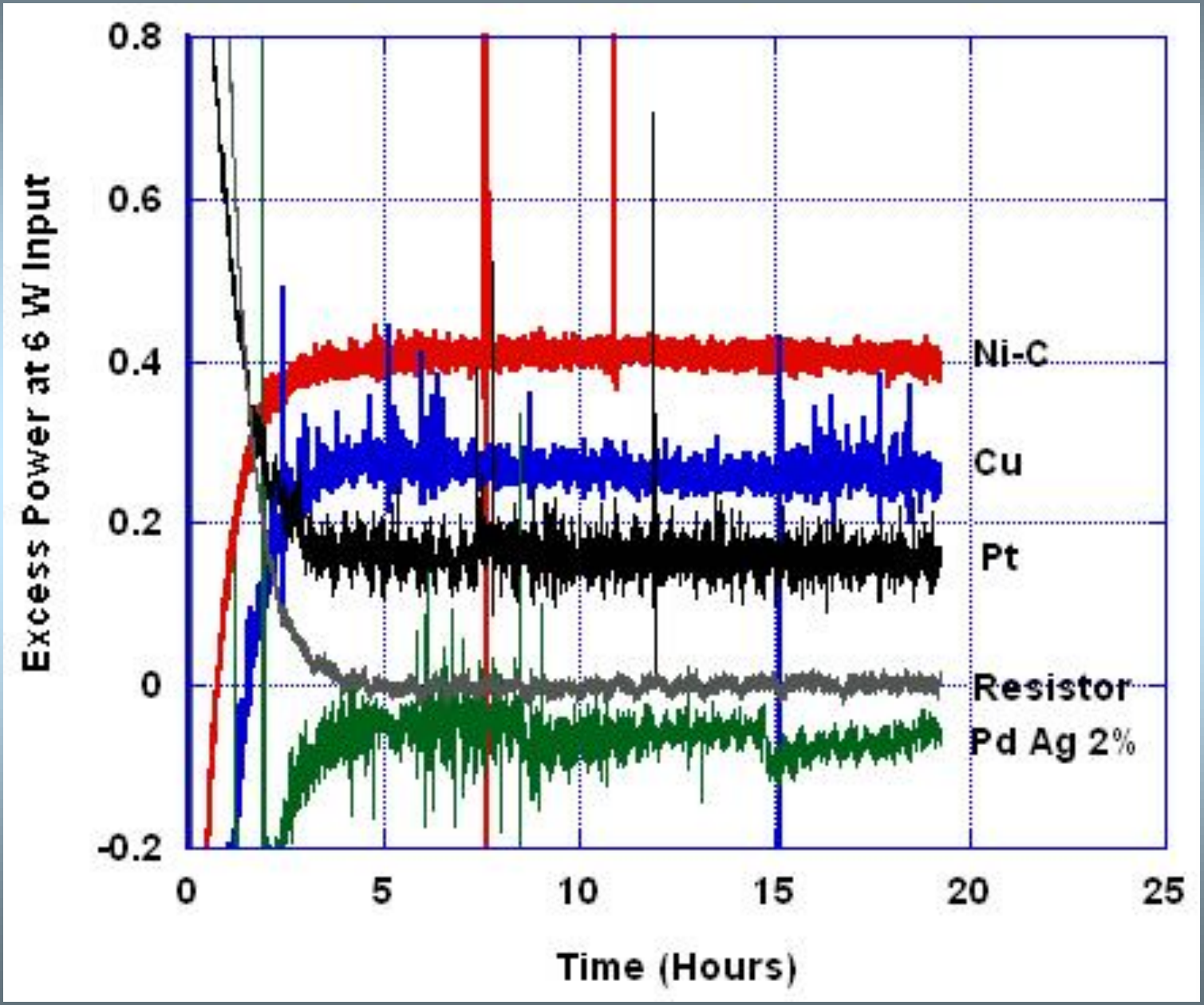
Highest rate over background 20kV-200kV is over twice background
Immediately after removal from plasma cell.



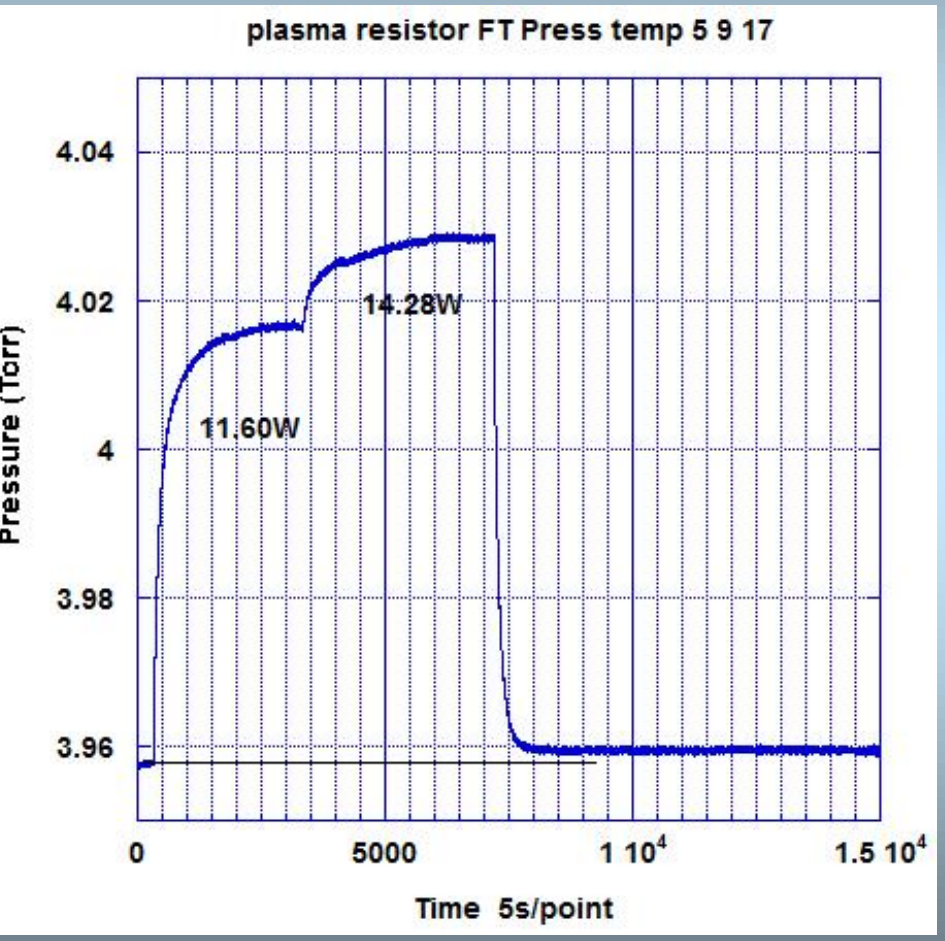
Seebeck Calorimeter

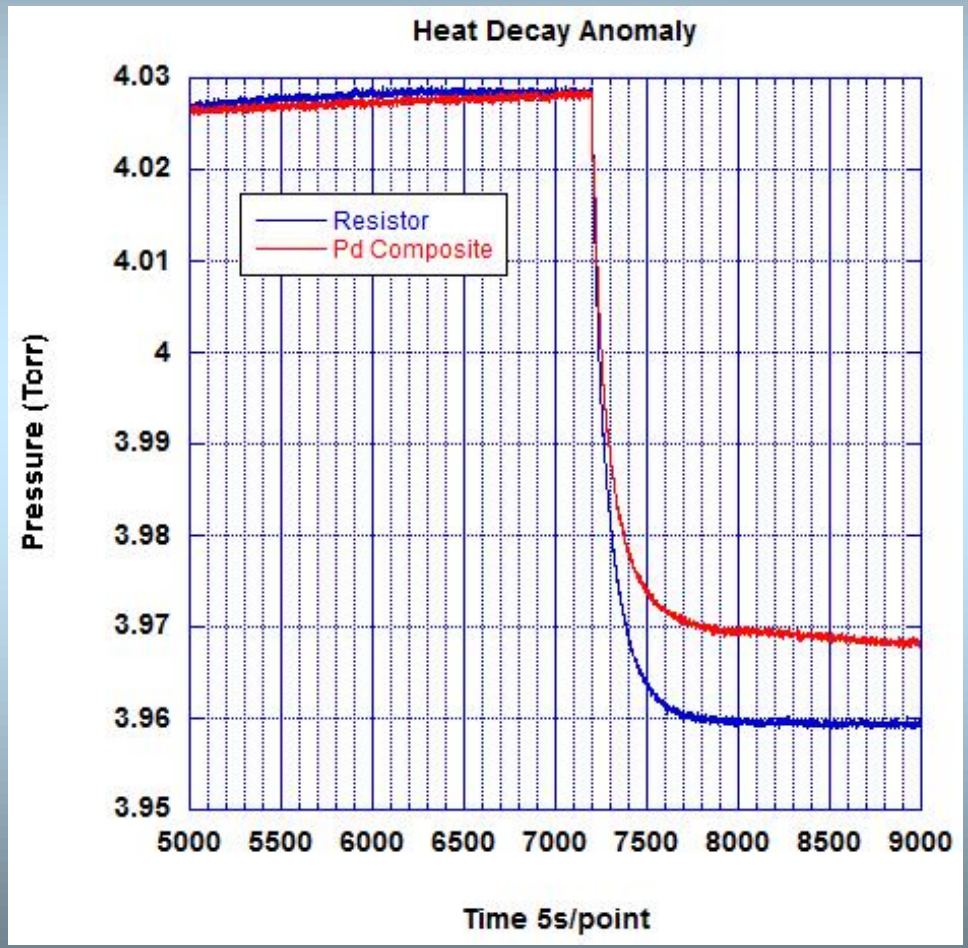


Heat Comparison 6W power input



Pressure Rise/Decay Heat Comparison





Is there Helium?

Gas analysis of initial gas and post-process gas from NiC sample
Finnigan 270 can easily separate ^4He, ^3He peaks from D_2, HD

Gas	^4He	^3He	
D_2 from bottle (lanl)	90±50 ppb (<40ppb)	< 1ppb	Gettered
H_2 bottle (lanl)	150ppb (<40 ppb)	ND	Gettered
Plasma run H/D 24/75	400±200 ppb	<200 ppb	Non Gettered
Plasma run New system	~ 200 ppb	NA	Activated carbon

New ^4He detection system built and tested, more confidence in results and lower error. Numbers in red are new results

Conclusions

Ni Alloy is reproducible,

Tritium can be several sigma over background

Effect can be obtained in 1-2 days

Excess heat is small (~5%) but is it consistent with the Helium data?

If X-ray effect can be increased, then might serve as a quick demo

Pursue pressure indication for excess heat

Parameter space, effects of pressure, electrical driving conditions, temperature, etc. have only been partially explored.

All positive experiments have a common driver, can an engineered material be fabricated to take advantage of this basic understanding?

Acknowlegments

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Anomalous Results from Sonofusion (with Rodger Stringham)

Pd