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RETROSPECTIVE AIR SAMPLING AT ARGONNE NATIONAL LABORATORY

Air Monitoring Users Group Meeting

Palace Station – Las Vegas

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May 5, 2009



U.S. Department
of Energy

UChicago ►
Argonne_{LLC}



Outline

- **Collection Equipment**
- **Counting Instrument QA Checks**
- **Activities Before Radon Decay**
- **Activities After Radon Decay**
- **Comparison of**
 - 4 day Decay & 10 minute count with
 - 7 day Decay & 30 minute count
- **Historical Data from Several Locations**

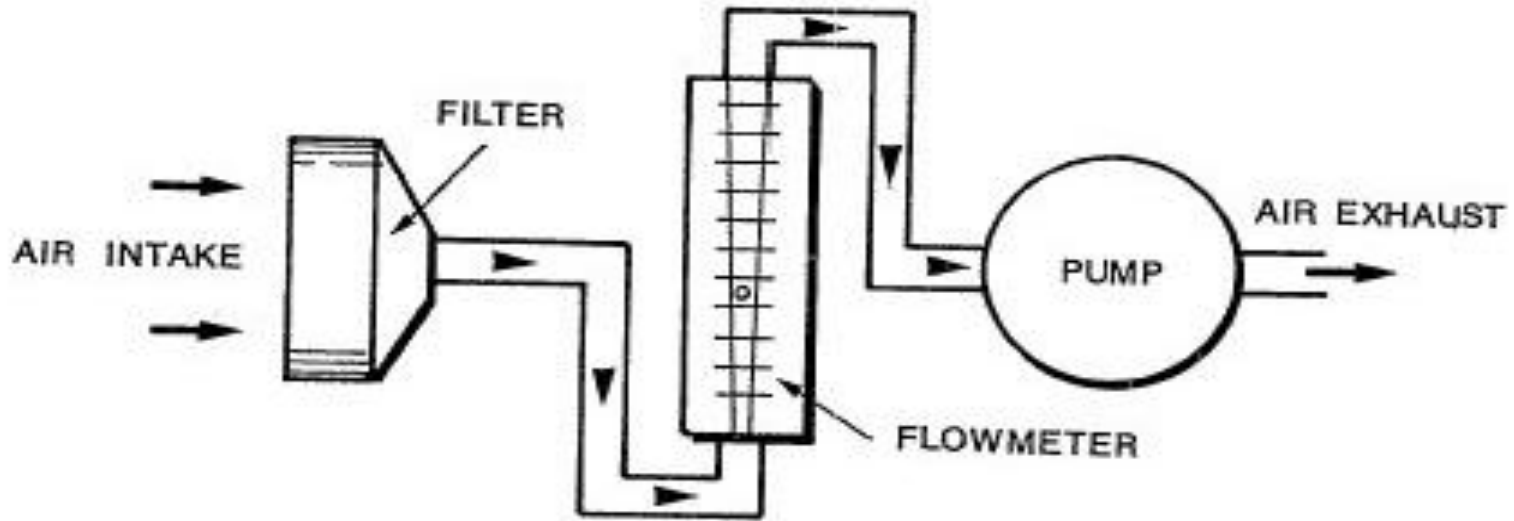
Air Sampling Objectives

- **Identify breakdowns in Engineering Controls**
 - **Locate Sampling Heads In or Near the Breathing Zone**
 - *At the Face of Hoods and Gloveboxes*
 - **Flow Studies are needed in some cases to Verify Sample Locations**
- **Trigger Special Bioassay Samples**
- **Document Airborne Radiological Conditions when Engineering Controls are needed**

Outline

■ **Collection Equipment**

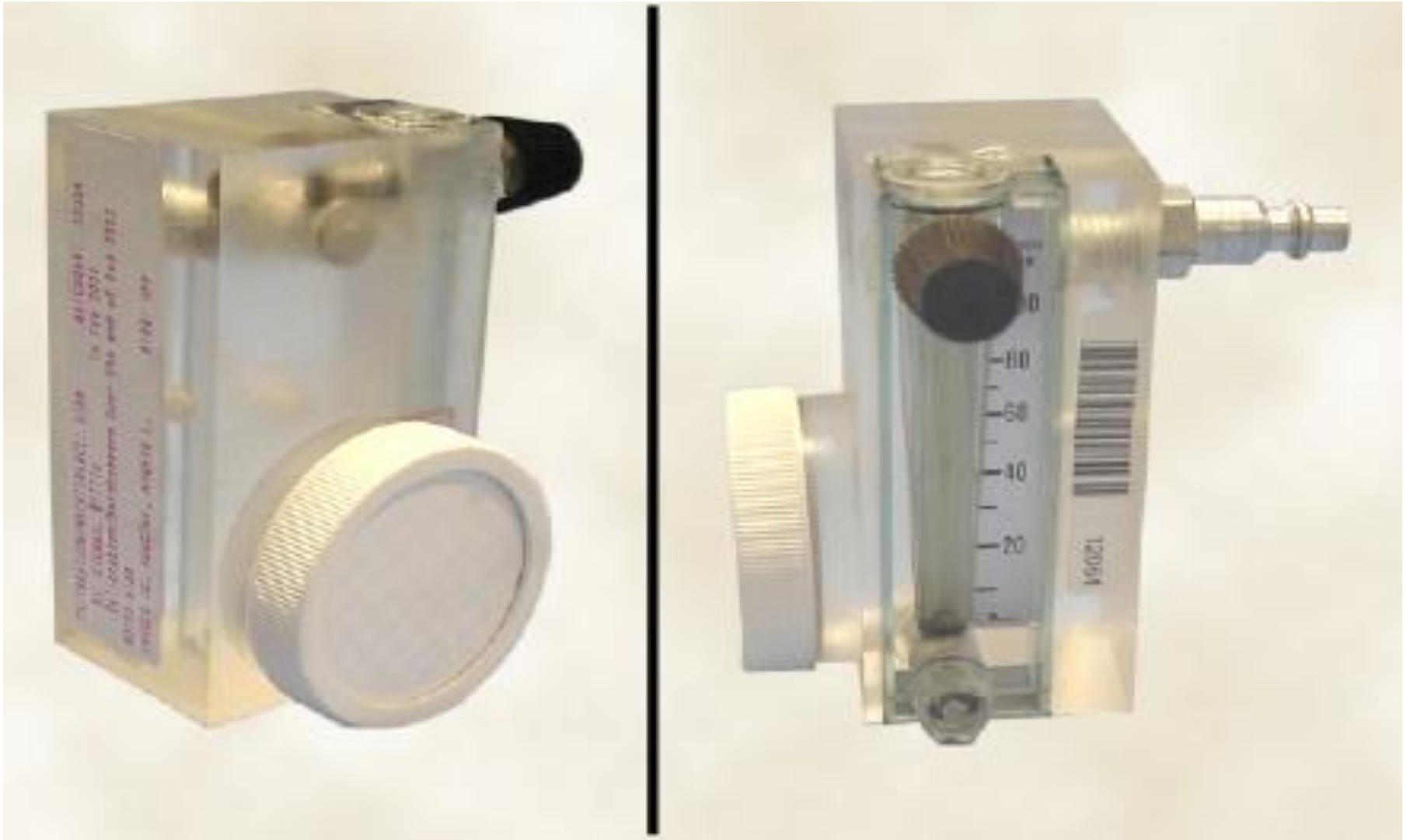
Aerosol Collection via Filtration



■ Basic system components:

- 1) Glass fiber filter (particles usually embedded in filter matrix) Membrane filters (surface deposition; higher ΔP)
- 2) Filter holder assembly
- 3) Rotameter to measure the flow rate
- 4) Rotary vane pump

ANL-Designed Retrospective Air Sampler



Air Sample Installation

Fixed Location



Portable



Distribution of Sampling Heads as of 4/1/09

Building	No. Rooms	No. Locations
200 – Radio Chemistry Labs	29	63
203 – Physics	2	5
205 – Chemical Technology	21	122
206 – Walk In Hood	3	4
212 – Hot Cells & Gloveboxes	22	74
306 – Waste Management	9	22
308 – Cathode Processor	1	6
315 – Walk in Hood	1	2
Weekly Totals	88	298
Total Yearly Samples		15,198

Outline

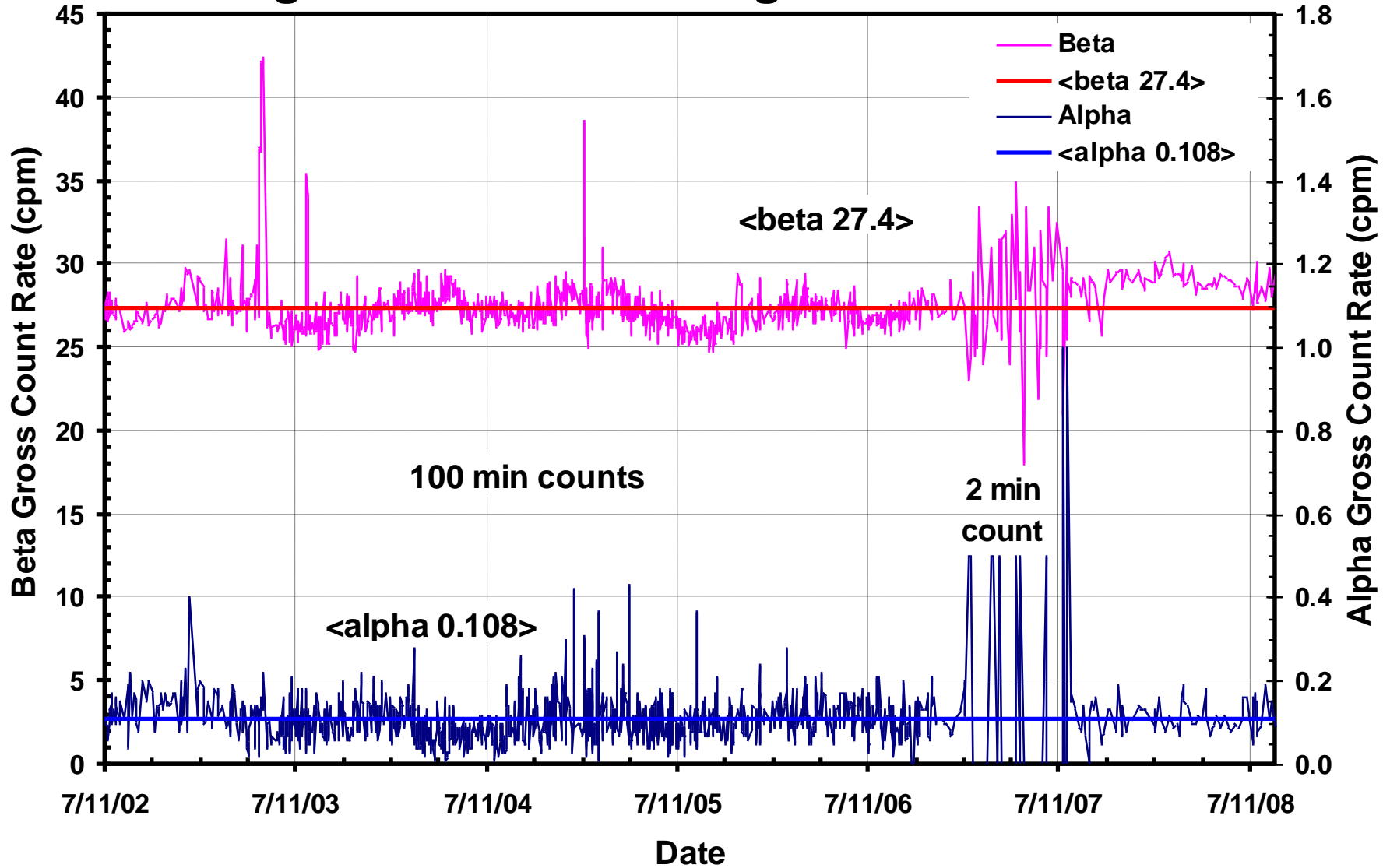
■ **Counting Instrument QA Checks**

Sample Counting System

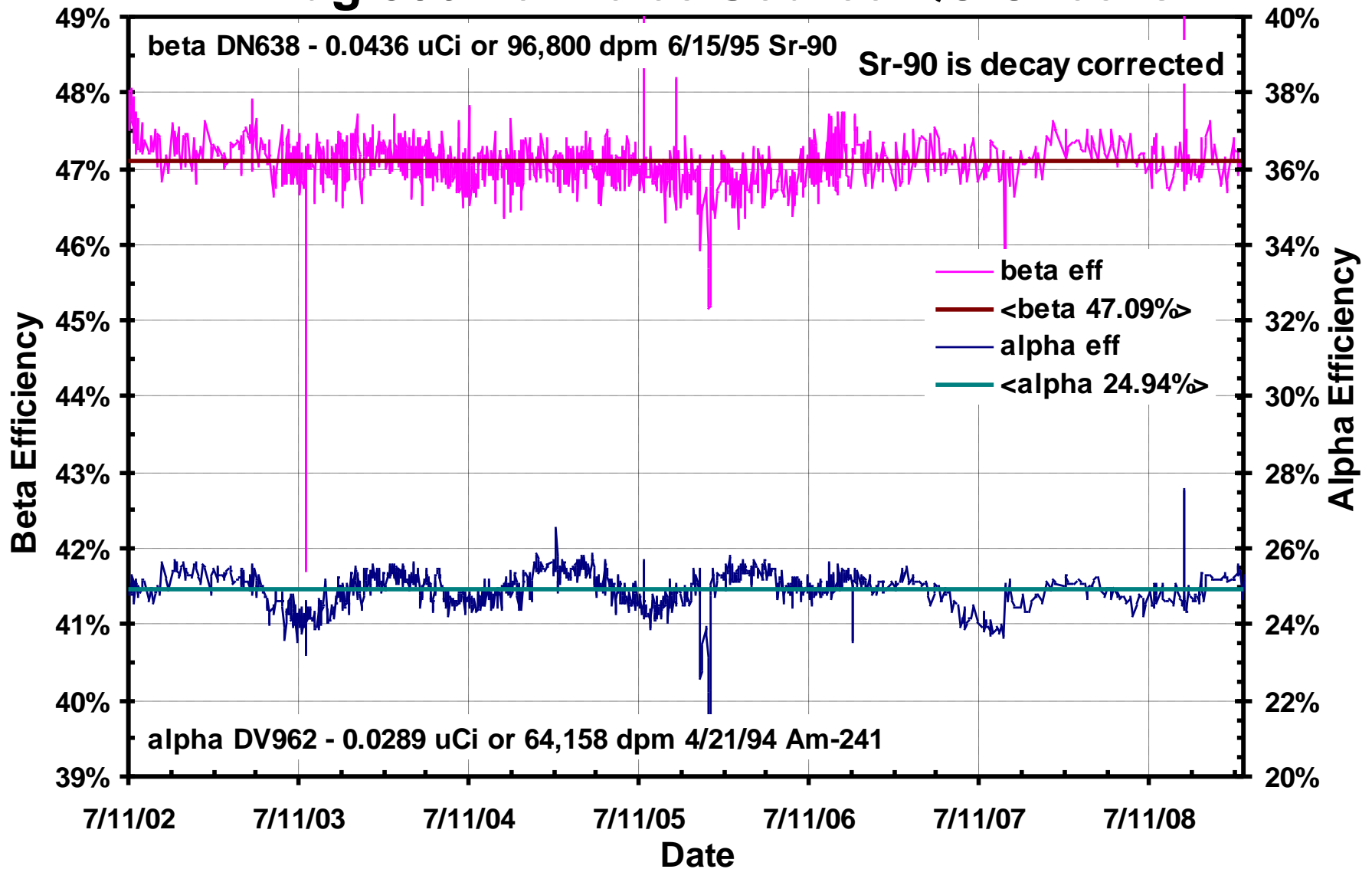
- **Gas Flow Proportional Counters**
 - Located in the Area Offices
 - Automatic Sample Changers

- **Improvement Starting January 2009**
 - Centralized Counting System

Bldg 306 Tennelec Background QC Checks



Bldg 306 Tennelec Source QC Checks



POST-PERFORMANCE ACTIVITY: SAMPLE ANALYSIS AND EVALUATION

– Evaluation and Investigation

- An investigation must be performed if the 10-minute count of the air sample yields any of the results given below:

■ TABLE 6.3-1 Investigation Levels

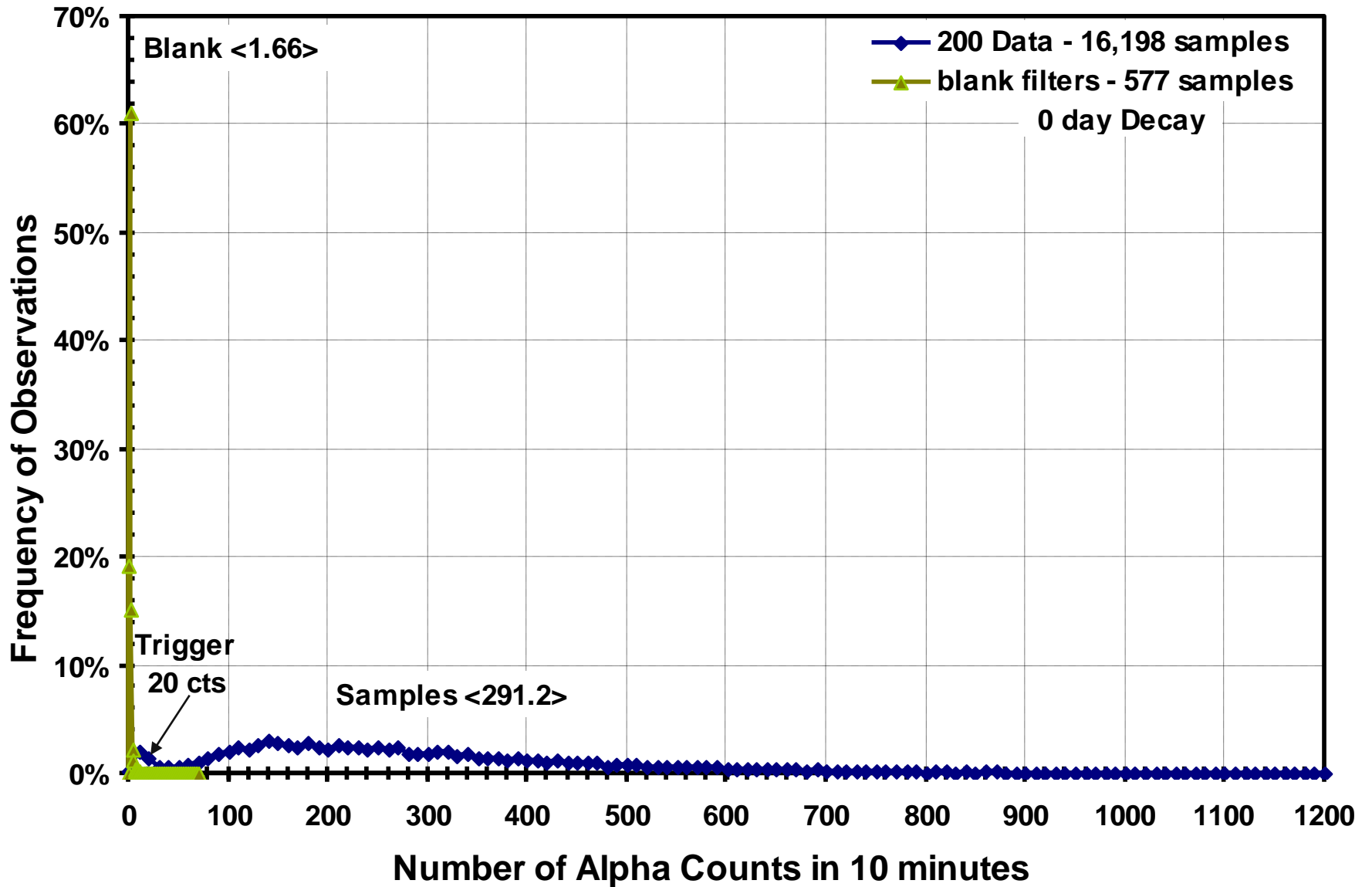
Minimum Detectable Concentration for 40 L/min flow rate 7 day collection ≥ 4 day decay	α Pu-239	β Sr-90
		≥ 0.8 DAC-hr 2 cts/min

- All air samples with activity exceeding the investigation level have follow-up radiochemical analyses performed.

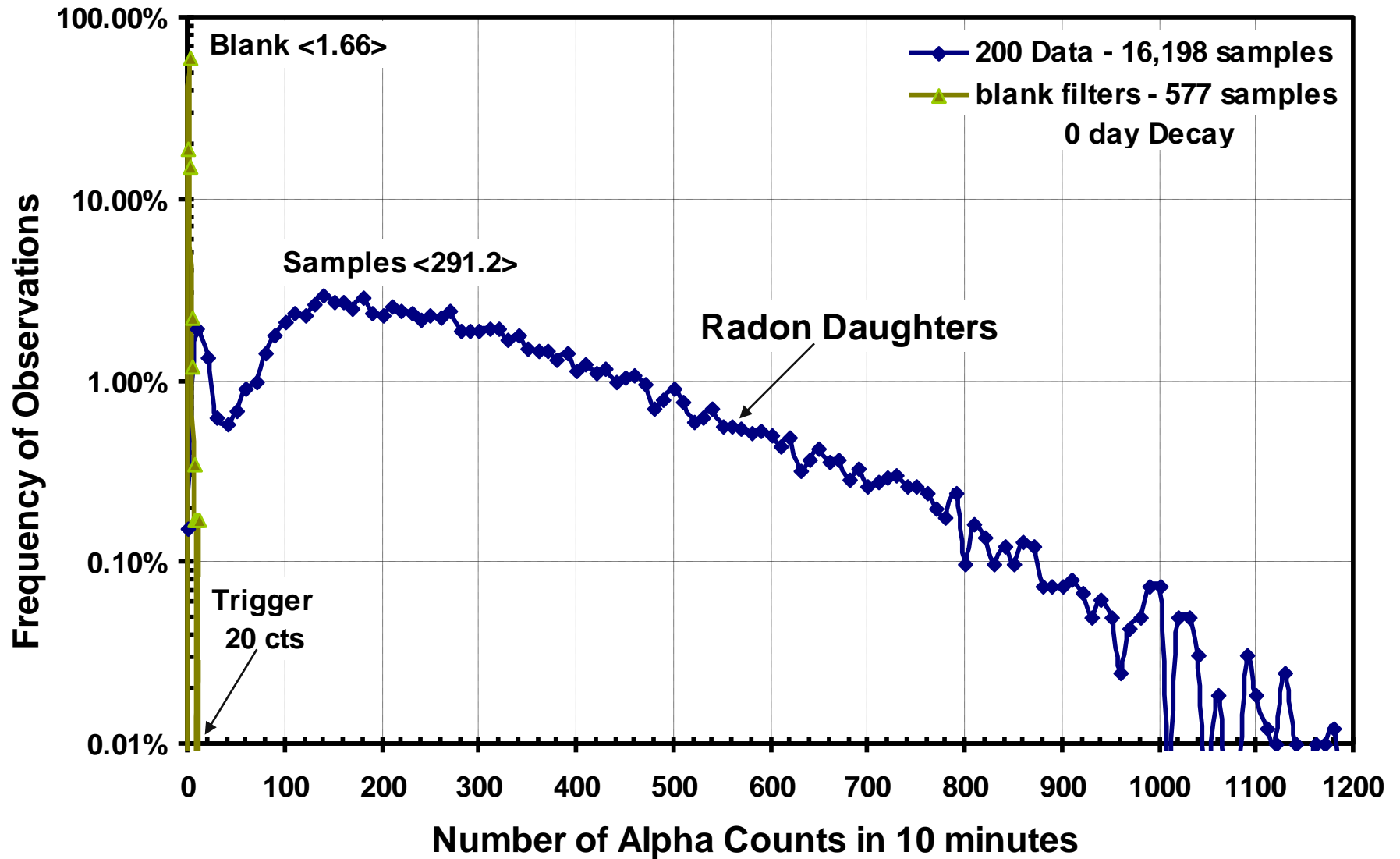
Outline

■ **Activities Before Radon Decay**

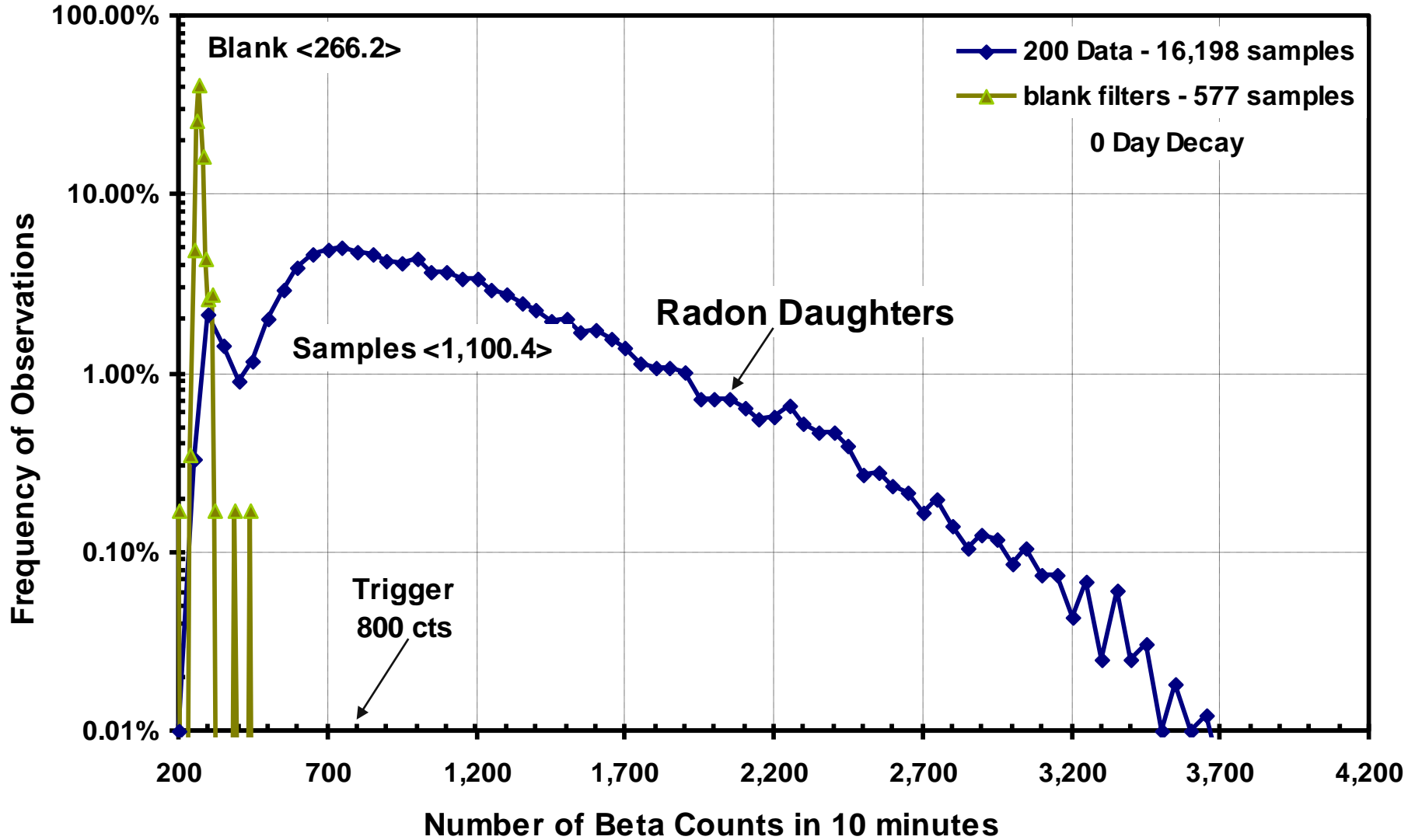
Retrospective Samples - Alpha Before Rn Decay



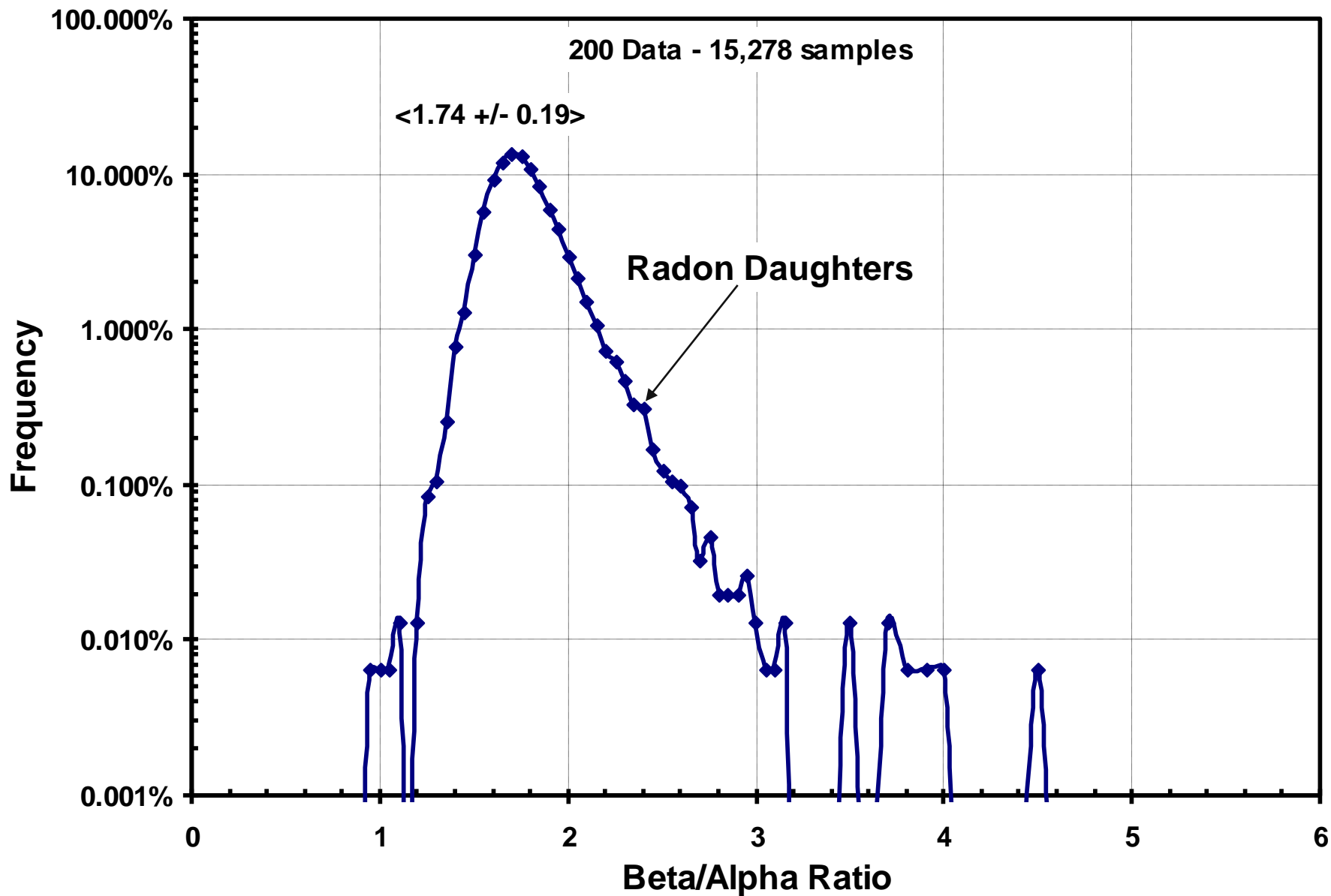
Retrospective Samples - Alpha Before Rn Decay



Retrospective Samples - Beta Before Rn Decay



Retrospective Air Sample Bldg 200 First Count Beta/Alpha Ratios



Outline

■ **Activities After Radon Decay**

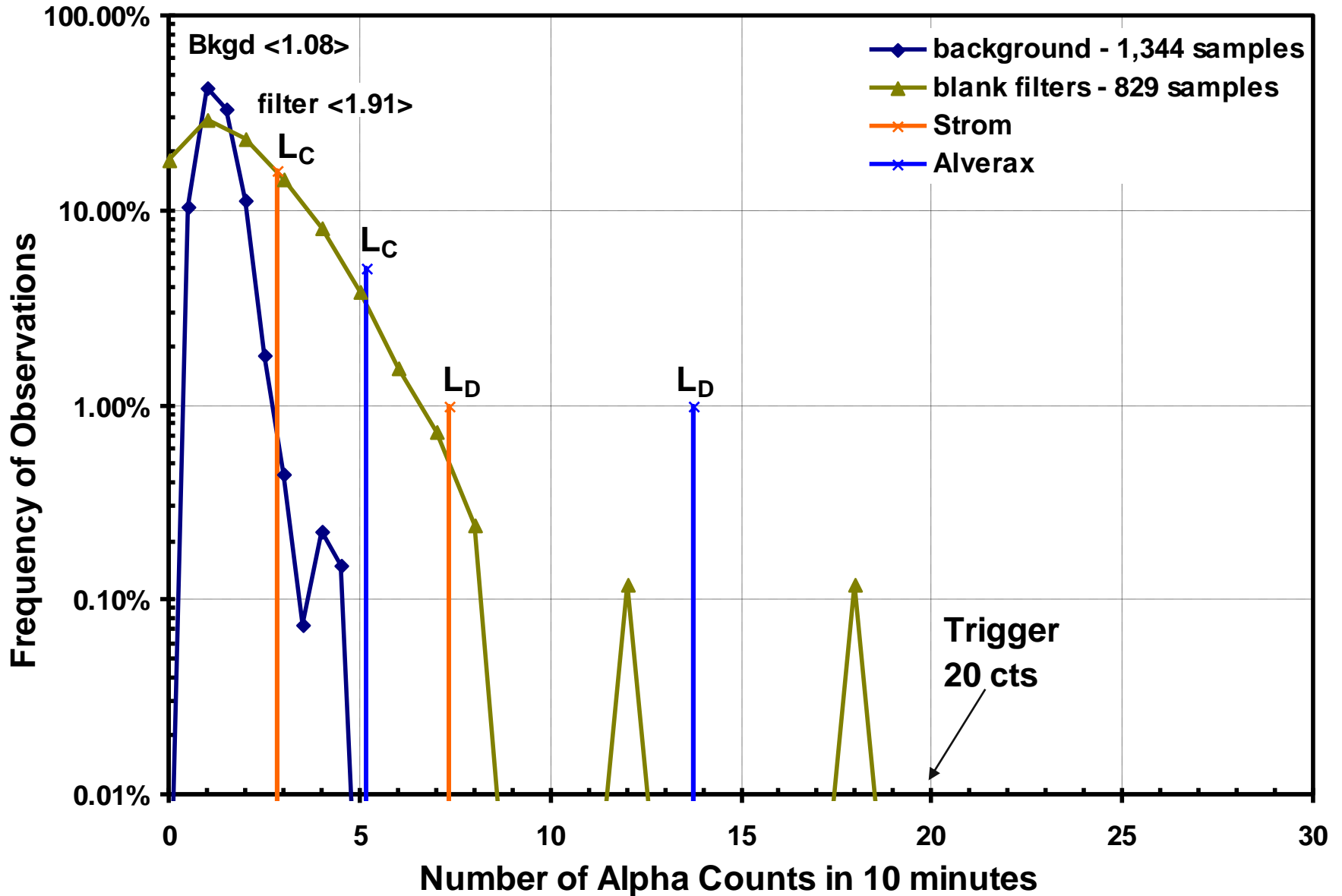
Calculation of L_C and L_D for a one sided confidence level at 95%

Strom	Alvarez
$L_C = k \text{ SQRT}[\mu_B t_s (1 + t_s/t_b)]$	$L_C = [k^2 + \text{SQRT}(k^4 + 8k^2 \mu_B)]/2$
$L_D = k^2 + 2 L_C$	$L_D = [4k^2 + \text{SQRT}(16k^4 + 32k^2 \mu_B)]/2$

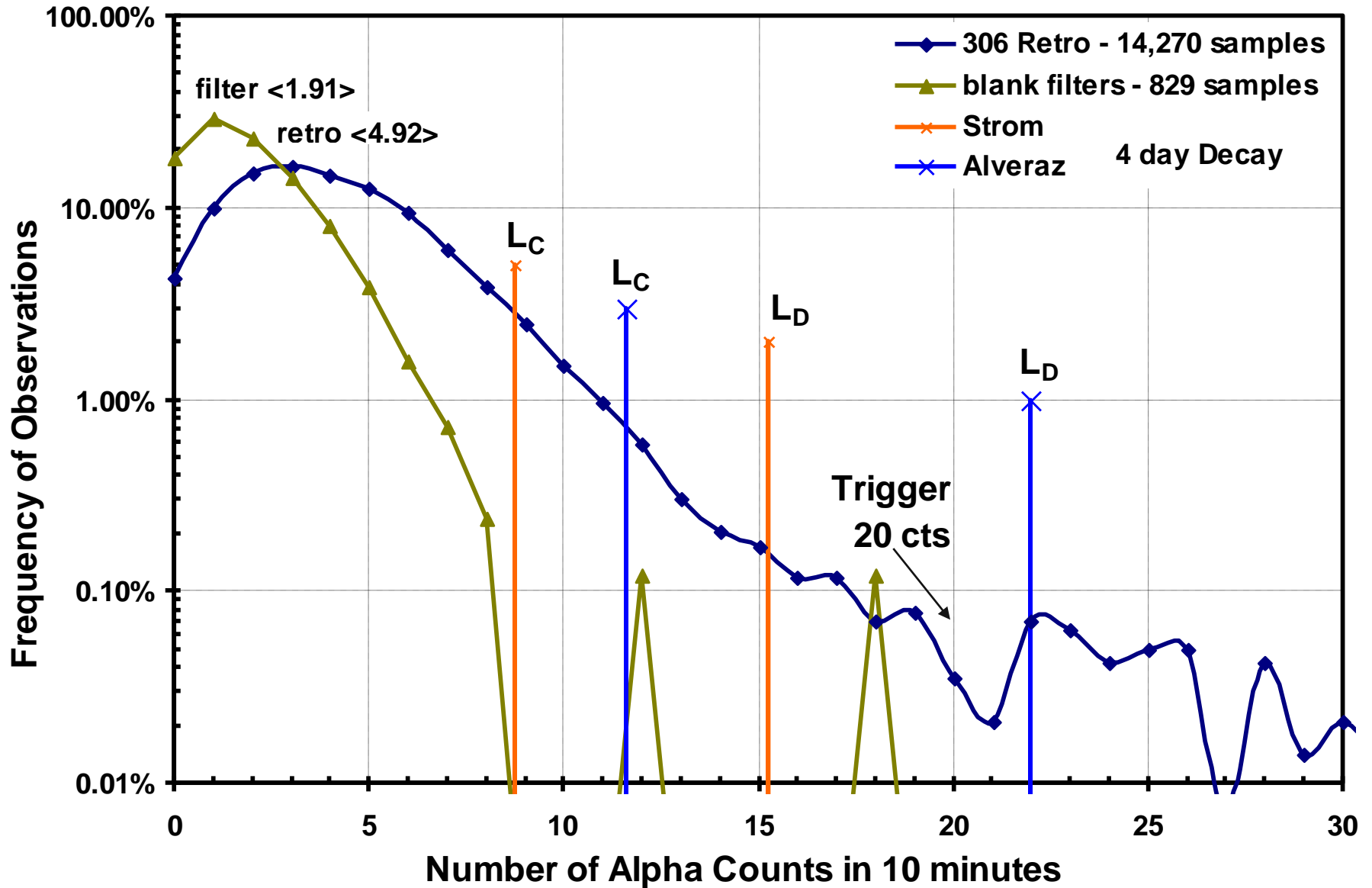
t_s	10	t_b	100
k	1.645	$2k$	3.29
k^2	2.706	k^4	7.323

	Strom		Alvarez		Strom		Alvarez	
	alpha	beta	alpha	Beta	alpha	beta	alpha	Beta
Bkgd (μ_B)	1.08	273.8	1.08	273.8	4.92	340.2	4.92	340.2
L_C	1.79	28.6	4.12	39.9	3.83	31.8	6.68	44.3
$L_C + \text{bkgd}$	2.87	301.4	5.20	313.7	8.74	372.0	11.60	384.5
L_D	6.29	59.8	12.66	82.6	10.36	66.4	17.06	91.4
$L_D + \text{bkgd}$	7.36	332.6	13.74	356.4	15.27	406.6	21.98	431.6

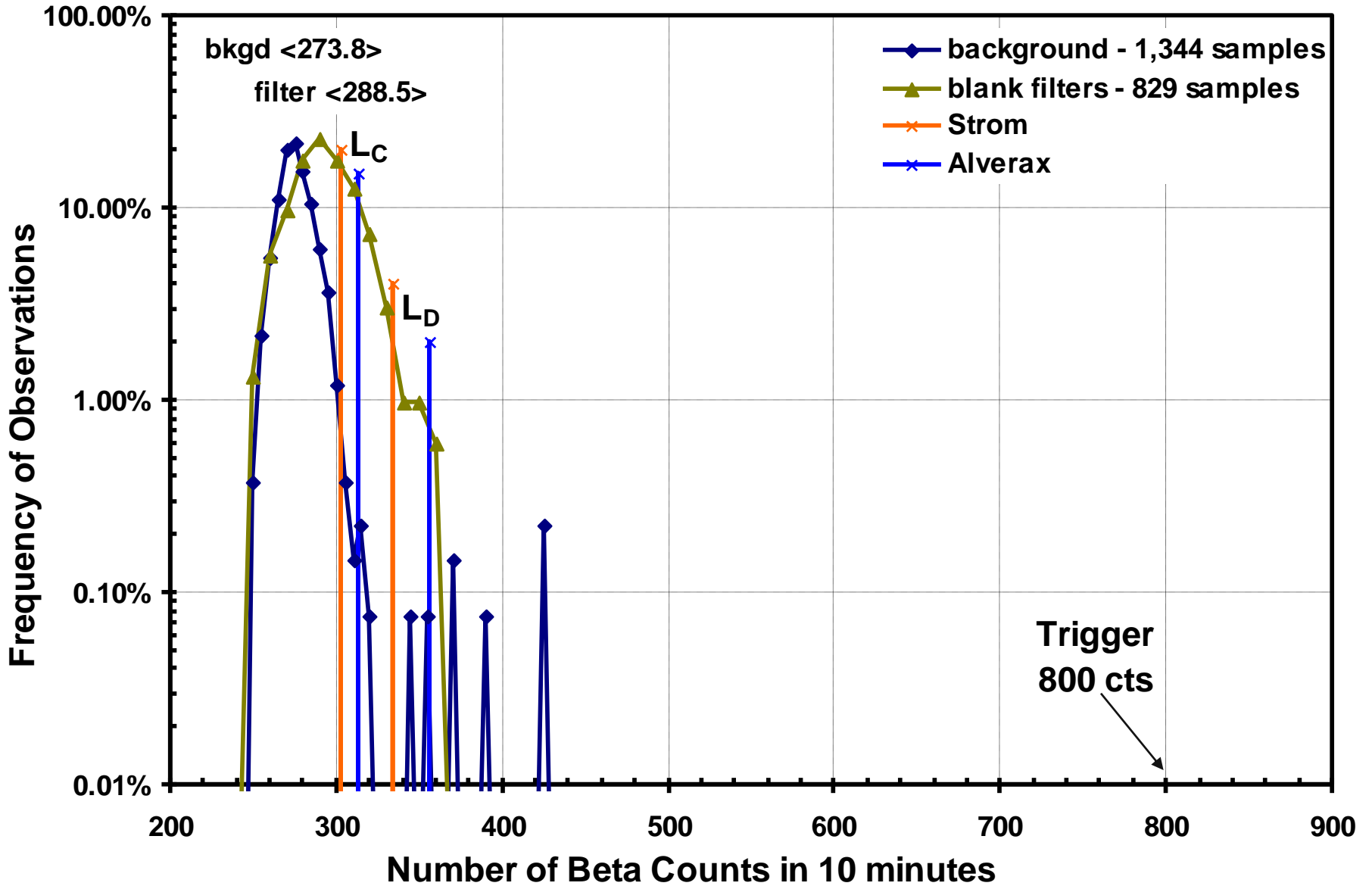
Background Alpha Activity



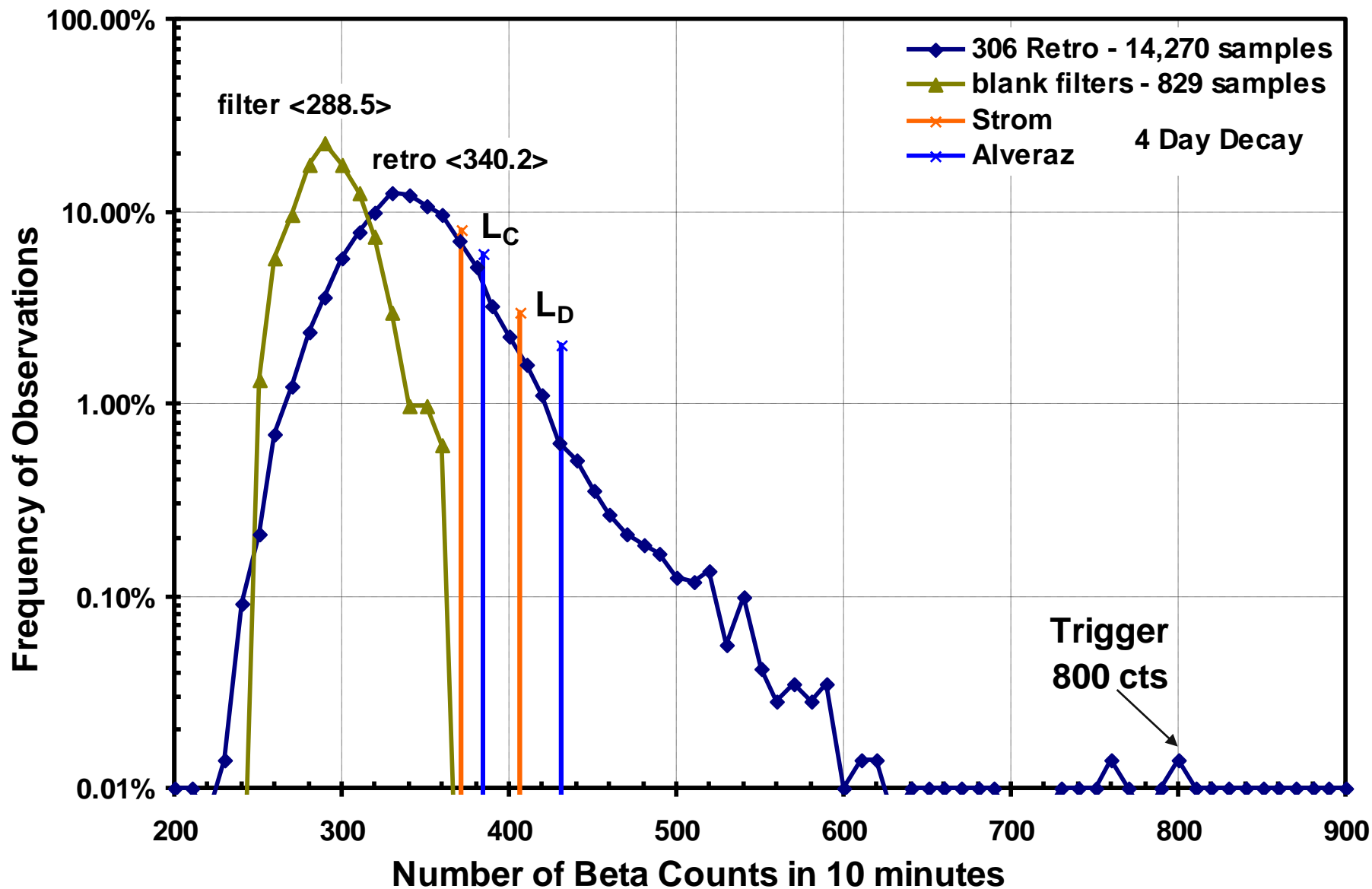
Retro Air Sample Bldg 306 Alpha Distribution



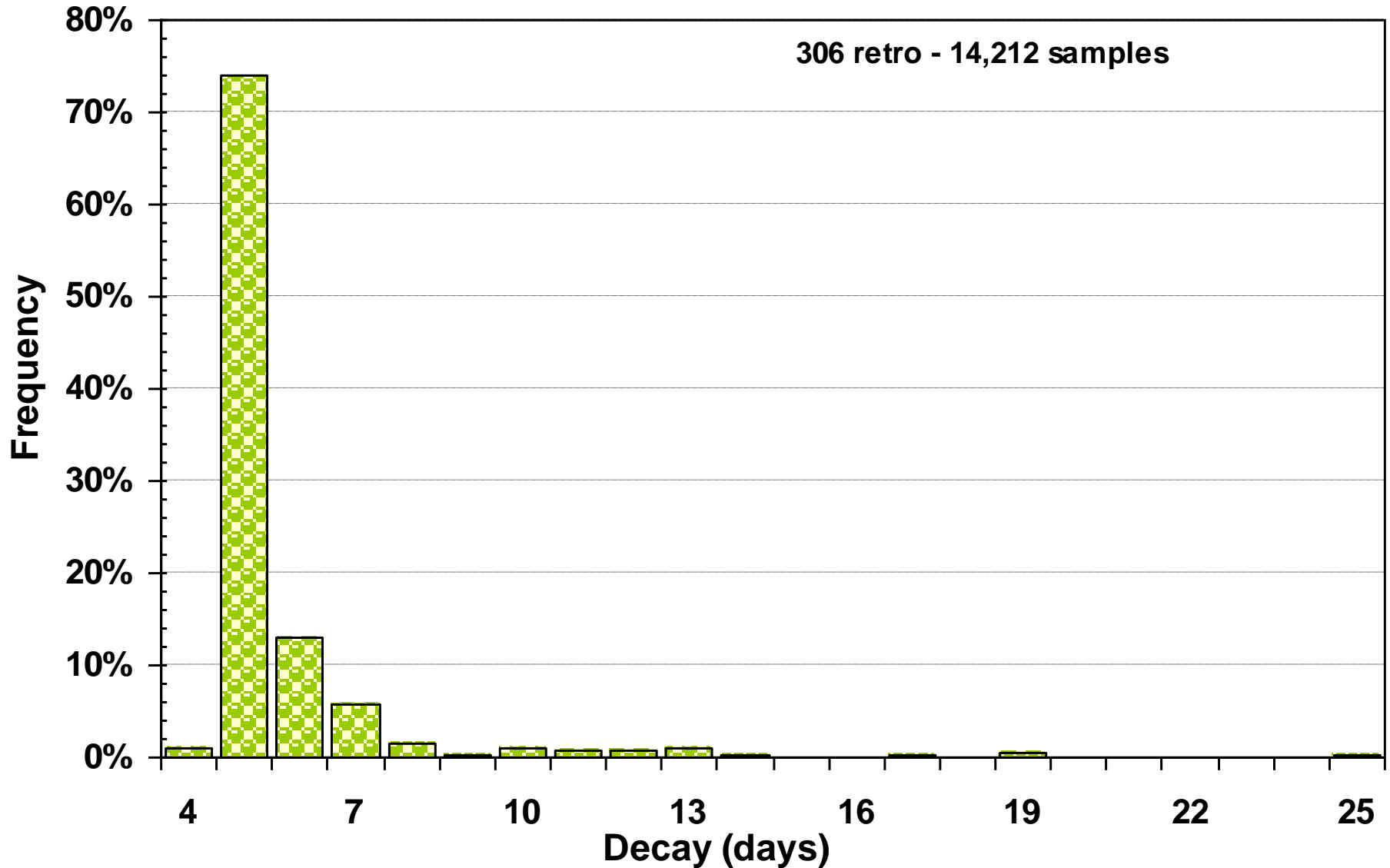
Background Beta Activity



Retrospective Air Sample Bldg 306 Beta Distribution



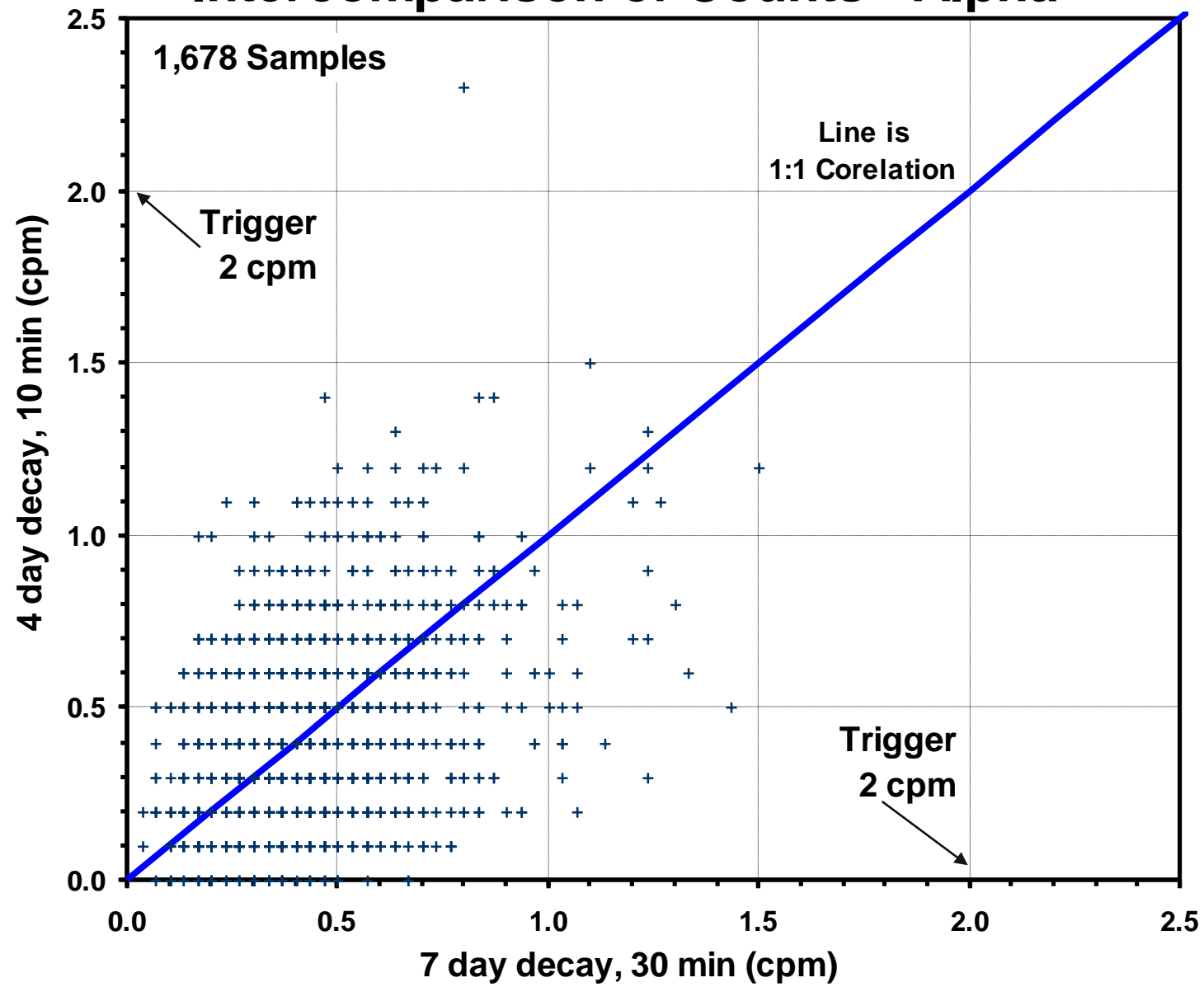
Decay Times for Bldg 306 Retro Samples



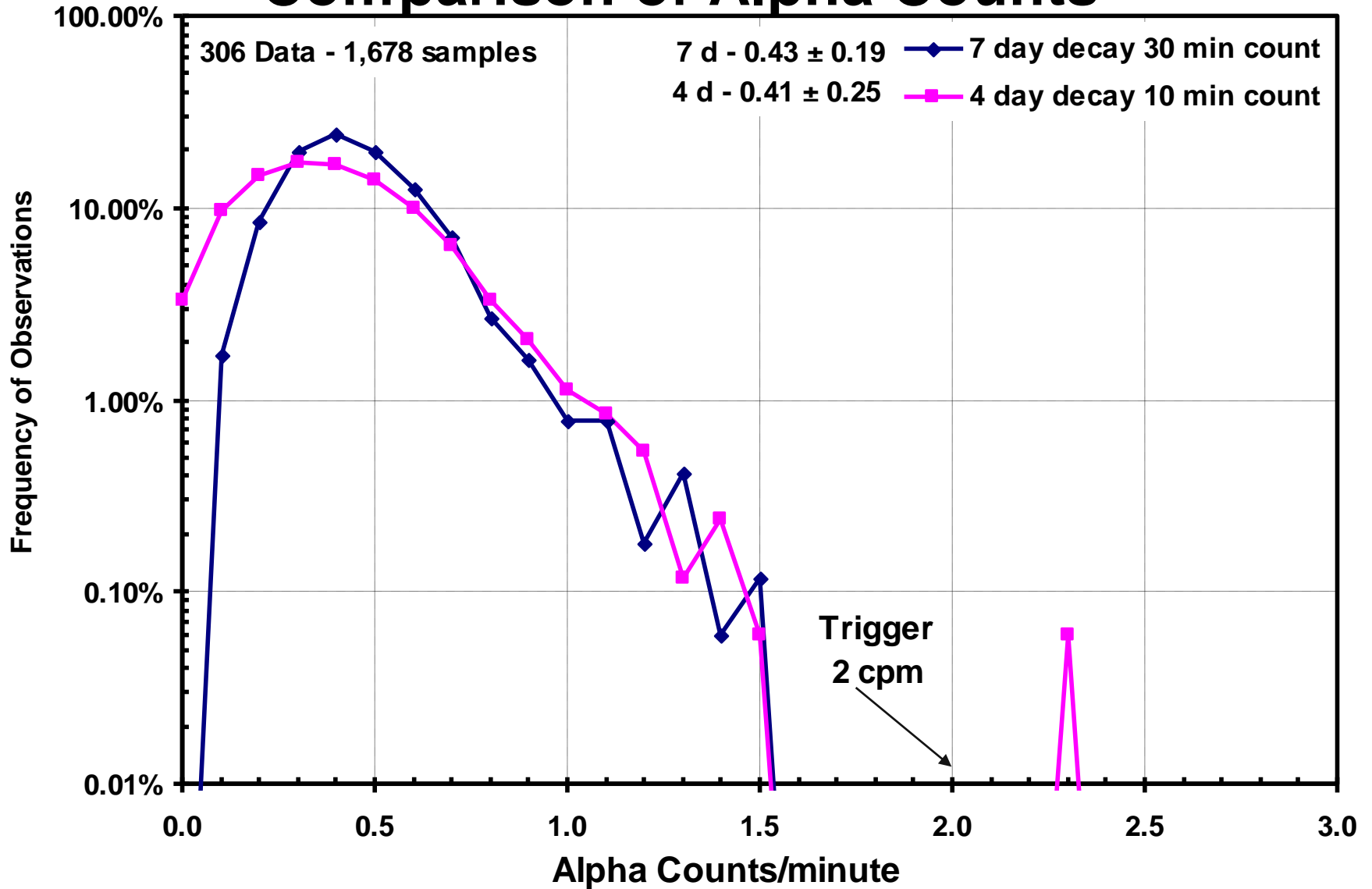
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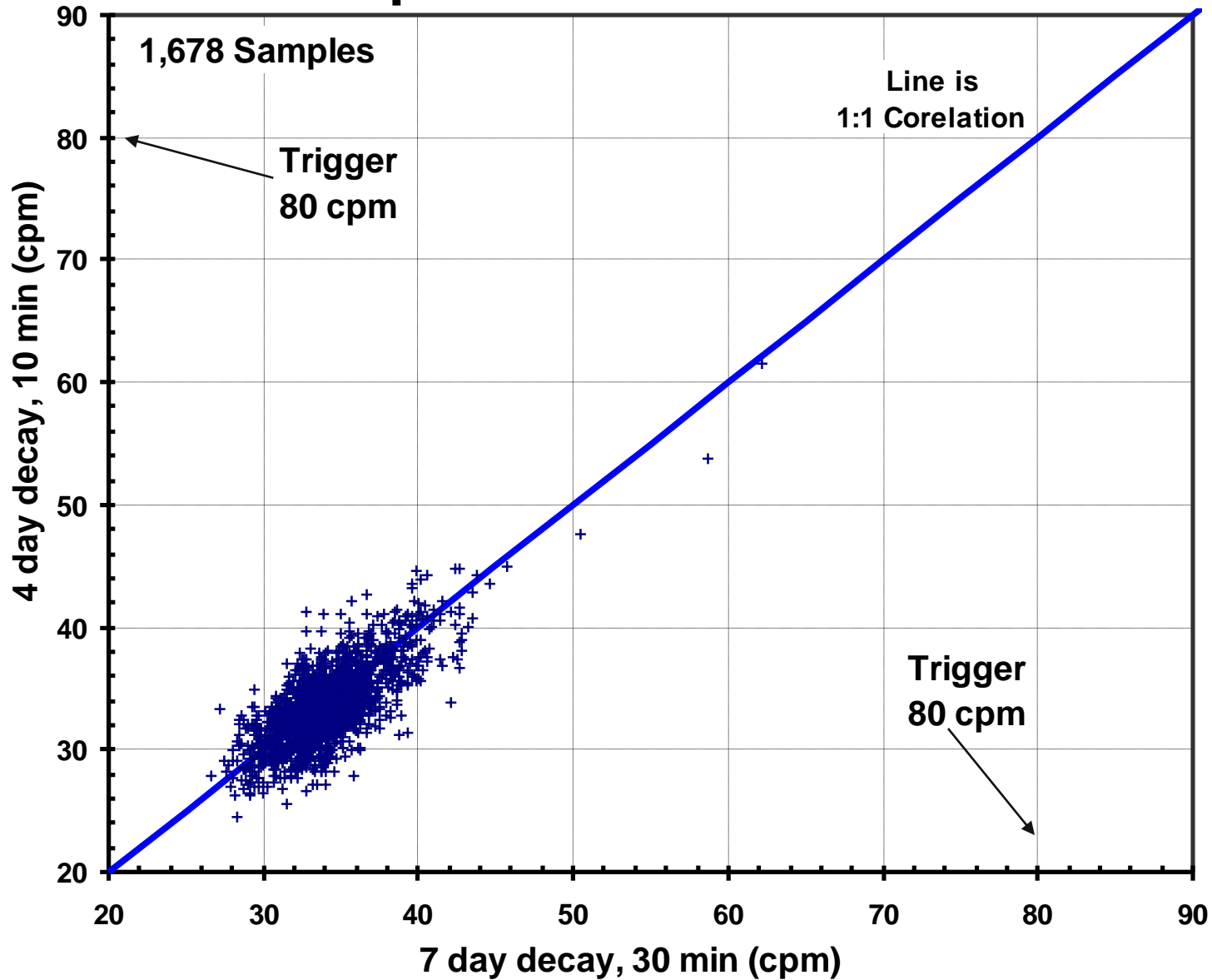
Intercomparison of Counts - Alpha



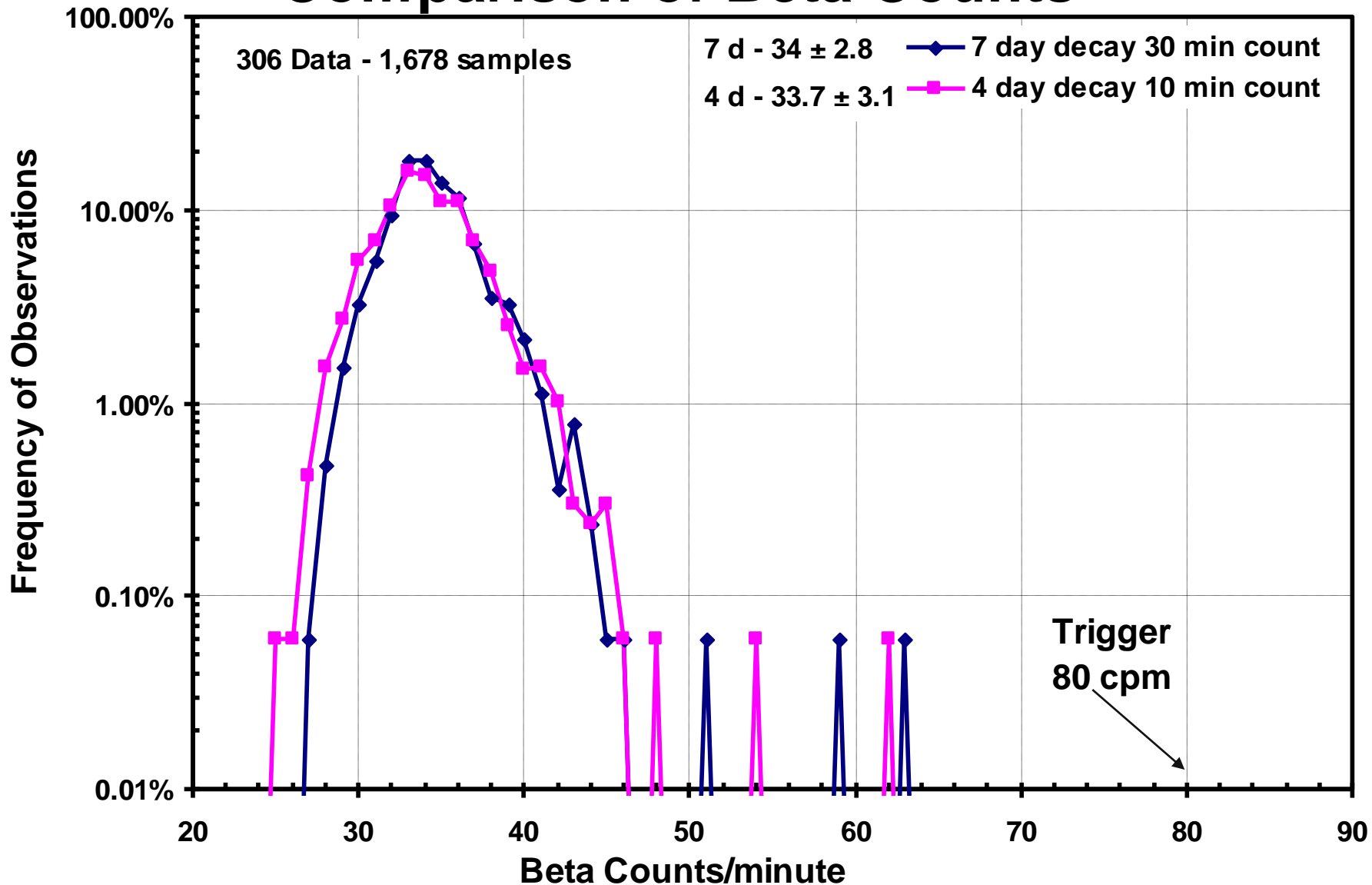
Comparison of Alpha Counts



Intercomparison of Counts - Beta



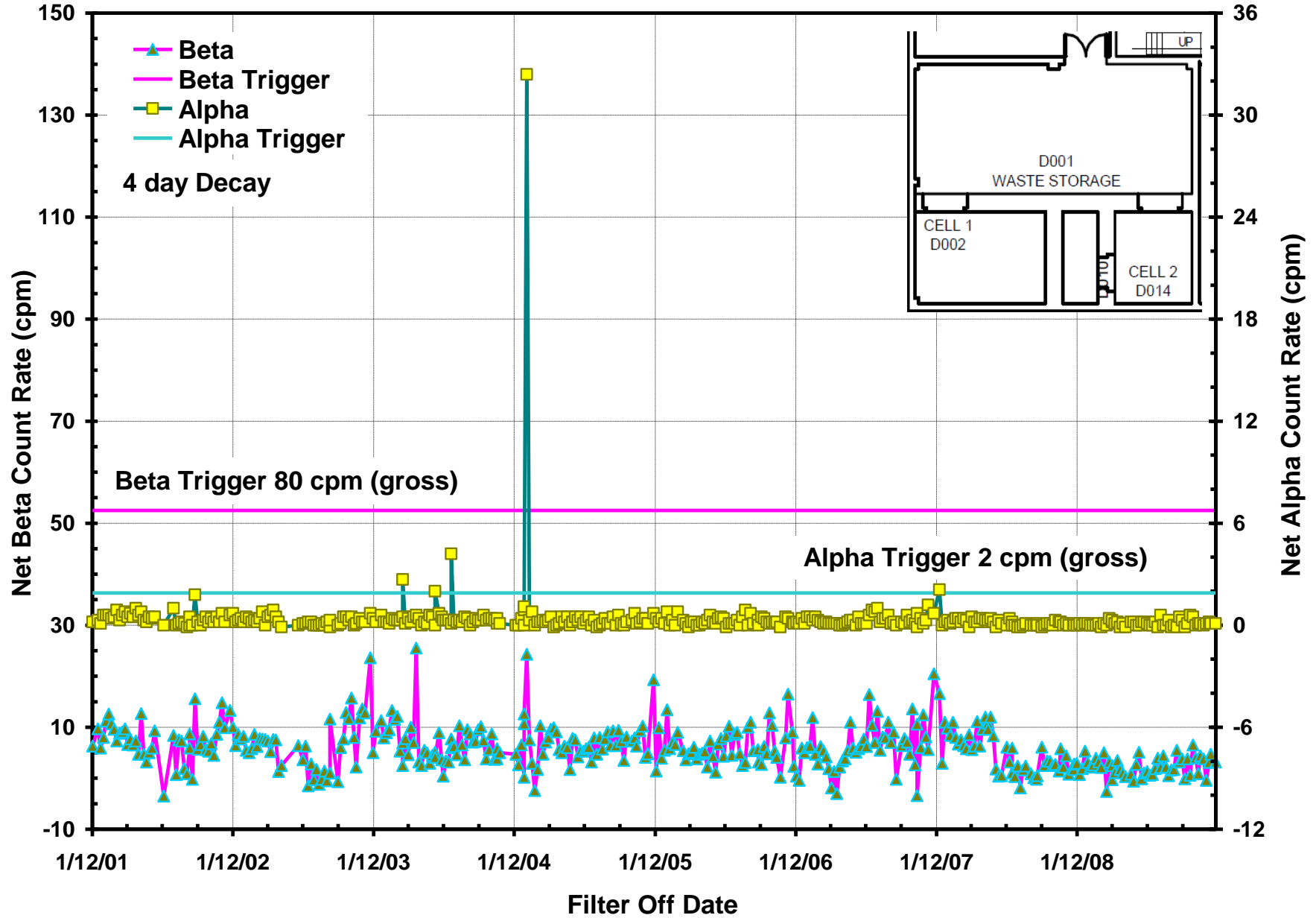
Comparison of Beta Counts



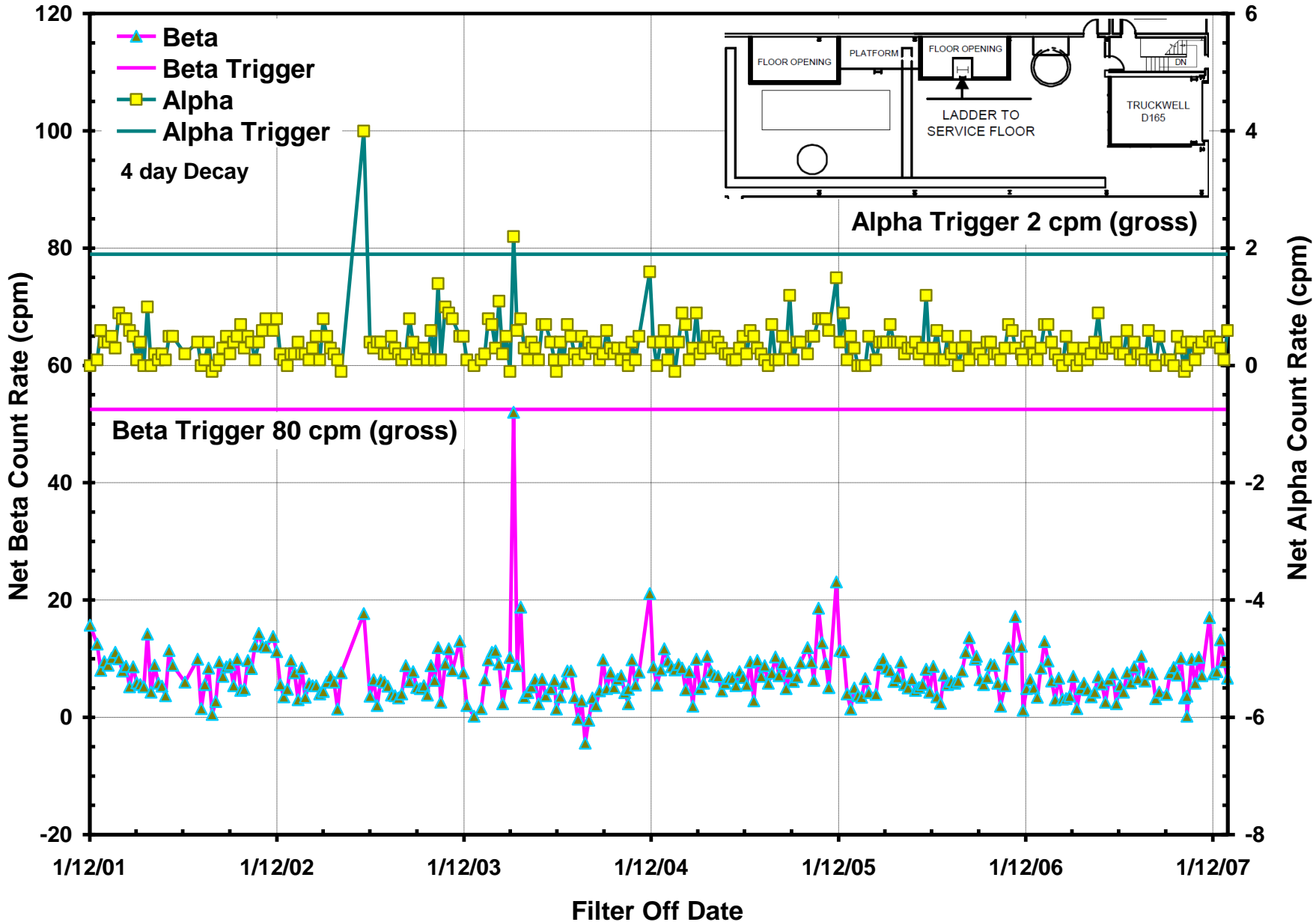
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■ **Historical Data from Several Locations**

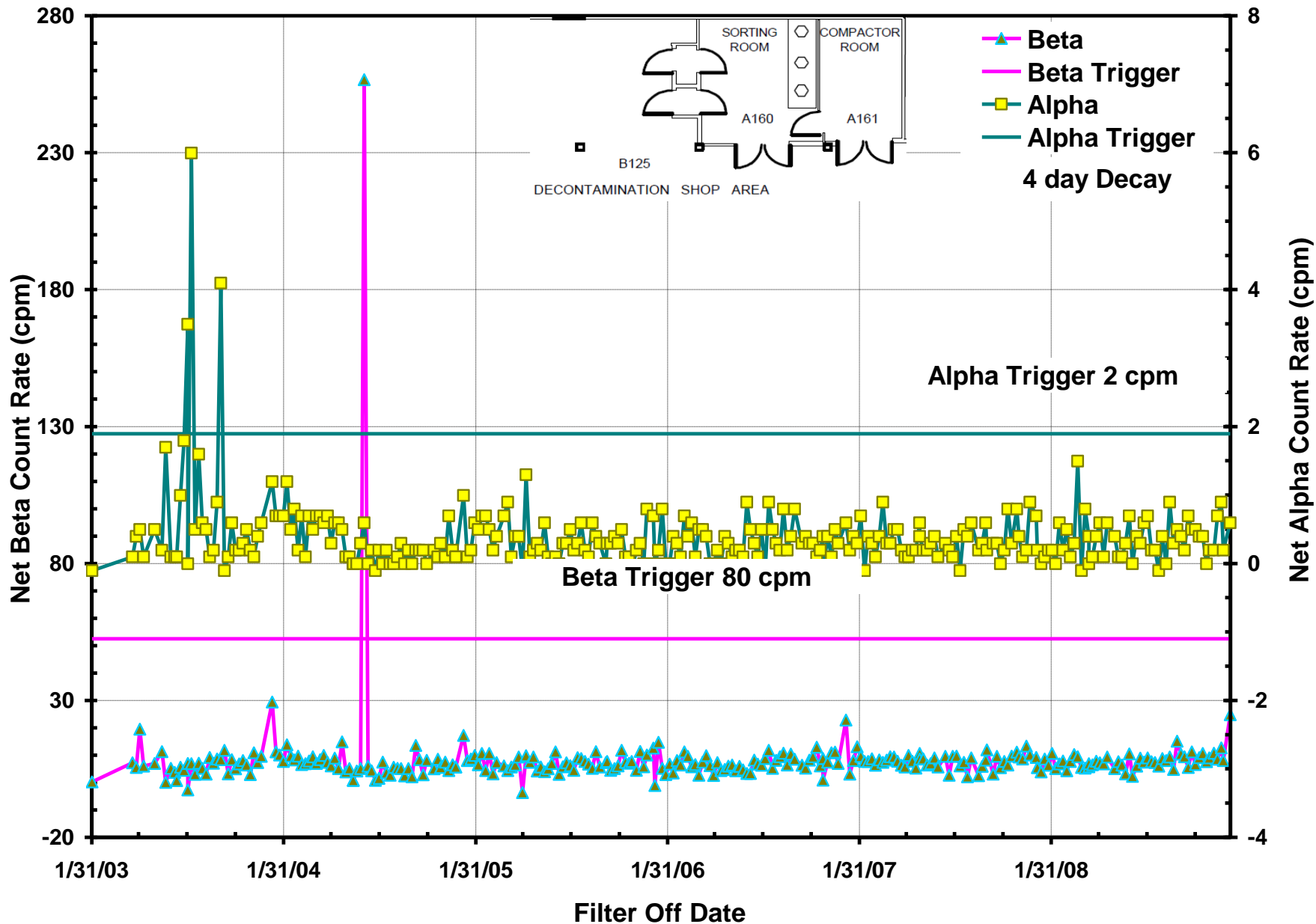
Weekly Air Samples; Location #1 - Room D001 by Cell 1 (D002) Door



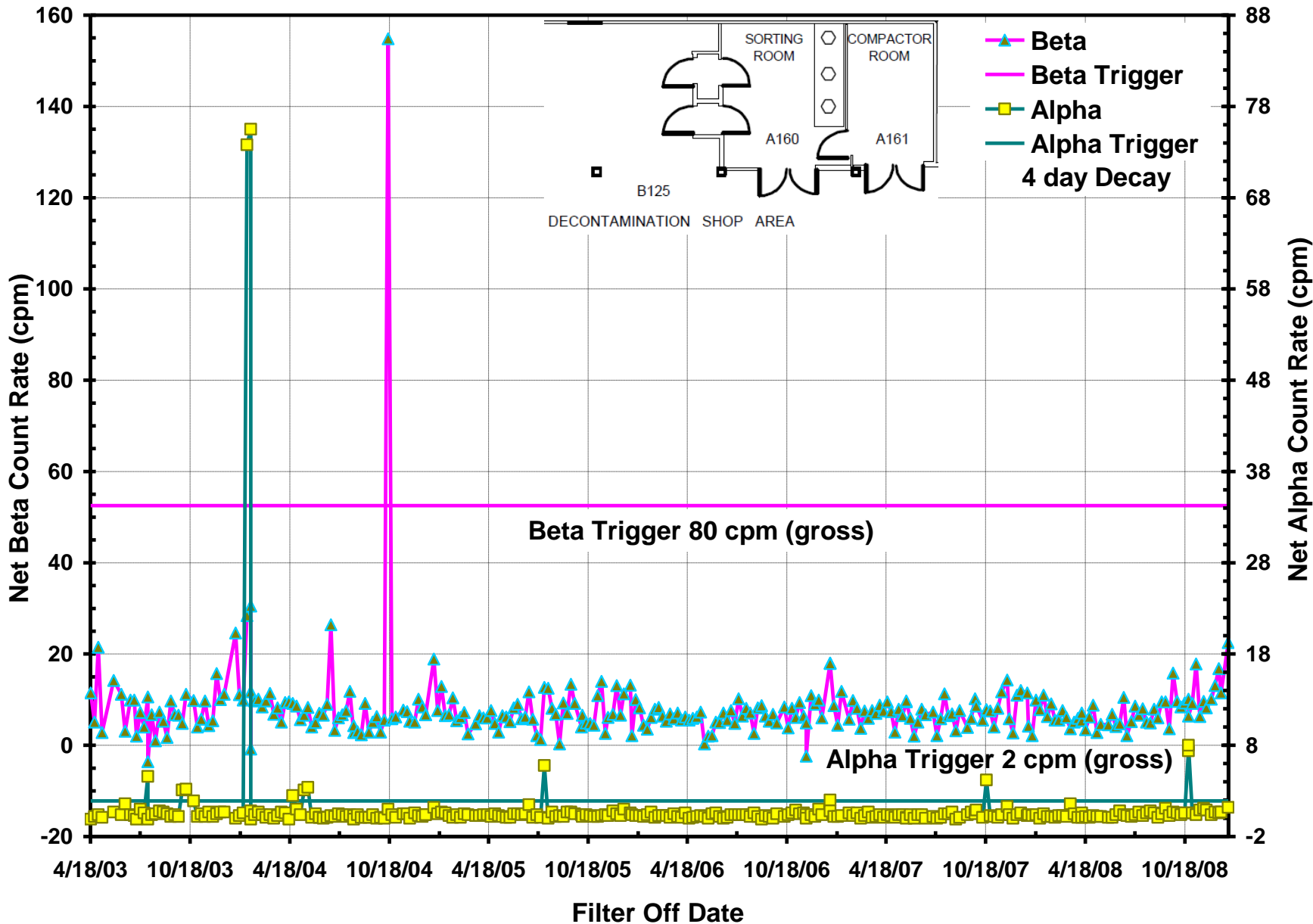
Weekly Air Samples; Location #16 - High Bay (evap #2 platform)



Weekly Air Samples; Location #64 - Room A-160 (S Pass Through)



Weekly Air Samples; Location #65 - Room A-160 (N Pass Through)



Conclusions

- **Retrospective Air Sampling is a Sensitive Indication of Breakdowns in Engineering Controls**
- **The Elevated Activities are Indications of Acute Incidents NOT Chronic Conditions**
- **The History of Radiological Conditions is Documented at Selected Locations**
- **Special Bioassay Samples are Triggered at the Discretion of the Area Health Physicist**
- **Future Upgrades**
 - **Automate the Graphical Presentation of the Data**
 - **Perform Flow Studies at Selected Locations**