308 - - - Q200401210023

Scientific Notebook No. 456: Record Calculations and Other Information Intended to Support Projects Related to the Radionuclide Transport KTI (04/05/2001 through 03/14/2003)

456

Radionuclide Transport KTI

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users

Paul Bertetti - Research Scientist CNWRA x5228	PB
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Copy made for QA Archives p1-37 9-19-01 BAW
copy made for QA Archives p 37 03/21/02 [illegible]

05 Apr 01 [illegible] This book will record calculations and other information intended to support projects related to the Radionuclide Transport KTI.

05 Apr 01 [illegible] We will undertake experiments to examine the sorption behavior of Np on calcite. Preliminary experimental work and much of the experimental data related to these studies can be found in scientific notebook number 309. Supporting and interpretive calculations will be recorded here. Published papers relevant to the Np-calcite studies will be listed as needed. Below are two papers that provide guidance for our experimental set-up. Additional information can be found in those references contained within these two papers.

Zachara, Cowan, and Resch. 1991. Sorption of divalent metals on calcite. Geochim Cosmochim Acta vol 55 p 1549-1562.

Davis, Fuller, and Cook. 1987. A model for trace metal sorption processes at the calcite surface: Adsorption of Ca^{2+} and subsequent solid solution formation. Geochim Cosmochim Acta vol 51. p. 1477-1490.

Also: Paquette and Reeder. 1995. Relationship between surface structure, growth mechanism, and trace element incorporation in calcite. Geochim Cosmochim Acta 59 (4) p. 735-749.

05 Apr 01
PB

As noted in notebook # 709, calcite has been prepared and preliminary steps have been completed to ready equipment needed for the Np-calcite studies.

06 Apr 01
PB

As part of the Np-calcite experiments, I would like to evaluate the counting effectiveness of the LSA with respect to ^{237}Np (w/ ^{232}Pa in solution). Since the LSA has not been operated using the α-β protocol in some time (periodic maintenance checks and calibrations have been satisfactorily performed in the interim), I want to check the performance and adjust the pulse discriminator as needed.

I will use samples drawn from spike #46A (031/301). Spike #46A is a Np-237 solution with ~ 118 ppm of ^{237}Np, which should give ~ 18,390 cpm/g solution.

Four samples will be analyzed, a blank and three vials with varying amounts of Np to check the analytical consistency of the LSA. The LSA has been normalized as needed.

Amount of Np spike will be varied from 0.1 mL to 0.25 mL to 0.5 mL to give expected cpms of ~1840, ~4600, and ~9200 respectively. Adjustment of the LSA will be made according to results.

vial	wt vial (g)	wt vial + Np spike (g)	wt Np spike (g)
1-blank	N/A	N/A	0
2-46A	7.2901	7.3913	0.1012
3-46A	7.2525	7.5056	0.2531
4-46A	7.2084	7.7127	0.5043

Ultima Gold AB scintillation cocktail will be used. If the 0.5 mL has an ionic strength that is too high (failure to mix homogeneously), only the lower two samples will be used for this test. 46A has a calculated normality of HNO_3 of 0.32 N (031/301).

Sample # 2-46A was used to perform a coarse adjustment of the LSA discriminator before all samples were analyzed.

06 Apr 01
PB

Inspection of the cpm reported by the LSA indicated that the count rate of ~18300 cpm/g was incorrect. The sample (2-46A) contained ~0.1 g of spike 46A and should have contained ~1800 cpm; however, sample 2-46A contained ~18,000 cpm. The correct values for spike 46A are determined below.

As indicated on p.300/031, 5.64659 g of ^{237}Np solution was transferred to a teflon container and diluted with water to a total mass of 63.0640 g. Total activity due to ^{237}Np in the spike was 5.242 μci.

$$\therefore \frac{5.242\ \mu ci}{63.0640\ g} = \frac{8.31 \times 10^{-2}\ \mu ci}{g}$$

$$\frac{8.31 \times 10^{-2}\ \mu ci}{g} \cdot \frac{2.22 \times 10^{12}\ dpm}{ci} \cdot \frac{ci}{10^{6}\ \mu ci} = 1.845 \times 10^{5}\ dpm/g\ soln.$$

Assuming 100% efficiency of counting, the samples should contain 184,500 cpm/g. Therefore,

sample	wt.	expected counts per min (^{237}Np activity)
2-46A	0.0102	18671
3-46A	0.2531	46697
4-46A	0.5043	93043

Since spike 46A is at secular equilibrium ($t_{1/2}$ of daughter ^{233}Pa is 27 d) the expected alpha and beta activity should be equal. Adjusting the LSA discriminator to achieve approximately equal α and β cpm in the regions of interest would suffice as a coarse adjustment. Fine adjustment can then be accomplished by finding total counts, α, β counts, and peak locations over longer count times (or equivalent %2s analyses). Using the 2-46A sample, a discriminator setting of 168 was chosen based on ~equal β and α count rates.

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PB

As shown below, results of counting all 46A samples revealed that the discriminator set point was not appropriate for the higher count rate samples. All samples were homogeneous (cocktail and spike mixed well with no phase separation).

4/9/01 11:39:40 AM QuantaSmart (TM) - 1.10 - Replay Page # 1
20010406_1519.results Serial# 405314

Assay Definition-

Assay Description:

Assay Type: Alpha/Beta
Report Name: Manual Np_Pa 3% 2sigma
Output Data Path: C:\Packard\Tricarb\Results\Nugent\Manual Np_Pa 3%2S
Raw Results Path: C:\Packard\Tricarb\Results\Nugent\Manual Np_Pa 3%2S
Comma-Delimited File Name: C:\Packard\Tricarb\Results\Nugent\Manual Np_Pa 3%2S\Manual Np_Pa 3%2S.txt

Count Conditions-

Nuclide: Manual Np/Pa
Quench Indicator: SIS
External Std Terminator (sec): n/a
Pre-Count Delay (min): 0.00
Quench Set:
Count Time (min): 60.00
Count Mode: Normal
Assay Count Cycles: 1 Repeat Sample Count: 1
#Vials/Sample: 1 Calculate % Reference: Off

Background Subtract: On - 1st Vial
Low CPM Threshold: Off
2 Sigma % Terminator: On - Any Region

In Use Discriminator: 160

Regions	LL	UL	Bkg Subtract	2Sigma % Terminator
Beta A	0.0	400.0	1st Vial	0.00
Beta B	0.0	2000.0	1st Vial	0.00
Alpha	100.0	400.0	1st Vial	0.50

Count Corrections-

Static Controller: On Luminescence Correction: Off
Colored Samples: n/a Heterogeneity Monitor: n/a
Coincidence Time (nsec): 18 Delay Before Burst (nsec): 75

Half Life-

Half Life Correction: Off

Regions	Half Life	Units	Reference Date	Reference Time
Beta A				
Beta B				
Alpha				

Cycle 1 Results

S#	Count Time	CPMA	A:2S%	CPMB	B:2S%	CPMa	alpha2S%	SIS	MESSAGES
1	60.00	19.12	5.91	23.18	5.36	0.77	29.49	813.35	B
2	8.39	17758.36	0.52	17760.49	0.52	19082.67	0.50	279.61	
3	3.69	49678.99	0.47	49686.30	0.47	43471.05	0.50	305.09	
4	2.41	119847.27	0.37	119856.90	0.37	66460.64	0.50	336.02	

Note that α, β counts for Np 4-46A (#4 on this list) are significantly different.

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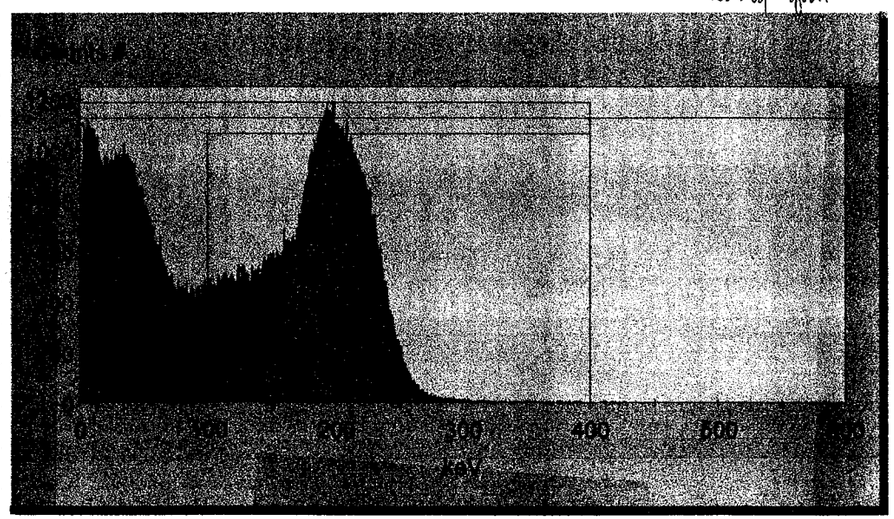
4/9/01 10:05:57 AM QuantaSmart (TM) - 1.10 Page# 1
Protocol # 41 Serial# 405314

SpectraView - Manual Np_Pa 3%2S.1sa

Sample #: 4
Count Time: 60.00
Pre-count Delay: 0.00
Acquisition Time: 2.41
View: Overlap
Scale: Linear
In Use Discriminator: 168

REGION	LL	UL	CPM	2S%	
Beta A	0.0	400.0	119843.2		0.3
Beta B	0.0	2000.0	119856.9		0.3
Alpha	100.0	400.0	66460.6	0.50	

should be nearly equal



A view of the spectrum for sample 4-46A at the 168 setting shows that a significant number of alpha events are being classified as beta events in the 100-400 kev region. I would not expect the β peak in this region to be so high in counts nor would I expect the tails (at higher kev's) to be so coincident. Obviously, the setting is not sufficient. Nearly 1/3 of the expected α counts are misclassified. The total number of counts, however, confirms secular equilibrium. 93043 x 2 = 186086 cpm. For this sample total cpm is 186303, within the counting error.

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To evaluate the discriminator setting further, I modified the count protocol to reflect a static/manually entered background (to prevent counting the blank each time) and recounted all samples at 0.50 %2s, adjusting the discriminator setting each time. Results showed that a setting between 140 and 150 may be appropriate. A setting of 142 was selected.

4/9/01 2:40:07 PM QuantaSmart (TM) - 1.10 Page # 1
Protocol# 41 - Manual Np_Pa 3%2S.1 Serial# 405314 User: Bertetti

discriminator at 150

IPA Block Data
Software Version IC: 2.09
Software Version EC: 1.10
Instrument Model: Tri-Carb 3100TR
Instrument Serial Number: 405314
3H Chi Square: 25.10 Date Processed: 4/9/01 11:41:43 AM
14C Chi Square: 9.15 Date Processed: 4/9/01 11:41:43 AM
3H E^2/B (0-18.6 keV and 1-18.6 keV): 283.84 Date Processed: 4/9/01 11:41:43 AM
14C E^2/B (0-156 keV and 1-156 keV): 511.80 Date Processed: 4/9/01 11:41:43 AM
3H Efficiency (0-18.6 keV): 65.73 Date Processed: 4/9/01 11:41:43 AM
14C Efficiency (0-156 keV): 96.56 Date Processed: 4/9/01 11:41:43 AM
IPA Background Date Processed: 4/9/01 11:41:43 AM
3H Background CPM (0-18.6 keV): 15.05 Date Processed: 4/9/01 11:41:43 AM
14C Background CPM (0-156 keV): 22.88 Date Processed: 4/9/01 11:41:43 AM
3H Calibration DPM: 285000
3H Reference Date: 10/29/99
14C Calibration DPM: 134100
========== Errors and Warnings ==========
========== End of Errors and Warnings ==========

Cycle 1 Results

S#	Count Time	CPMA	A:2S%	CPMB	B:2S%	CPMa	alpha2S%	SIS	MESSAGES
1	7.86	16292.12	0.56	16293.14	0.56	20365.31	0.50	273.34	
2	3.36	45704.69	0.51	45706.62	0.51	47687.46	0.50	271.76	
3	1.84	99331.72	0.47	99337.53	0.47	87137.36	0.50	278.63	

4/9/01 3:29:03 PM QuantaSmart (TM) - 1.10 Page # 1
Protocol# 41 - Manual Np_Pa 3%2S.1 Serial# 405314 User: Bertetti

discriminator at 140

IPA Block Data
Software Version IC: 2.09
Software Version EC: 1.10
Instrument Model: Tri-Carb 3100TR
Instrument Serial Number: 405314
3H Chi Square: 25.10 Date Processed: 4/9/01 11:41:43 AM
14C Chi Square: 9.15 Date Processed: 4/9/01 11:41:43 AM
3H E^2/B (0-18.6 keV and 1-18.6 keV): 283.84 Date Processed: 4/9/01 11:41:43 AM
14C E^2/B (0-156 keV and 1-156 keV): 511.80 Date Processed: 4/9/01 11:41:43 AM
3H Efficiency (0-18.6 keV): 65.73 Date Processed: 4/9/01 11:41:43 AM
14C Efficiency (0-156 keV): 96.56 Date Processed: 4/9/01 11:41:43 AM
IPA Background Date Processed: 4/9/01 11:41:43 AM
3H Background CPM (0-18.6 keV): 15.05 Date Processed: 4/9/01 11:41:43 AM
14C Background CPM (0-156 keV): 22.88 Date Processed: 4/9/01 11:41:43 AM
3H Calibration DPM: 285000
3H Reference Date: 10/29/99
14C Calibration DPM: 134100
========== Errors and Warnings ==========
========== End of Errors and Warnings ==========

Cycle 1 Results

S#	Count Time	CPMA	A:2S%	CPMB	B:2S%	CPMa	alpha2S%	SIS	MESSAGES
1	7.25	14210.56	0.62	14210.85	0.62	22086.49	0.50	238.09	
2	3.28	44331.79	0.52	44335.07	0.52	48823.47	0.50	263.63	
3	1.71	93125.04	0.50	93126.87	0.50	93701.69	0.50	256.20	

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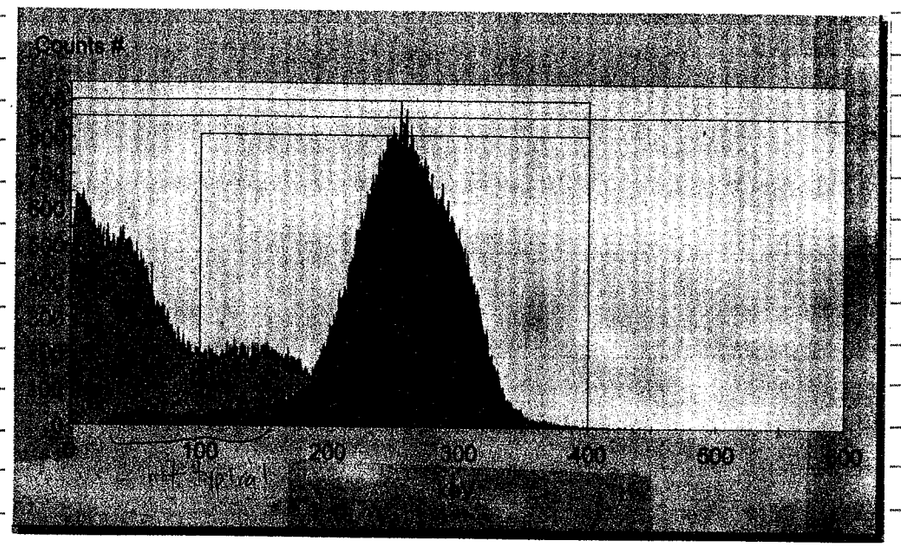
Note that at the lower setting, the high count rate samples are okay, but the lower rate sample seems to have an excess of α's. So, β's are being misclassified as α's. This is somewhat perplexing because the discrimination between α's and β's should be independent of count rate. It should depend only on the α/β pair. Results of counting the three samples at 142 are shown on the opposite page (009).

A sample spectrum of 2-46A sample is shown below.

4/9/01 3:18:47 PM QuantaSmart (TM) - 1.10 Page# 1
Sample #: 1 Serial# 405314

Replay SpectraView - 20010409_1425.results



The extension of the α-peak below 150 kev is unusual and unexpected. It indicates that β's are misclassified as α's in this region. This is especially unusual because of the low energies involved. There seems to be a fundamental problem with the counting. As the discriminator setting is increased number of α's counted a β's increases. As the discriminator setting is lowered, the number of β's counted as α's increases.

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4/9/01 4:05:08 PM QuantaSmart (TM) - 1.10 Page # 1
Protocol# 41 - Manual Np_Pa 3%2S.1 Serial# 405314 User: Bertetti

Assay Definition-

Assay Description:

Assay Type: Alpha/Beta
Report Name: Manual Np_Pa 3% 2sigma
Output Data Path: C:\Packard\Tricarb\Results\Bertetti\Manual Np_Pa 3%2S
Raw Results Path: C:\Packard\Tricarb\Results\Bertetti\Manual Np_Pa 3%2S
Comma-Delimited File Name: C:\Packard\Tricarb\Results\Bertetti\Manual Np_Pa 3%2S\Manual Np_Pa 3%2S.txt

Count Conditions-

Nuclide: Manual Np/Pa
Quench Indicator: SIS
External Std Terminator (sec): n/a
Pre-Count Delay (min): 0.00
Quench Set:
Count Time (min): 60.00
Count Mode: Normal
Assay Count Cycles: 1 Repeat Sample Count: 1
#Vials/Sample: 1 Calculate % Reference: Off

Background Subtract: On - Manual
Low CPM Threshold: Off
2 Sigma % Terminator: On - Any Region

In Use Discriminator: 142

Regions	LL	UL	Bkg Subtract	2Sigma % Terminator
Beta A	0.0	400.0	18.82	0.00
Beta B	0.0	2000.0	22.25	0.00
Alpha	100.0	400.0	1.23	0.50

Count Corrections-

Static Controller: On Luminescence Correction: Off
Colored Samples: n/a Heterogeneity Monitor: n/a
Coincidence Time (nsec): 18 Delay Before Burst (nsec): 75

Half Life-

Half Life Correction: Off

Regions	Half Life	Units	Reference Date	Reference Time
Beta A				
Beta B				
Alpha				

IPA Block Data
Software Version IC: 2.09
Software Version EC: 1.10
Instrument Model: Tri-Carb 3100TR
Instrument Serial Number: 405314
3H Chi Square: 25.10 Date Processed: 4/9/01 11:41:43 AM
14C Chi Square: 9.15 Date Processed: 4/9/01 11:41:43 AM
3H E^2/B (0-18.6 keV and 1-18.6 keV): 283.84 Date Processed: 4/9/01 11:41:43 AM
14C E^2/B (0-156 keV and 1-156 keV): 511.80 Date Processed: 4/9/01 11:41:43 AM
3H Efficiency (0-18.6 keV): 65.73 Date Processed: 4/9/01 11:41:43 AM
14C Efficiency (0-156 keV): 96.56 Date Processed: 4/9/01 11:41:43 AM
IPA Background Date Processed: 4/9/01 11:41:43 AM
3H Background CPM (0-18.6 keV): 15.05 Date Processed: 4/9/01 11:41:43 AM
14C Background CPM (0-156 keV): 22.88 Date Processed: 4/9/01 11:41:43 AM
3H Calibration DPM: 285000
3H Reference Date: 10/29/99

4/9/01 4:05:08 PM QuantaSmart (TM) - 1.10 Page # 2
Protocol# 41 - Manual Np_Pa 3%2S.1 Serial# 405314 User: Bertetti

14C Calibration DPM: 134100
========== Errors and Warnings ==========
========== End of Errors and Warnings ==========

Cycle 1 Results

S#	Count Time	CPMA	A:2S%	CPMB	B:2S%	CPMa	alpha2S%	SIS	MESSAGES
1	7.38	14638.90	0.61	14638.05	0.61	21686.30	0.50	245.04	
2	3.30	44645.73	0.52	44645.93	0.52	48630.89	0.50	266.22	
3	1.73	93678.29	0.50	93681.22	0.50	92943.28	0.50	259.64	

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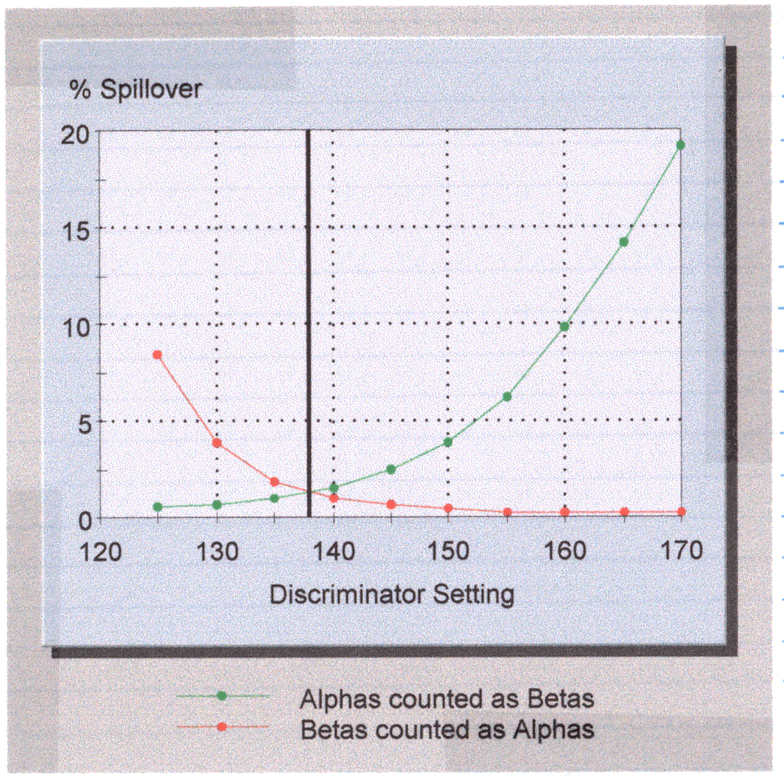
This change in spillover is shown in the figure below which represents a generic α/β standard curve.



As the curves indicate, it is expected that an increase/decrease in discriminator setting will produce the effects seen in the sample measurements. However, one would expect that a given setting would produce similar misclassification values for all samples, since they originated from the same solution. I do not believe that the spectra differences are due to count rates. Possibilities include changes in geometry between 0.1, 0.25 and 0.5 mL added to 5 mL of cocktail, or changes in chemistry caused by adding more/less acid to the cocktail.

A simple experiment will be conducted to evaluate the influence of acid content (≈ ionic strength) on the spectra of

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samples. Geometry will be controlled and a varying amount of acid + water + spike will be added to vials and counted. A discriminator setting of 142 will be used. 142 represents the best case for all samples ~~given~~ 4/9/01 even with the 2-46A problems. At least in that case the majority of the α peak is captured and in real samples (experimental results, typically) the Pa portion is very much reduced due to loss of Pa. [Although that may not be the case for calcite].

10 Apr 01 PB

To examine effects of changes in HNO_3 concentration on α/β counting, several scintillation vials will be prepared. Each is spiked with 46A (^{237}Np + ^{233}Pa). Some vials will contain acid, some will contain water + acid. A stock solution of 0.32N acid was prepared as the acid additive ( ). The spike #46A has been calculated to contain 0.32N HNO_3 (031/301).

vial	spike amt (mL)	acid added (mL)	water added (mL)	wt vial + acid + water (g)	wt vial + spike (g)	wt. spike (g)
iNp 1	0.1	0.4	0	7.6817	7.7831	0.1014
iNp 2	0.25	0.25	0	7.5588	7.8143	0.2555
iNp 3	0.5	0	0	7.2712	7.7737	0.5025
iNp 4	0.1	0	0.4	7.6899	7.7912	0.1013
iNp 5	0.1	0.1	0.3	7.7109	7.8118	0.1009
iNp 6	0.1	0.2	0.2	7.6785	7.7793	0.1008
iNp 7	0.25	0.1	0.15	7.5145	7.7683	0.2538
iNp 8	0.25	0	0.25	7.5762	7.8304	0.2542
(blank) iNp 9	0	0.25	0.25	N/A	N/A	N/A

5 mL of ultima gold AB cocktail added to each vial. The vials were shaken to mix and placed in LSA rack. 4/10/01 PB

Results are shown on the following page (011).

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PB

4/10/01 4:06:55 PM QuantaSmart (TM) - 1.10 Page # 1
Protocol# 41 - Manual Np_Pa 3%2S.1Serial# 405314 User: Bertetti

Assay Definition-

Assay Description:

Assay Type: Alpha/Beta
Report Name: Manual Np_Pa 3% 2sigma
Output Data Path: C:\Packard\Tricarb\Results\Bertetti\Manual Np_Pa 3%2S
Raw Results Path: C:\Packard\Tricarb\Results\Bertetti\Manual Np_Pa 3%2S
Comma-Delimited File Name: C:\Packard\Tricarb\Results\Bertetti\Manual Np_Pa 3%2S\Manual Np_Pa 3%2S.txt

Count Conditions-

Nuclide: Manual Np/Pa
Quench Indicator: SIS
External Std Terminator (sec): n/a
Pre-Count Delay (min): 0.00
Quench Set:
Count Time (min): 60.00
Count Mode: Normal
Assay Count Cycles: 1 Repeat Sample Count: 1
#Vials/Sample: 1 Calculate % Reference: Off

Background Subtract: On - 1st Vial
Low CPM Threshold: Off
2 Sigma % Terminator: On - Any Region

In Use Discriminator: 142

Regions	LL	UL	Bkg Subtract	2Sigma % Terminator
Beta A	0.0	400.0	1st Vial	0.00
Beta B	0.0	2000.0	1st Vial	0.00
Alpha	100.0	400.0	1st Vial	0.50

Count Corrections-

Static Controller: On Luminescence Correction: Off
Colored Samples: n/a Heterogeneity Monitor: n/a
Coincidence Time (nsec): 18 Delay Before Burst (nsec): 75

Half Life-

Half Life Correction: Off

Regions	Half Life	Units	Reference Date	Reference Time
Beta A				
Beta B				
Alpha				

IPA Block Data
Software Version IC: 2.09
Software Version EC: 1.10
Instrument Model: Tri-Carb 3100TR
Instrument Serial Number: 405314
3H Chi Square: 16.06 Date Processed: 4/10/01 11:27:53 AM
14C Chi Square: 10.06 Date Processed: 4/10/01 11:27:53 AM
3H E^2/B (0-18.6 keV and 1-18.6 keV): 269.55 Date Processed: 4/10/01 11:27:53 AM
14C E^2/B (0-156 keV and 1-156 keV): 512.56 Date Processed: 4/10/01 11:27:53 AM
3H Efficiency (0-18.6 keV): 65.55 Date Processed: 4/10/01 11:27:53 AM
14C Efficiency (0-156 keV): 96.77 Date Processed: 4/10/01 11:27:53 AM
IPA Background Date Processed: 4/10/01 11:27:53 AM
3H Background CPM (0-18.6 keV): 15.77 Date Processed: 4/10/01 11:27:53 AM
14C Background CPM (0-156 keV): 23.20 Date Processed: 4/10/01 11:27:53 AM
3H Calibration DPM: 285000
3H Reference Date: 10/29/99

S#	Vial Sample
1	iNp9
2	iNp1
3	iNp2
4	iNp3
5	iNp4
6	iNp5
7	iNp6
8	iNp7
9	iNp8
10	2-46A
11	3-46A
12	4-46A

→

4/10/01 4:06:55 PM QuantaSmart (TM) - 1.10 Page # 2
Protocol# 41 - Manual Np_Pa 3%2S.1Serial# 405314 User: Bertetti

14C Calibration DPM: 134100
========== Errors and Warnings ==========
========== End of Errors and Warnings ==========

Cycle 1 Results

S#	Count Time	CPMA	A:2S%	CPMB	B:2S%	CPMa	alpha2S%	SIS	MESSAGES
1	60.00	21.70	5.54	26.13	5.05	0.35	43.64	753.85	B
2	8.54	19021.51	0.50	19021.29	0.50	18759.95	0.50	276.50	
3	3.39	48517.83	0.49	48519.00	0.49	47295.52	0.50	281.08	
4	1.73	95126.85	0.49	95124.73	0.49	92956.87	0.50	274.96	
5	8.15	17879.90	0.52	17879.76	0.52	19653.88	0.50	280.47	
6	8.34	18548.80	0.51	18550.01	0.51	19192.94	0.50	282.19	
7	8.49	18759.45	0.50	18760.20	0.50	18849.24	0.50	280.95	
8	3.39	47308.98	0.50	47309.56	0.50	47224.43	0.50	281.03	
9	3.35	46982.18	0.50	46984.32	0.50	47916.67	0.50	283.15	
10	7.31	14625.63	0.61	14624.07	0.61	21914.29	0.50	246.81	
11	3.31	44614.86	0.52	44616.47	0.52	48385.45	0.50	267.29	
12	1.73	93684.66	0.50	93684.27	0.50	92825.66	0.50	259.02	

10 Apr 01
PB

Of particular interest is the fact that the lower the concentration of acid, the more misclassifications (higher α rate and higher α-β difference) ~~occur~~ that occur. Also of note is that addition of water (PB 4/10/01 w/o other acid) with the spike also results in a decrease in misclassification (compare #9/iNp8 to #11/3-46A for example). These results seem to indicate that addition of water or water + acid "improves"/affects the quench of the cocktail. With additional quenching the LSA may be better able to resolve the pulse decay of α's from that of β's.

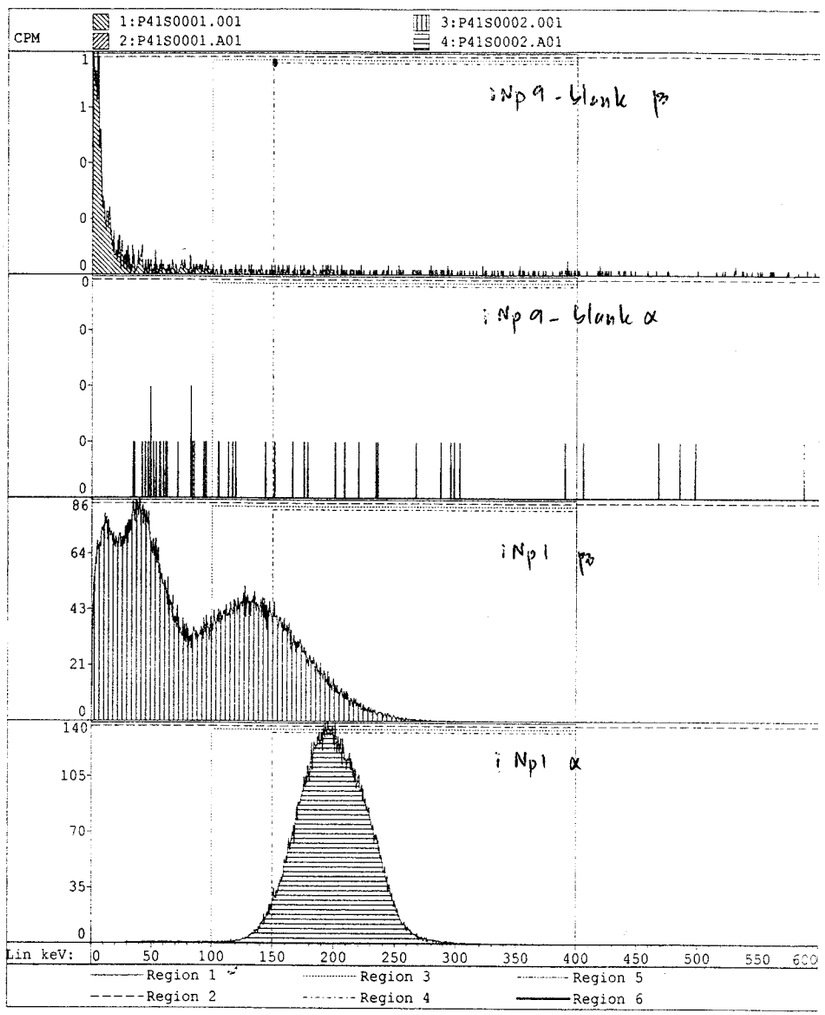
A summary of spectra for the samples is provided ~~below and~~ 4/10/01 PB on the following pages. Note that the peak (α) extensions occur only in cases where little acid is present (0.1 mL from spike), but that addition of water and/or additional acid minimizes the effect. The spectra shown represent count values shown on p. 012.

Not a set
PB
4/10/01

10 Apr 01 no entries 4/11/01

11 Apr 01

SpectraWorks 4/11/01 11:26a Page: 1



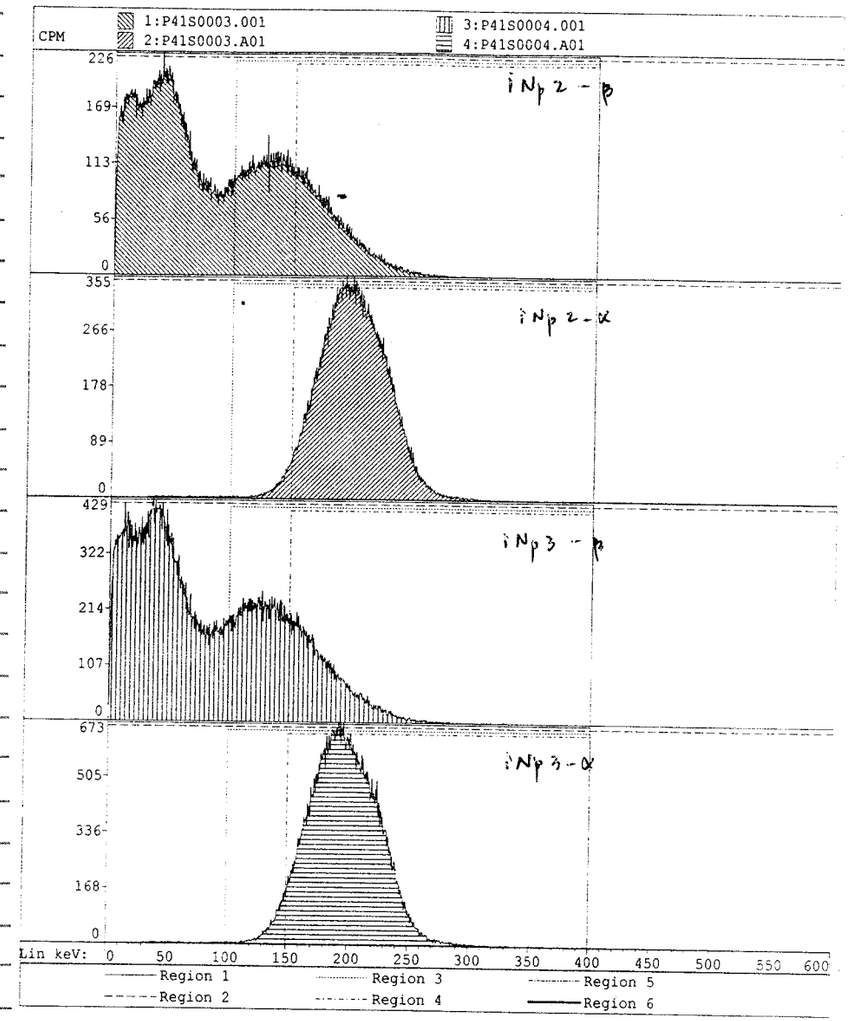
SpectraWorks 4/11/01 11:38a Page: 1

Spectrum Region Summary

CPM	1:P41S0001.001	2:P41S0001.A01	3:P41S0002.001	4:P41S0002.A01
Region 1 (0.0- 400.0):	22	1	19043	18835
Region 2 (0.0-2000.0):	26	2	19047	18839
Region 3 (100.0- 400.0):	4	0	7670	18760
Region 4 (150.0- 400.0):	3	0	3378	18209

11 Apr 01

SpectraWorks 4/11/01 11:27a Page: 1



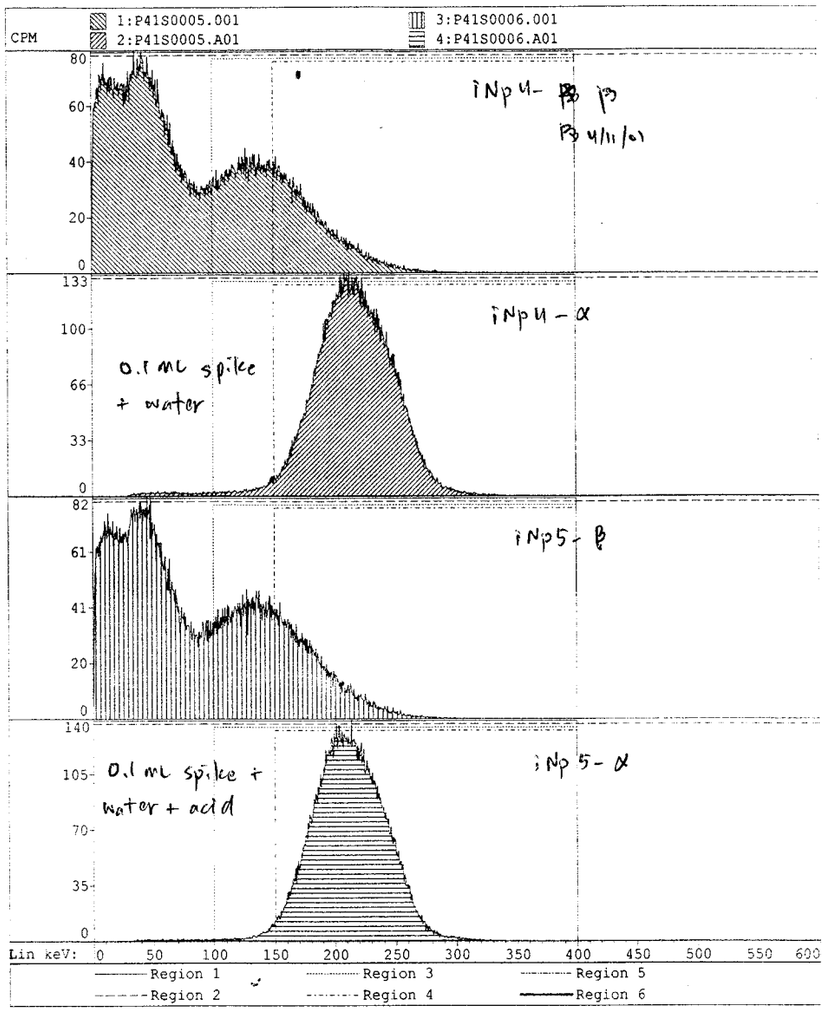
SpectraWorks 4/11/01 11:38a Page: 1

Spectrum Region Summary

CPM	1:P41S0003.001	2:P41S0003.A01	3:P41S0004.001	4:P41S0004.A01
Region 1 (0.0- 400.0):	48540	47482	95149	93337
Region 2 (0.0-2000.0):	48545	47494	95151	93386
Region 3 (100.0- 400.0):	19988	47296	37912	92957
Region 4 (150.0- 400.0):	8996	45977	16580	89262

11 Apr 01
PB

SpectraWorks 4/11/01 11:28a Page: 1



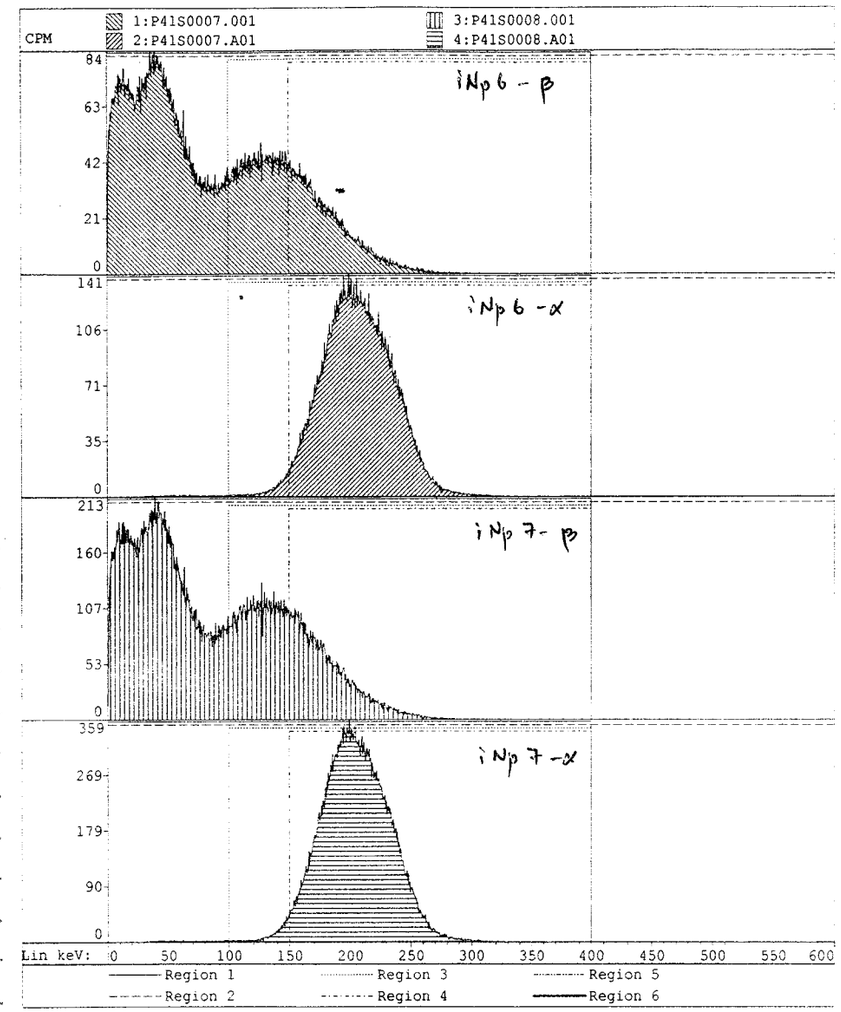
SpectraWorks 4/11/01 11:39a Page: 1

Spectrum Region Summary

CPM	1:P41S0005.001	2:P41S0005.A01	3:P41S0006.001	4:P41S0006.A01
Region 1 (0.0- 400.0):	17902	19885	18571	19302
Region 2 (0.0-2000.0):	17906	19892	18576	19307
Region 3 (100.0- 400.0):	7113	19654	7523	19193
Region 4 (150.0- 400.0):	3470	19273	3575	18888

11 Apr 01
PB

SpectraWorks 4/11/01 11:29a Page: 1



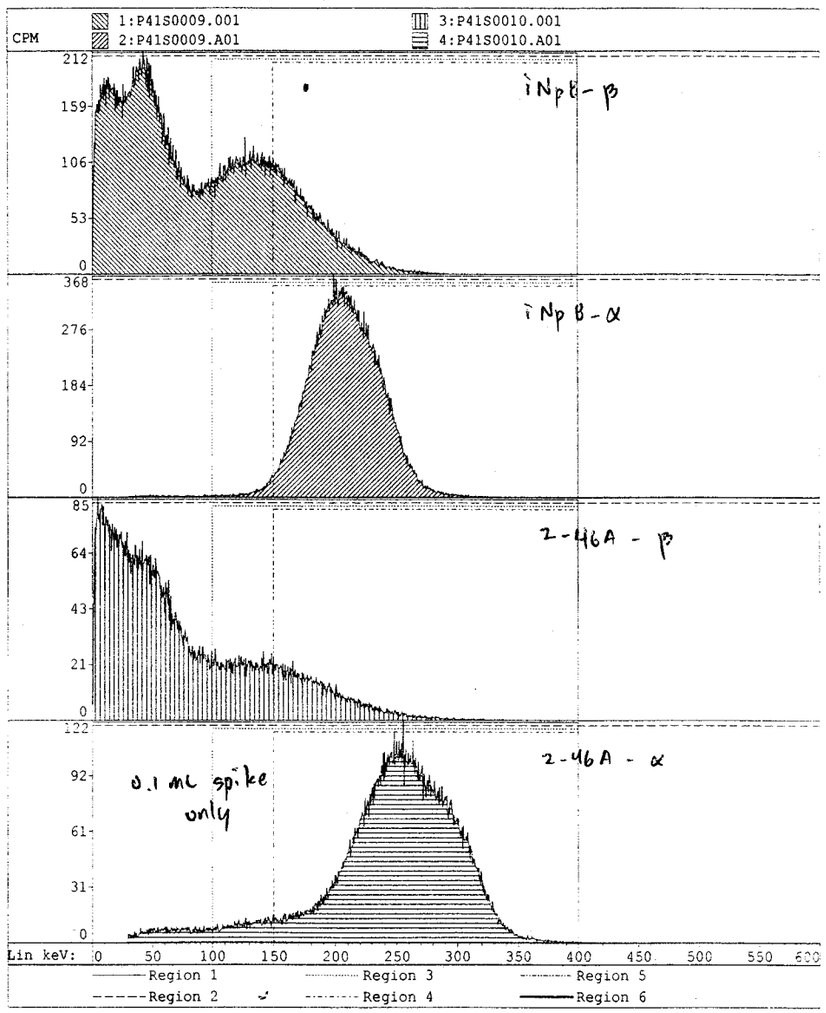
SpectraWorks 4/11/01 11:39a Page: 1

Spectrum Region Summary

CPM	1:P41S0007.001	2:P41S0007.A01	3:P41S0008.001	4:P41S0008.A01
Region 1 (0.0- 400.0):	18781	18932	47331	47428
Region 2 (0.0-2000.0):	18786	18936	47336	47447
Region 3 (100.0- 400.0):	7633	18850	19302	47225
Region 4 (150.0- 400.0):	3533	18483	8858	46268

11 Apr 01
PB

SpectraWorks 4/11/01 11:31a Page: 1



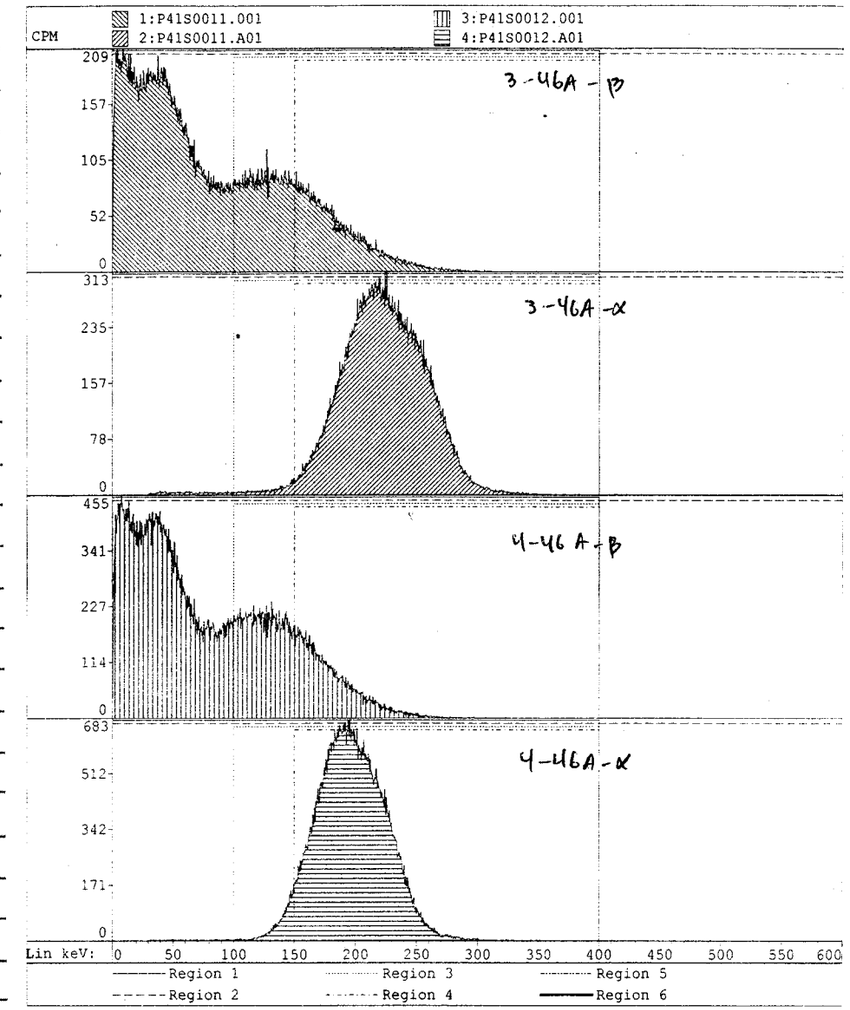
SpectraWorks 4/11/01 11:40a Page: 1

Spectrum Region Summary

CPM	1:P41S0009.001	2:P41S0009.A01	3:P41S0010.001	4:P41S0010.A01
Region 1 (0.0- 400.0):	47004	48161	14647	22821
Region 2 (0.0-2000.0):	47010	48184	14650	22841
Region 3 (100.0- 400.0):	19266	47917	4461	21915
Region 4 (150.0- 400.0):	9058	47109	2356	20929

11 Apr 01
PB

SpectraWorks 4/11/01 11:31a Page: 1



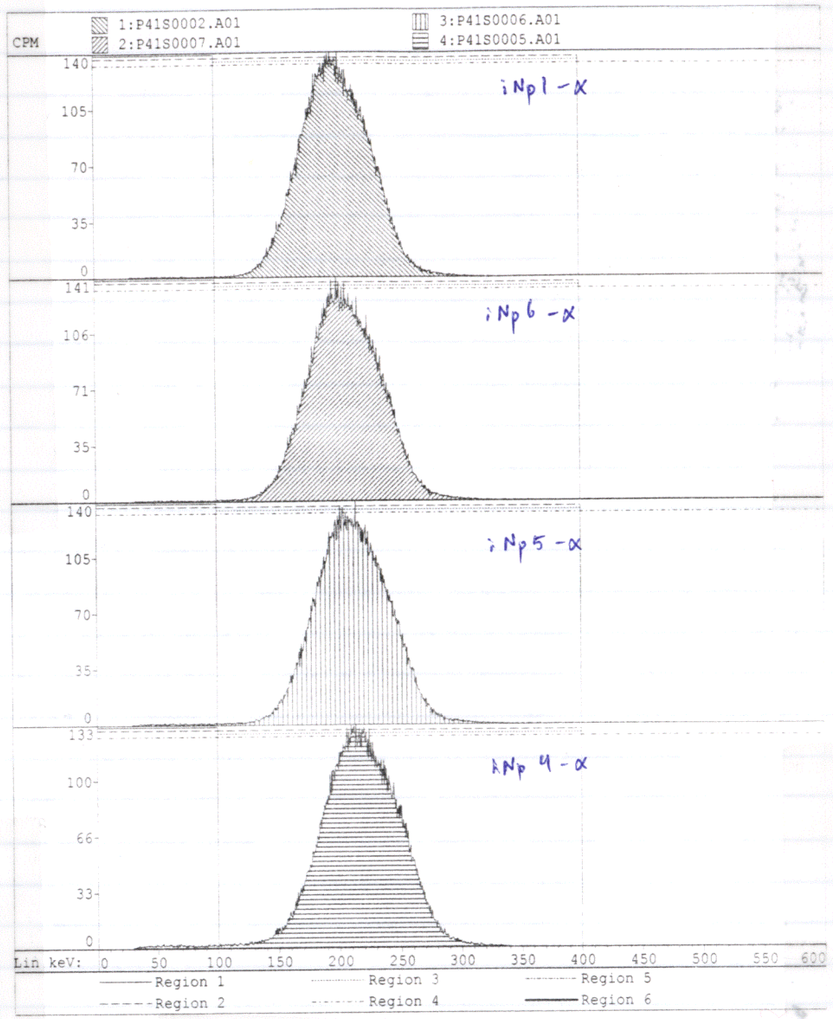
SpectraWorks 4/11/01 11:34a Page: 1

Spectrum Region Summary

CPM	1:P41S0011.001	2:P41S0011.A01	3:P41S0012.001	4:P41S0012.A01
Region 1 (0.0- 400.0):	44637	48805	93706	93171
Region 2 (0.0-2000.0):	44643	48836	93710	93217
Region 3 (100.0- 400.0):	16420	48386	34246	92826
Region 4 (150.0- 400.0):	7841	47688	14249	89129

11 Apr 01
PB

SpectraWorks 4/11/01 3:18p Page: 1



SpectraWorks 4/11/01 3:19p Page: 1

Spectrum Region Summary

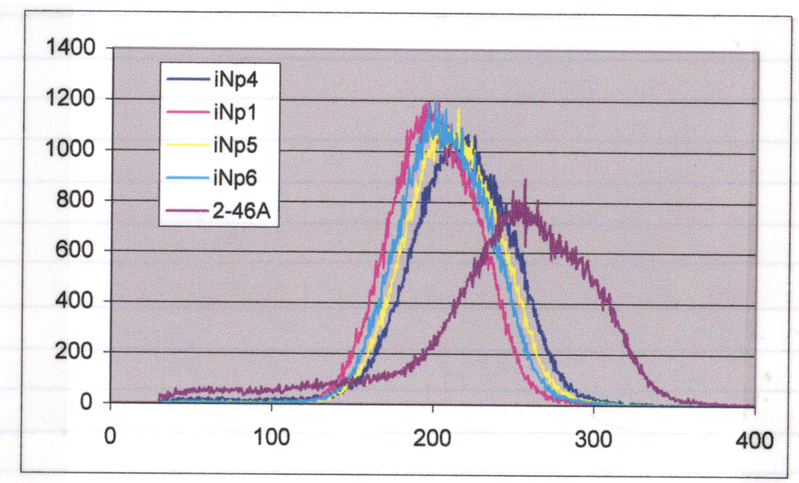
CPM	1:P41S0002.A01	2:P41S0007.A01	3:P41S0006.A01	4:P41S0005.A01
Region 1 (0.0- 100.0):	75	82	108	230
Region 2 (0.0- 400.0):	18835	18932	19302	19885
Region 3 (100.0- 400.0):	18760	18850	19193	19654
Region 4 (0.0-2000.0):	18839	18936	19307	19892

11 Apr 01
PB

Quench in the LSA is noted by a shift in peak location to lower kev values and an increase in peak height at low kev's. Note that as acid is added (samples iNp4, iNp5, iNp6, and iNp1 represent, 0.1, 0.2, 0.3, 0.5 mL acid, respectively) peaks are shifted to lower kev's => more quench with more acid. Note also that simply adding water improves misclassification at low kev's.

Therefore, the 142 is appropriate for all count rates but care must be exercised to ensure adequate acid/water loading of the cocktail.

A plot with all samples (α-spectra) that contained 0.1 mL spike is shown for comparison.



12 Apr 01
PB

The misclassification differences seem to result from a difference in cocktail/LSA behavior when different acid/water loading is applied. An additional consideration now is: Are there more appropriate discriminator settings?

12 Apr 01
PB

Expected and measured values for each sample are shown below:

4/12/01 PB

Vial	mass spike (from p. 11)	expected cpm	measured cpm α (from p. ~~312~~)
iNp1	0.1014	18708	18760
iNp2	0.2555	47140	47296
iNp3	0.5025	92711	92957
iNp4	0.1013	18690	19654
iNp5	0.1009	18616	19193
iNp6	0.1008	18598	18849
iNp7	0.2538	~~48~~ 46826	47224
iNp8	0.2542	46900	47916

~~expected total~~ 4/12/01 PB

4/12/01 PB

An additional analysis of these samples, also at 142 setting, is provided on p. 023.

The setting of 142 seems to minimize misclassification for those samples with the most acid but is best with samples that have nearly equal amounts acid + water iNp6 and iNp8. A higher discriminator would be better for lower acid samples. Runs at 145 and 150 will be conducted. Considerations for an appropriate setting include: counting error, expected composition of samples, and amount of scintillation cocktail to be used. Note that even the background counts for α, β regions are affected by the addition of water + acid (compare p. 23 with p. 5).

If it is assumed that the activity of ^{233}Pa will be reduced during the experiment (Pa has exhibited a high degree of sorption on nearly all materials under previous experimental conditions), then the error caused by misclassifying betas as alphas (low acidity conditions) is low. If significant quantities of ^{233}Pa are present, then, for low acid samples, the discriminator should be set higher to reduce the β induced error, but caution should be used in an effort to not miss α counts with high acid samples.

12 Apr 01
PB

4/11/01 3:21:50 PM QuantaSmart (TM) - 1.10 Page # 1
Protocol# 41 - Manual Np_Pa 3%2S.1 Serial# 405314 User: Bertetti

Assay Definition-

Assay Description:

Assay Type: Alpha/Beta
Report Name: Manual Np_Pa 3% 2sigma
Output Data Path: C:\Packard\Tricarb\Results\Bertetti\Manual Np_Pa 3%2S
Raw Results Path: C:\Packard\Tricarb\Results\Bertetti\Manual Np_Pa 3%2S
Comma-Delimited File Name: C:\Packard\Tricarb\Results\Bertetti\Manual Np_Pa 3%2S\Manual Np_Pa 3%2S.txt

Count Conditions-

Nuclide: Manual Np/Pa
Quench Indicator: SIS
External Std Terminator (sec): n/a
Pre-Count Delay (min): 0.00
Quench Set:
Count Time (min): 60.00
Count Mode: Normal
Assay Count Cycles: 1 Repeat Sample Count: 1
#Vials/Sample: 1 Calculate % Reference: Off

Background Subtract: On - 1st Vial
Low CPM Threshold: Off
2 Sigma % Terminator: On - Any Region

In Use Discriminator: 142

Regions	LL	UL	Bkg Subtract	2Sigma % Terminator
Beta A	0.0	400.0	1st Vial	0.00
Beta B	0.0	2000.0	1st Vial	0.00
Alpha	100.0	400.0	1st Vial	0.50

Count Corrections-

Static Controller: On Luminescence Correction: Off
Colored Samples: n/a Heterogeneity Monitor: n/a
Coincidence Time (nsec): 18 Delay Before Burst (nsec): 75

Half Life-

Half Life Correction: Off

Regions	Half Life	Units	Reference Date	Reference Time
Beta A				
Beta B				
Alpha				

IPA Block Data
Software Version IC: 2.09
Software Version EC: 1.10
Instrument Model: Tri-Carb 3100TR
Instrument Serial Number: 405314
3H Chi Square: 20.64 Date Processed: 4/11/01 1:18:05 PM
14C Chi Square: 12.60 Date Processed: 4/11/01 1:18:05 PM
3H E^2/B (0-18.6 keV and 1-18.6 keV): 269.41 Date Processed: 4/11/01 1:18:05 PM
14C E^2/B (0-156 keV and 1-156 keV): 547.57 Date Processed: 4/11/01 1:18:05 PM
3H Efficiency (0-18.6 keV): 65.65 Date Processed: 4/11/01 1:18:05 PM
14C Efficiency (0-156 keV): 96.60 Date Processed: 4/11/01 1:18:05 PM
IPA Background Date Processed: 4/11/01 1:18:05 PM
3H Background CPM (0-18.6 keV): 15.73 Date Processed: 4/11/01 1:18:05 PM
14C Background CPM (0-156 keV): 22.55 Date Processed: 4/11/01 1:18:05 PM
3H Calibration DPM: 285000
3H Reference Date: 10/29/99

4/11/01 3:21:50 PM QuantaSmart (TM) - 1.10 Page # 2
Protocol# 41 - Manual Np_Pa 3%2S.1 Serial# 405314 User: Bertetti

14C Calibration DPM: 134100
========== Errors and Warnings ==========
========== End of Errors and Warnings ==========

Cycle 1 Results

S#	Count Time	CPMA	A:2S%	CPMB	B:2S%	CPMa	alpha2S%	SIS	MESSAGES
1	60.00	20.33	5.73	24.47	5.22	0.25	51.64	749.76	B
2	8.53	18950.95	0.50	18951.50	0.50	18769.39	0.50	277.67	
3	3.39	48272.29	0.49	48273.17	0.49	47321.58	0.50	279.74	
4	1.74	95192.88	0.49	95199.10	0.49	92477.34	0.50	276.37	
5	8.17	17948.33	0.52	17949.34	0.52	19587.51	0.50	280.28	
6	8.34	18484.82	0.51	18485.49	0.51	19202.51	0.50	281.32	
7	8.53	18701.12	0.50	18701.79	0.50	18769.97	0.50	280.02	
8	3.37	47328.33	0.50	47330.73	0.50	47511.32	0.50	280.13	
9	3.34	46747.93	0.51	46747.09	0.51	48016.52	0.50	278.92	
10	7.36	14569.07	0.61	14568.74	0.61	21758.04	0.50	247.47	
11	3.30	44581.49	0.52	44584.93	0.52	48592.78	0.50	266.54	
12	1.73	93743.83	0.50	93744.32	0.50	92819.40	0.50	259.00	

13 Apr 01
PB

4/13/01 1:21:25 PM QuantaSmart (TM) - 1.10 Page # 1
Protocol# 41 - Manual Np_Pa 3%2S.1Serial# 405314 User: Bertetti

Assay Definition-

Assay Description:

Assay Type: Alpha/Beta
Report Name: Manual Np_Pa 3% 2sigma
Output Data Path: C:\Packard\Tricarb\Results\Bertetti\Manual Np_Pa 3%2S
Raw Results Path: C:\Packard\Tricarb\Results\Bertetti\Manual Np_Pa 3%2S
Comma-Delimited File Name: C:\Packard\Tricarb\Results\Bertetti\Manual Np_Pa 3%2S\Manual Np_Pa 3%2S.txt

Count Conditions-

Nuclide: Manual Np/Pa
Quench Indicator: SIS
External Std Terminator (sec): n/a
Pre-Count Delay (min): 0.00
Quench Set:
Count Time (min): 60.00
Count Mode: Normal
Assay Count Cycles: 1 Repeat Sample Count: 1
#Vials/Sample: 1 Calculate % Reference: Off

Background Subtract: On - 1st Vial
Low CPM Threshold: Off
2 Sigma % Terminator: On - Any Region

In Use Discriminator: 150

Regions	LL	UL	Bkg Subtract	2Sigma % Terminator
Beta A	0.0	400.0	1st Vial	0.00
Beta B	0.0	2000.0	1st Vial	0.00
Alpha	100.0	400.0	1st Vial	0.50

Count Corrections-

Static Controller: On Luminescence Correction: Off
Colored Samples: n/a Heterogeneity Monitor: n/a
Coincidence Time (nsec): 18 Delay Before Burst (nsec): 75

Half Life-

Half Life Correction: Off

Regions	Half Life	Units	Reference Date	Reference Time
Beta A				
Beta B				
Alpha				

IPA Block Data
Software Version IC: 2.09
Software Version EC: 1.10
Instrument Model: Tri-Carb 3100TR
Instrument Serial Number: 405314
3H Chi Square: 28.24 Date Processed: 4/13/01 11:15:09 AM
14C Chi Square: 29.89 Date Processed: 4/13/01 11:15:09 AM
3H E^2/B (0-18.6 keV and 1-18.6 keV): 275.02 Date Processed: 4/13/01 11:15:09 AM
14C E^2/B (0-156 keV and 1-156 keV): 516.08 Date Processed: 4/13/01 11:15:09 AM
3H Efficiency (0-18.6 keV): 65.71 Date Processed: 4/13/01 11:15:09 AM
14C Efficiency (0-156 keV): 96.76 Date Processed: 4/13/01 11:15:09 AM
IPA Background Date Processed: 4/13/01 11:15:09 AM
3H Background CPM (0-18.6 keV): 15.63 Date Processed: 4/13/01 11:15:09 AM
14C Background CPM (0-156 keV): 22.80 Date Processed: 4/13/01 11:15:09 AM
3H Calibration DPM: 285000
3H Reference Date: 10/29/99

4/13/01 1:21:25 PM QuantaSmart (TM) - 1.10 Page # 2
Protocol# 41 - Manual Np_Pa 3%2S.1Serial# 405314 User: Bertetti

14C Calibration DPM: 134100
========== Errors and Warnings ==========
========== End of Errors and Warnings ==========

Cycle 1 Results

S#	Count Time	CPMA	A:2S%	CPMB	B:2S%	CPMa	alpha2S%	SIS	MESSAGES
1	60.00	20.45	5.71	25.28	5.13	0.22	55.47	849.83	B
2	9.01	20029.94	0.47	20030.76	0.47	17763.49	0.50	291.76	
3	3.57	50910.08	0.47	50912.53	0.47	44894.18	0.50	292.88	
4	1.84	100606.72	0.46	100610.04	0.46	87275.87	0.50	291.42	
5	8.36	18559.57	0.51	18559.65	0.51	19162.10	0.50	285.54	
6	8.57	18943.96	0.50	18944.38	0.50	18696.17	0.50	288.28	
7	8.81	19471.83	0.48	19473.58	0.48	18169.48	0.50	291.83	
8	3.54	49470.79	0.48	49471.33	0.48	45265.32	0.50	292.54	
9	3.45	48617.52	0.49	48615.30	0.49	46427.03	0.50	288.62	
10	7.81	16163.03	0.56	16162.30	0.56	20500.94	0.50	274.59	
11	3.36	46028.66	0.51	46030.97	0.51	47722.11	0.50	274.09	
12	1.83	99094.30	0.47	99098.21	0.47	87826.01	0.50	276.39	

13 Apr 01
PB

The preceding page shows results from counting the iNpX samples at a discriminator setting of 150. The following page contains a printout of results at a setting of 145. (p.26)

13 Apr 01
PB

Review of the results at discriminator settings of 145 and 150 indicates that the actual count rate is very sensitive to acid loading. What is not completely known is how sensitive count rate might be to the composition of the calcite-equilibrium solution composition.

Calcite solutions for use in the sorption experiments are being prepared. When they are ready, samples from these solutions will be used to help determine sensitivity and efficiency for each discriminator setting.

No further entries this page
PB

13 Apr 01
PB

4/13/01 3:49:59 PM QuantaSmart (TM) - 1.10 Page # 1
Protocol# 41 - Manual Np_Pa 3%2S.1Serial# 405314 User: Bertetti

Assay Definition-

Assay Description:

Assay Type: Alpha/Beta
Report Name: Manual Np_Pa 3% 2sigma
Output Data Path: C:\Packard\Tricarb\Results\Bertetti\Manual Np_Pa 3%2S
Raw Results Path: C:\Packard\Tricarb\Results\Bertetti\Manual Np_Pa 3%2S
Comma-Delimited File Name: C:\Packard\Tricarb\Results\Bertetti\Manual Np_Pa 3%2S\Manual Np_Pa 3%2S.txt

Count Conditions-

Nuclide: Manual Np/Pa
Quench Indicator: SIS
External Std Terminator (sec): n/a
Pre-Count Delay (min): 0.00
Quench Set:
Count Time (min): 60.00
Count Mode: Normal
Assay Count Cycles: 1 Repeat Sample Count: 1
#Vials/Sample: 1 Calculate % Reference: Off

Background Subtract: On - 1st Vial
Low CPM Threshold: Off
2 Sigma % Terminator: On - Any Region

In Use Discriminator: 145

Regions	LL	UL	Bkg Subtract	2Sigma % Terminator
Beta A	0.0	400.0	1st Vial	0.00
Beta B	0.0	2000.0	1st Vial	0.00
Alpha	100.0	400.0	1st Vial	0.50

Count Corrections-

Static Controller: On Luminescence Correction: Off
Colored Samples: n/a Heterogeneity Monitor: n/a
Coincidence Time (nsec): 18 Delay Before Burst (nsec): 75

Half Life-

Half Life Correction: Off

Regions	Half Life	Units	Reference Date	Reference Time
Beta A				
Beta B				
Alpha				

IPA Block Data
Software Version IC: 2.09
Software Version EC: 1.10
Instrument Model: Tri-Carb 3100TR
Instrument Serial Number: 405314
3H Chi Square: 28.24 Date Processed: 4/13/01 11:15:09 AM
14C Chi Square: 29.89 Date Processed: 4/13/01 11:15:09 AM
3H E^2/B (0-18.6 keV and 1-18.6 keV): 275.02 Date Processed: 4/13/01 11:15:09 AM
14C E^2/B (0-156 keV and 1-156 keV): 516.08 Date Processed: 4/13/01 11:15:09 AM
3H Efficiency (0-18.6 keV): 65.71 Date Processed: 4/13/01 11:15:09 AM
14C Efficiency (0-156 keV): 96.76 Date Processed: 4/13/01 11:15:09 AM
IPA Background Date Processed: 4/13/01 11:15:09 AM
3H Background CPM (0-18.6 keV): 15.63 Date Processed: 4/13/01 11:15:09 AM
14C Background CPM (0-156 keV): 22.80 Date Processed: 4/13/01 11:15:09 AM
3H Calibration DPM: 285000
3H Reference Date: 10/29/99

4/13/01 3:49:59 PM QuantaSmart (TM) - 1.10 Page # 2
Protocol# 41 - Manual Np_Pa 3%2S.1Serial# 405314 User: Bertetti

14C Calibration DPM: 134100
========== Errors and Warnings ==========
========== End of Errors and Warnings ==========

Cycle 1 Results

S#	Count Time	CPMA	A:2S%	CPMB	B:2S%	CPMa	alpha2S%	SIS	MESSAGES
1	60.00	20.08	5.76	24.65	5.20	0.20	57.74	772.61	B
2	8.69	19406.73	0.49	19406.19	0.49	18431.22	0.50	283.91	
3	3.47	48965.80	0.49	48964.11	0.49	46209.02	0.50	282.87	
4	1.77	97309.86	0.48	97311.51	0.48	90911.10	0.50	280.46	
5	8.23	18197.17	0.52	18196.25	0.52	19458.85	0.50	281.11	
6	8.43	18655.00	0.50	18655.78	0.50	18996.24	0.50	283.29	
7	8.61	18916.50	0.50	18916.12	0.50	18587.37	0.50	283.40	
8	3.44	48063.06	0.49	48063.43	0.49	46685.56	0.50	284.00	
9	3.39	47543.04	0.50	47544.38	0.50	47228.41	0.50	282.55	
10	7.55	15310.11	0.59	15308.86	0.59	21198.87	0.50	260.49	
11	3.34	45366.74	0.51	45368.17	0.51	48027.35	0.50	269.76	
12	1.78	95982.73	0.48	95984.34	0.48	90422.27	0.50	265.98	

7 May 01
PB

Using calcite-equilibrated solutions and the Np spike (#46A) expected to be used in the Np-calcite experiments, several samples will be prepared and analyzed in the USA. The samples will be prepared in 7-mL glass scintillation vials using 0.5 mL of calcite solution and 50 µL of Np spike solution. Later, 0.5 mL of 0.1 N HNO_3 will be added to assess the impact of that acid addition (Note that 0.02 N to 0.1 N HNO_3 has been used in sorption expts as a sample additive to minimize potential radionuclide sorption onto the scintillation vial).

All mass measurements are taken with the Mettler AE 240. 8 glass vials are labeled A through H, representing the calcite-equilibrium solution label. Solutions are in equilibrium w/calcite at pH values from 7.25 to 9 in 0.25 increments.

(004/450)

vial	wt. vial + cal. soln. (g)	wt. vial + Np soln	wt. Np soln.	approx. cpm @ 184500 cpm/g
A	7.7852	7.8357	0.0505	9320
B	7.7391	7.7895	0.0504	9300
C	7.8353	7.8859	0.0506	9335
D	7.8445	7.8950	0.0505	9320
E	7.7990	7.8494	0.0504	9300
F	7.8431	7.8933	0.0502	9260
G	7.8039	7.8544	0.0505	9320
H	7.7971	7.8474	0.0503	9280

Using a 500 µL Eppendorf pipettor w/tip (separate tip for each solution), 500 µL of solutions A-H were transferred to labeled vials and weighed. Weights are recorded above. ~~100 µL~~ PB 5/7/01 50 µL of Np spike #46A was then added to each vial, and the vials were reweighed.

08 May 01 PB

Results of LSA counting of samples from p. 27. Note background is based on IPA.

PB
05 /7/01 5:32:10 PM QuantaSmart (TM) - 1.10 Page # 1
rotocol# 18 - Np_Pa AB.lsa Serial# 405314 User: Bertetti

Assay Definition-

Assay Description:

Assay Type: Alpha/Beta
Report Name: Np_Pa AB
Output Data Path: C:\Packard\Tricarb\Results\Bertetti\Np_Pa AB
Raw Results Path: C:\Packard\Tricarb\Results\Bertetti\Np_Pa AB
Comma-Delimited File Name: C:\Packard\Tricarb\Results\Bertetti\Np_Pa AB\Np_Pa_AB.txt

Count Conditions-

Nuclide: Manual Np/Pa
Quench Indicator: SIS
External Std Terminator (sec): n/a
Pre-Count Delay (min): 0.00
Quench Set:
Count Time (min): 60.00
Count Mode: Normal
Assay Count Cycles: 1 Repeat Sample Count: 1
#Vials/Sample: 1 Calculate % Reference: Off

Background Subtract: On - IPA
Low CPM Threshold: Off
2 Sigma % Terminator: On - Any Region

In Use Discriminator 142

Regions	LL	UL	Bkg Subtract	2Sigma % Terminator
Beta A	0.0	400.0	IPA	0.00
Beta B	0.0	2000.0	IPA	0.00
Alpha	100.0	400.0	IPA	0.50

Count Corrections-

Static Controller: On Luminescence Correction: Off
Colored Samples: n/a Heterogeneity Monitor: n/a
Coincidence Time (nsec): 18 Delay Before Burst (nsec): 75

Half Life-

Half Life Correction: Off

Regions	Half Life	Units	Reference Date	Reference Time
Beta A				
Beta B				
Alpha				

IPA Block Data
Software Version IC: 2.09
Software Version EC: 1.10
Instrument Model: Tri-Carb 3100TR
Instrument Serial Number: 405314
3H Chi Square: 27.72 Date Processed: 5/4/01 12:10:03 PM
14C Chi Square: 18.27 Date Processed: 5/4/01 12:10:03 PM
3H E^2/B (0-18.6 keV and 1-18.6 keV): 264.59 Date Processed: 5/4/01 12:10:03 PM
14C E^2/B (0-156 keV and 1-156 keV): 511.32 Date Processed: 5/4/01 12:10:03 PM
3H Efficiency (0-18.6 keV): 65.92 Date Processed: 5/4/01 12:10:03 PM
14C Efficiency (0-156 keV): 96.49 Date Processed: 5/4/01 12:10:03 PM
IPA Background Date Processed: 5/4/01 12:10:03 PM
3H Background CPM (0-18.6 keV): 16.37 Date Processed: 5/4/01 12:10:03 PM
14C Background CPM (0-156 keV): 23.75 Date Processed: 5/4/01 12:10:03 PM
3H Calibration DPM: 285000
3H Reference Date: 10/29/99
14C Calibration DPM: 134100

results cont'd.

05 May 01 PB

/7/01 5:32:11 PM QuantaSmart (TM) - 1.10 Page # 2
rotocol# 18 - Np_Pa AB.lsa Serial# 405314 User: Bertetti

05/7/01 PB
========== Errors and Warnings ==========
========== End of Errors and Warnings ==========

Cycle 1 Results

S#	Count Time	CPMA	A:2S%	CPMB	B:2S%	CPMa	alpha2S%	SIS	MESSAGES
5/7/01 5:01:00 PM: Warning: User Has Modified Count Conditions.									
1	4.23	9088.91	1.02	9085.72	1.02	9723.64	0.99	273.33	
2	4.10	8888.94	1.05	8883.94	1.05	9775.37	1.00	275.89	
3	4.11	8903.50	1.05	8900.68	1.05	9761.07	1.00	274.94	
4	4.07	8906.01	1.05	8901.28	1.05	9850.37	1.00	271.36	
5	4.11	9024.18	1.04	9019.90	1.04	9756.93	1.00	274.50	
6	4.08	8861.33	1.05	8857.32	1.05	9826.47	1.00	272.68	
7	4.06	9009.30	1.05	9006.05	1.05	9857.39	1.00	273.17	
8	4.06	8849.20	1.06	8847.18	1.06	9865.02	1.00	273.07	

08 May 01 Discriminator settings will be altered with results posted on following pages

Page one on following page for convenience (150)

5 /8/01 10:21:30 AM QuantaSmart (TM) - 1.10 Page # 2
rotocol# 18 - Np_Pa AB.lsa Serial# 405314 User: Bertetti

========== Errors and Warnings ==========
========== End of Errors and Warnings ==========

Cycle 1 Results

S#	Count Time	CPMA	A:2S%	CPMB	B:2S%	CPMa	alpha2S%	SIS	MESSAGES
1	4.27	9286.98	1.01	9283.21	1.01	9381.97	1.00	274.42	
2	4.19	9056.74	1.03	9052.09	1.03	9553.46	1.00	279.60	
3	4.20	9073.44	1.03	9069.50	1.03	9535.71	1.00	278.85	
4	4.16	9211.68	1.02	9208.02	1.02	9632.45	1.00	278.11	
5	4.17	9147.79	1.03	9142.68	1.03	9614.15	1.00	277.95	
6	4.22	9097.59	1.02	9093.40	1.02	9491.47	1.00	278.24	
7	4.17	9185.68	1.02	9181.29	1.02	9600.00	1.00	278.69	
8	4.19	9093.25	1.03	9090.51	1.03	9568.50	1.00	278.47	

08 May 01
PB

5/8/01 10:21:29 AM QuantaSmart (TM) - 1.10 Page # 1
rotocol# 18 - Np_Pa AB.lsa Serial# 405314 User: Bertetti
PB

Assay Definition-

Assay Description:

Assay Type: Alpha/Beta
Report Name: Np_Pa AB
Output Data Path: C:\Packard\Tricarb\Results\Bertetti\Np_Pa AB
Raw Results Path: C:\Packard\Tricarb\Results\Bertetti\Np_Pa AB
Comma-Delimited File Name: C:\Packard\Tricarb\Results\Bertetti\Np_Pa AB\Np_Pa_AB.txt

Count Conditions-

Nuclide: Manual Np/Pa
Quench Indicator: SIS
External Std Terminator (sec): n/a
Pre-Count Delay (min): 0.00
Quench Set:
Count Time (min): 60.00
Count Mode: Normal
Assay Count Cycles: 1 Repeat Sample Count: 1
#Vials/Sample: 1 Calculate % Reference: Off

Background Subtract: On - IPA
Low CPM Threshold: Off
2 Sigma % Terminator: On - Any Region

In Use Discriminator: 150

Regions	LL	UL	Bkg Subtract	2Sigma % Terminator
Beta A	0.0	400.0	IPA	0.00
Beta B	0.0	2000.0	IPA	0.00
Alpha	100.0	400.0	IPA	1.00

Count Corrections-

Static Controller: On Luminescence Correction: Off
Colored Samples: n/a Heterogeneity Monitor: n/a
Coincidence Time (nsec): 18 Delay Before Burst (nsec): 75

Half Life-

Half Life Correction: Off

Regions	Half Life	Units	Reference Date	Reference Time
Beta A				
Beta B				
Alpha				

IPA Block Data
Software Version IC: 2.09
Software Version EC: 1.10
Instrument Model: Tri-Carb 3100TR
Instrument Serial Number: 405314
3H Chi Square: 20.96 Date Processed: 5/7/01 7:05:39 PM
14C Chi Square: 13.12 Date Processed: 5/7/01 7:05:39 PM
3H E^2/B (0-18.6 keV and 1-18.6 keV): 245.70 Date Processed: 5/7/01 7:05:39 PM
14C E^2/B (0-156 keV and 1-156 keV): 500.67 Date Processed: 5/7/01 7:05:39 PM
3H Efficiency (0-18.6 keV): 65.87 Date Processed: 5/7/01 7:05:39 PM
14C Efficiency (0-156 keV): 96.78 Date Processed: 5/7/01 7:05:39 PM
IPA Background Date Processed: 5/7/01 7:05:39 PM
3H Background CPM (0-18.6 keV): 17.70 Date Processed: 5/7/01 7:05:39 PM
14C Background CPM (0-156 keV): 25.32 Date Processed: 5/7/01 7:05:39 PM
3H Calibration DPM: 285000
3H Reference Date: 10/29/99
14C Calibration DPM: 134100

page 2 on previous note book page.

08 May 01
PB

0.5 mL of 0.1 N HNO_3 is added to each vial and the series is run again.

08 May 01
PB

5/8/01 12:45:56 PM QuantaSmart (TM) - 1.10 Page # 1
rotocol# 18 - Np_Pa AB.lsa Serial# 405314 User: Bertetti
PB

Assay Definition-

Assay Description:

Assay Type: Alpha/Beta
Report Name: Np_Pa AB
Output Data Path: C:\Packard\Tricarb\Results\Bertetti\Np_Pa AB
Raw Results Path: C:\Packard\Tricarb\Results\Bertetti\Np_Pa AB
Comma-Delimited File Name: C:\Packard\Tricarb\Results\Bertetti\Np_Pa AB\Np_Pa_AB.txt

Count Conditions-

Nuclide: Manual Np/Pa
Quench Indicator: SIS
External Std Terminator (sec): n/a
Pre-Count Delay (min): 0.00
Quench Set:
Count Time (min): 60.00
Count Mode: Normal
Assay Count Cycles: 1 Repeat Sample Count: 1
#Vials/Sample: 1 Calculate % Reference: Off

Background Subtract: On - IPA
Low CPM Threshold: Off
2 Sigma % Terminator: On - Any Region

In Use Discriminator: 150 w/acid

Regions	LL	UL	Bkg Subtract	2Sigma % Terminator
Beta A	0.0	400.0	IPA	0.00
Beta B	0.0	2000.0	IPA	0.00
Alpha	100.0	400.0	IPA	1.00

Count Corrections-

Static Controller: On Luminescence Correction: Off
Colored Samples: n/a Heterogeneity Monitor: n/a
Coincidence Time (nsec): 18 Delay Before Burst (nsec): 75

Half Life-

Half Life Correction: Off

Regions	Half Life	Units	Reference Date	Reference Time
Beta A				
Beta B				
Alpha				

IPA Block Data
Software Version IC: 2.09
Software Version EC: 1.10
Instrument Model: Tri-Carb 3100TR
Instrument Serial Number: 405314
3H Chi Square: 20.48 Date Processed: 5/8/01 12:08:16 PM
14C Chi Square: 26.48 Date Processed: 5/8/01 12:08:16 PM
3H E^2/B (0-18.6 keV and 1-18.6 keV): 260.06 Date Processed: 5/8/01 12:08:16 PM
14C E^2/B (0-156 keV and 1-156 keV): 496.98 Date Processed: 5/8/01 12:08:16 PM
3H Efficiency (0-18.6 keV): 66.01 Date Processed: 5/8/01 12:08:16 PM
14C Efficiency (0-156 keV): 96.40 Date Processed: 5/8/01 12:08:16 PM
IPA Background Date Processed: 5/8/01 12:08:16 PM
3H Background CPM (0-18.6 keV): 16.75 Date Processed: 5/8/01 12:08:16 PM
14C Background CPM (0-156 keV): 24.13 Date Processed: 5/8/01 12:08:16 PM
3H Calibration DPM: 285000
3H Reference Date: 10/29/99
14C Calibration DPM: 134100

5/8/01 12:45:56 PM QuantaSmart (TM) - 1.10 Page # 2
rotocol# 18 - Np_Pa AB.lsa Serial# 405314 User: Bertetti
PB

========== Errors and Warnings ==========
========== End of Errors and Warnings ==========

Cycle 1 Results

S#	Count Time	CPMA	A:2S%	CPMB	B:2S%	CPMa	alpha2S%	SIS	MESSAGES
1	4.41	9590.44	0.97	9587.84	0.97	9082.77	1.00	264.03	
2	4.33	9414.79	0.99	9412.98	0.99	9254.50	1.00	265.01	
3	4.33	9485.46	0.99	9482.27	0.99	9258.89	1.00	266.05	
4	4.30	9440.21	0.99	9436.58	0.99	9308.60	1.00	264.02	
5	4.36	9463.58	0.99	9461.27	0.99	9194.95	1.00	264.54	
6	4.38	9357.69	0.99	9354.67	0.99	9138.36	1.00	265.31	
7	4.33	9555.90	0.98	9552.47	0.99	9259.12	1.00	263.71	
8	4.37	9338.66	0.99	9335.42	0.99	9181.69	1.00	263.74	

08 May 01
PD

5/8/01 1:26:43 PM QuantaSmart (TM) - 1.10 Page # 1
Protocol# 18 - Np_Pa AB.lsa Serial# 405314 User: Bertetti

Assay Definition-

Assay Description:

Assay Type: Alpha/Beta
Report Name: Np_Pa AB
Output Data Path: C:\Packard\Tricarb\Results\Bertetti\Np_Pa AB
Raw Results Path: C:\Packard\Tricarb\Results\Bertetti\Np_Pa AB
Comma-Delimited File Name: C:\Packard\Tricarb\Results\Bertetti\Np_Pa AB\Np_Pa_AB.txt

Count Conditions-

Nuclide: Manual Np/Pa
Quench Indicator: SIS
External Std Terminator (sec): n/a
Pre-Count Delay (min): 0.00
Quench Set:
Count Time (min): 60.00
Count Mode: Normal
Assay Count Cycles: 1 Repeat Sample Count: 1
#Vials/Sample: 1 Calculate % Reference: Off

Background Subtract: On - IPA
Low CPM Threshold: Off
2 Sigma % Terminator: On - Any Region

In Use Discriminator: 142

Regions	LL	UL	Bkg Subtract	2Sigma % Terminator
Beta A	0.0	400.0	IPA	0.00
Beta B	0.0	2000.0	IPA	0.00
Alpha	100.0	400.0	IPA	1.00

Count Corrections-

Static Controller: On Luminescence Correction: Off
Colored Samples: n/a Heterogeneity Monitor: n/a
Coincidence Time (nsec): 18 Delay Before Burst (nsec): 75

Half Life-

Half Life Correction: Off

Regions	Half Life	Units	Reference Date	Reference Time
Beta A				
Beta B				
Alpha				

IPA Block Data
Software Version IC: 2.09
Software Version EC: 1.10
Instrument Model: Tri-Carb 3100TR
Instrument Serial Number: 405314
3H Chi Square: 20.48 Date Processed: 5/8/01 12:08:16 PM
14C Chi Square: 26.48 Date Processed: 5/8/01 12:08:16 PM
3H E^2/B (0-18.6 keV and 1-18.6 keV): 260.06 Date Processed: 5/8/01 12:08:16 PM
14C E^2/B (0-156 keV and 1-156 keV): 496.98 Date Processed: 5/8/01 12:08:16 PM
3H Efficiency (0-18.6 keV): 66.01 Date Processed: 5/8/01 12:08:16 PM
14C Efficiency (0-156 keV): 96.40 Date Processed: 5/8/01 12:08:16 PM
IPA Background Date Processed: 5/8/01 12:08:16 PM
3H Background CPM (0-18.6 keV): 16.75 Date Processed: 5/8/01 12:08:16 PM
14C Background CPM (0-156 keV): 24.13 Date Processed: 5/8/01 12:08:16 PM
3H Calibration DPM: 285000
3H Reference Date: 10/29/99
14C Calibration DPM: 134100

8/01 1:26:43 PM QuantaSmart (TM) - 1.10 Page # 2
rotocol# 18 - Np_Pa AB.lsa Serial# 405314 User: Bertetti

========== Errors and Warnings ==========
========== End of Errors and Warnings ==========

Cycle 1 Results

S#	Count Time	CPMA	A:2S%	CPMB	B:2S%	CPMa	alpha2S%	SIS	MESSAGES
1	4.24	9232.91	1.01	9230.52	1.01	9440.33	1.00	251.32	
2	4.21	9168.50	1.02	9165.43	1.02	9513.54	1.00	255.75	
3	4.22	9149.79	1.02	9147.90	1.02	9485.07	1.00	257.33	
4	4.17	9212.11	1.02	9208.61	1.02	9607.43	1.00	257.87	
5	4.20	9204.21	1.02	9200.44	1.02	9541.91	1.00	257.14	
6	4.18	9119.43	1.03	9114.96	1.03	9580.14	1.00	255.95	
7	4.18	9218.95	1.02	9215.68	1.02	9592.58	1.00	257.75	
8	4.16	9117.97	1.03	9116.89	1.03	9619.71	1.00	259.31	

08 May 01
PD

5/8/01 2:26:19 PM QuantaSmart (TM) - 1.10 Page # 1
rotocol# 18 - Np_Pa AB.lsa Serial# 405314 User: Bertetti

Assay Definition-

Assay Description:

Assay Type: Alpha/Beta
Report Name: Np_Pa AB
Output Data Path: C:\Packard\Tricarb\Results\Bertetti\Np_Pa AB
Raw Results Path: C:\Packard\Tricarb\Results\Bertetti\Np_Pa AB
Comma-Delimited File Name: C:\Packard\Tricarb\Results\Bertetti\Np_Pa AB\Np_Pa_AB.txt

Count Conditions-

Nuclide: Manual Np/Pa
Quench Indicator: SIS
External Std Terminator (sec): n/a
Pre-Count Delay (min): 0.00
Quench Set:
Count Time (min): 60.00
Count Mode: Normal
Assay Count Cycles: 1 Repeat Sample Count: 1
#Vials/Sample: 1 Calculate % Reference: Off

Background Subtract: On - IPA
Low CPM Threshold: Off
2 Sigma % Terminator: On - Any Region

In Use Discriminator: 145

Regions	LL	UL	Bkg Subtract	2Sigma % Terminator
Beta A	0.0	400.0	IPA	0.00
Beta B	0.0	2000.0	IPA	0.00
Alpha	100.0	400.0	IPA	1.00

Count Corrections-

Static Controller: On Luminescence Correction: Off
Colored Samples: n/a Heterogeneity Monitor: n/a
Coincidence Time (nsec): 18 Delay Before Burst (nsec): 75

Half Life-

Half Life Correction: Off

Regions	Half Life	Units	Reference Date	Reference Time
Beta A				
Beta B				
Alpha				

IPA Block Data
Software Version IC: 2.09
Software Version EC: 1.10
Instrument Model: Tri-Carb 3100TR
Instrument Serial Number: 405314
3H Chi Square: 20.48 Date Processed: 5/8/01 12:08:16 PM
14C Chi Square: 26.48 Date Processed: 5/8/01 12:08:16 PM
3H E^2/B (0-18.6 keV and 1-18.6 keV): 260.06 Date Processed: 5/8/01 12:08:16 PM
14C E^2/B (0-156 keV and 1-156 keV): 496.98 Date Processed: 5/8/01 12:08:16 PM
3H Efficiency (0-18.6 keV): 66.01 Date Processed: 5/8/01 12:08:16 PM
14C Efficiency (0-156 keV): 96.40 Date Processed: 5/8/01 12:08:16 PM
IPA Background Date Processed: 5/8/01 12:08:16 PM
3H Background CPM (0-18.6 keV): 16.75 Date Processed: 5/8/01 12:08:16 PM
14C Background CPM (0-156 keV): 24.13 Date Processed: 5/8/01 12:08:16 PM
3H Calibration DPM: 285000
3H Reference Date: 10/29/99
14C Calibration DPM: 134100

8/01 2:26:20 PM QuantaSmart (TM) - 1.10 Page # 2
rotocol# 18 - Np_Pa AB.lsa Serial# 405314 User: Bertetti

========== Errors and Warnings ==========
========== End of Errors and Warnings ==========

Cycle 1 Results

S#	Count Time	CPMA	A:2S%	CPMB	B:2S%	CPMa	alpha2S%	SIS	MESSAGES
1	4.29	9317.52	1.00	9312.50	1.00	9335.90	1.00	254.16	
2	4.26	9281.45	1.01	9279.04	1.01	9398.83	1.00	259.18	
3	4.23	9347.48	1.01	9345.81	1.01	9471.39	1.00	261.49	
4	4.24	9193.06	1.01	9189.48	1.02	9462.03	1.00	258.71	
5	4.28	9379.54	1.00	9375.23	1.00	9350.70	1.00	259.11	
6	4.28	9228.61	1.01	9226.87	1.01	9354.67	1.00	258.77	
7	4.24	9344.71	1.01	9340.90	1.01	9451.42	1.00	257.76	
8	4.24	9274.42	1.01	9270.14	1.01	9449.53	1.00	260.72	

08 May 01 PB

Based on these conditions it appears that a setting of 145 will be adequate for this (these) sample chemistries. Settings of 142 and 150 tend to overestimate or underestimate Np activity, respectively.

11 May 01 PB

Samples will be recounted using protocol 18 to gather additional count data.

12 May 01 PB

collection of count runs from Friday night show that count rates using 145 are consistent. Though a slight trend dependent on solution chemistry may be evident - will test next week.

12 May 01 PB

5 /10/01 4:51:19 PM QuantaSmart (TM) - 1.10 Page # 1
rotocol# 18 - Np_Pa AB.lsa Serial# 405314 User: Bertetti

PB

Assay Definition-

Assay Description:

Assay Type: Alpha/Beta
Report Name: Np_Pa AB
Output Data Path: C:\Packard\Tricarb\Results\Bertetti\Np_Pa AB
Raw Results Path: C:\Packard\Tricarb\Results\Bertetti\Np_Pa AB
Comma-Delimited File Name: C:\Packard\Tricarb\Results\Bertetti\Np_Pa AB\Np_Pa_AB.txt

Count Conditions-

Nuclide: Manual Np/Pa
Quench Indicator: SIS
External Std Terminator (sec): n/a
Pre-Count Delay (min): 0.00
Quench Set:
Count Time (min): 60.00
Count Mode: Normal
Assay Count Cycles: 1 Repeat Sample Count: 1
#Vials/Sample: 1 Calculate % Reference: Off

Background Subtract: On - IPA
Low CPM Threshold: Off
2 Sigma % Terminator: On - Any Region

In Use Discriminator: 145

Regions	LL	UL	Bkg Subtract	2Sigma % Terminator
Beta A	0.0	400.0	IPA	0.00
Beta B	0.0	2000.0	IPA	0.00
Alpha	100.0	400.0	IPA	1.00

Count Corrections-

Static Controller: On Luminescence Correction: Off
Colored Samples: n/a Heterogeneity Monitor: n/a
Coincidence Time (nsec): 18 Delay Before Burst (nsec): 75

Half Life-

Half Life Correction: Off

Regions	Half Life	Units	Reference Date	Reference Time
Beta A				
Beta B				
Alpha				

IPA Block Data
Software Version IC: 2.09
Software Version EC: 1.10
Instrument Model: Tri-Carb 3100TR
Instrument Serial Number: 405314
3H Chi Square: 15.13 Date Processed: 5/10/01 3:52:12 PM
14C Chi Square: 8.47 Date Processed: 5/10/01 3:52:12 PM
3H E^2/B (0-18.6 keV and 1-18.6 keV): 248.39 Date Processed: 5/10/01 3:52:12 PM
14C E^2/B (0-156 keV and 1-156 keV): 427.65 Date Processed: 5/10/01 3:52:12 PM
3H Efficiency (0-18.6 keV): 65.95 Date Processed: 5/10/01 3:52:12 PM
14C Efficiency (0-156 keV): 96.64 Date Processed: 5/10/01 3:52:12 PM
IPA Background Date Processed: 5/10/01 3:52:12 PM
3H Background CPM (0-18.6 keV): 17.77 Date Processed: 5/10/01 3:52:12 PM
14C Background CPM (0-156 keV): 27.92 Date Processed: 5/10/01 3:52:12 PM
3H Calibration DPM: 285000
3H Reference Date: 10/29/99
14C Calibration DPM: 134100

5 /10/01 4:51:19 PM QuantaSmart (TM) - 1.10 Page # 2
rotocol# 18 - Np_Pa AB.lsa Serial# 405314 User: Bertetti

PB

========== Errors and Warnings ==========
========== End of Errors and Warnings ==========

Cycle 1 Results

S#	Count Time	CPMA	A:2S%	CPMB	B:2S%	CPMa	alpha2S%	SIS	MESSAGES
1	4.29	9386.63	1.00	9384.69	1.00	9336.60	1.00	257.00	
2	4.27	9198.43	1.01	9195.35	1.01	9370.96	1.00	258.19	
3	4.22	9269.90	1.01	9265.46	1.01	9485.07	1.00	258.50	
4	4.26	9373.15	1.00	9369.85	1.00	9395.77	1.00	257.76	
5	4.24	9259.96	1.01	9256.93	1.01	9444.81	1.00	257.71	
6	4.27	9132.62	1.01	9129.31	1.02	9379.63	1.00	259.37	
7	4.20	9281.58	1.01	9278.11	1.02	9528.81	1.00	256.39	
8	4.23	9214.81	1.01	9211.77	1.02	9462.17	1.00	259.35	

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Assay Definition-

Assay Description:

Assay Type: Alpha/Beta
Report Name: Np_Pa AB
Output Data Path: C:\Packard\Tricarb\Results\Bertetti\Np_Pa AB
Raw Results Path: C:\Packard\Tricarb\Results\Bertetti\Np_Pa AB
Comma-Delimited File Name: C:\Packard\Tricarb\Results\Bertetti\Np_Pa AB\Np_Pa_AB.txt

Count Conditions-

Nuclide: Manual Np/Pa
Quench Indicator: SIS
External Std Terminator (sec): n/a
Pre-Count Delay (min): 0.00
Quench Set:
Count Time (min): 60.00
Count Mode: Normal
Assay Count Cycles: 1 Repeat Sample Count: 1
#Vials/Sample: 1 Calculate % Reference: Off

Background Subtract: On - IPA
Low CPM Threshold: Off
2 Sigma % Terminator: On - Any Region

In Use Discriminator: 145

Regions	LL	UL	Bkg Subtract	2Sigma % Terminator
Beta A	0.0	400.0	IPA	0.00
Beta B	0.0	2000.0	IPA	0.00
Alpha	100.0	400.0	IPA	1.00

Count Corrections-

Static Controller: On Luminescence Correction: Off
Colored Samples: n/a Heterogeneity Monitor: n/a
Coincidence Time (nsec): 18 Delay Before Burst (nsec): 75

Half Life-

Half Life Correction: Off

Regions	Half Life	Units	Reference Date	Reference Time
Beta A				
Beta B				
Alpha				

IPA Block Data
Software Version IC: 2.09
Software Version EC: 1.10
Instrument Model: Tri-Carb 3100TR
Instrument Serial Number: 405314
3H Chi Square: 15.72 Date Processed: 5/11/01 5:29:29 PM
14C Chi Square: 27.79 Date Processed: 5/11/01 5:29:29 PM
3H E^2/B (0-18.6 keV and 1-18.6 keV): 264.12 Date Processed: 5/11/01 5:29:29 PM
14C E^2/B (0-156 keV and 1-156 keV): 455.02 Date Processed: 5/11/01 5:29:29 PM
3H Efficiency (0-18.6 keV): 65.93 Date Processed: 5/11/01 5:29:29 PM
14C Efficiency (0-156 keV): 96.80 Date Processed: 5/11/01 5:29:29 PM
IPA Background Date Processed: 5/11/01 5:29:29 PM
3H Background CPM (0-18.6 keV): 16.55 Date Processed: 5/11/01 5:29:29 PM
14C Background CPM (0-156 keV): 26.17 Date Processed: 5/11/01 5:29:29 PM
3H Calibration DPM: 285000
3H Reference Date: 10/29/99
14C Calibration DPM: 134100

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PB

========== Errors and Warnings ==========
========== End of Errors and Warnings ==========

Cycle 1 Results

S#	Count Time	CPMA	A:2S%	CPMB	B:2S%	CPMa	alpha2S%	SIS	MESSAGES
1	4.28	9373.81	1.00	9371.06	1.00	9350.23	1.00	254.21	
2	4.22	9223.41	1.02	9221.22	1.02	9491.47	1.00	256.68	
3	4.26	9255.99	1.01	9254.92	1.01	9402.58	1.00	258.98	
4	4.24	9326.21	1.01	9321.40	1.01	9452.12	1.00	257.78	
5	4.24	9243.43	1.01	9240.74	1.01	9449.76	1.00	256.53	
6	4.22	9182.41	1.02	9180.70	1.02	9491.23	1.00	257.79	
7	4.21	9271.28	1.01	9269.34	1.01	9527.08	1.00	257.10	
8	4.24	9257.11	1.01	9254.89	1.01	9456.60	1.00	257.43	

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Values from counting efforts : @ 145

Soln	5/8/01	5/10/01	5/11/01	average	expected
A	9335.90	9336.6	9350.23	9341	9320
B	9398.83	9370.96	9491.47	9420	9300
C	9471.39	9485.07	9402.58	9453	9335
D	9462.03	9395.77	9452.12	9420	9320
E	9350.70	9444.81	9449.76	9415	9300
F	9354.67	9379.63	9491.23	9408	9260
G	9451.42	9528.81	9527.08	9502	9320
H	9449.53	9462.17	9456.60	9456	9280

1-2% high

=) Country error of 1%, but values are consistently high by 1-2%, closer to 2% in many cases. However, the error seems to be similar over the entire solution range.

9-19-01 Copy made for QA Archives.
BAW

03/21/02 Copy made for QA archives.
PB

3/14/03 Copy made for QA archives
PB

I have reviewed this scientific notebook and find it in agreement with QAP-001. There is sufficient information regarding methods used for conducting tests, acquiring and analyzing data so that another qualified individual could repeat the activity.

R.C. [illegible] 1/20/2004