

## BOOK83R

*Notes:*

"Tinker Toy Experiments Series IV" on front

"~15 kgU/unit" on front

"Series IV" on spine

"IV" on spine

Blank pages: inside front cover sheets, 2, 4, 5, 14, 34, 42, 43, 52, 54, 73, 82, 86, 98, 112, 114, 120, 128, 132, 134, inside back cover sheets

-1 photo attached to each of the following pages: 10, 12, 16, 20, 22, 24, 26, 28, 30, 32, 36, 38, 40, 66, 102, 104, 108, 116, 122

-pages 24/25 have 1 half sheet between pages

-page 68 has 1 (8.5x11) graph sheet taped

-pages 116/117 have 3 (8.5x11) sheets between pages

*Scanned by:*

*Sheila Finch*

*RSICC /Oak Ridge National Lab.*

*August 31, 1999*

NOMINAL 15 kg U(922) units

Dia 3.595 in.

ht 1.703 in.

THE PAPER USED IN THIS BOOK WILL  
GIVE COMPLETE WRITING SATISFACTION.  
IT WAS SELECTED FROM MANY PAPERS  
FOR ITS FINE WRITING LEDGER SURFACE



## No. 168 BLANK BOOK

JOURNAL	}	WITHOUT U N I T S
SINGLE ENTRY LEDGER		
DOUBLE ENTRY LEDGER		
RECORD		

IN 150 AND 300 PAGES

M A D E I N T H E U . S . A .

TO REORDER THIS BOOK, SPECIFY  
NUMBER, RULING AND THICKNESS  
AS INDICATED ON BACKBONE OF BOOK

Expr.	No. of units	Ave. $Kg U^{235}/unit$	DESCRIPTION OF Experiment	Summary p.	p.
1	8	15.692	Unreflected	7	5
2	27	15.683	"	"	8
3	27	15.683	" Replacement of Center Unit	13	12
4	8	15.692	" Repeat Expt. 1	15	14
5	8	15.692	Reflected 6-in-thick paraffin	18	16
6	8	15.692	" 3-in- " "	21	20
7	8	15.692	" 1 1/2-in " "	23	22
8	8	15.692	" 1/2-in " "	25	24
9	8	15.696	Unreflected " Dumbbell "	26	26
10	8	15.696	Reflected 6-in-thick Paraffin	29	28
11	<del>8</del> 27	15.683	" 1/2 " " "	30	30
12	27	15.683	" 6 " " "	32	32
13	27	15.683	" 3 " " "	37	36
14	27	15.683	" 1 1/2 " " "	39	39
15	8	15.696	Unreflected CTC	41	40
<i>Uranium Graphite systems</i>					
1-4	8	15.696	Centered in Graphite 14.6 x 14.6 x 12.2" unreflected		47
5-7	8	"	" " " "		49
8	8	"	" " " "	51	51
9-10	8	"	Movie runs		53
11-12	8	"	Graphite (12.6 x 12.6 x 10.2)		53
13-16	8	"	"		55
17-19	8	"	"	56	57
20-22	"	"	"	58	59
23-25	"	"	"	60	61
26-29	"	"	"	62	63
30-31	"	"	Reflected U-C system		65
32-42	"	"	" " " "	68+70	71

Expr	# of units	ave. $k_{eff}$ /unit	Description of Expr.	Summary p.	P.
I-64	8	20.896	2 - (4 unit clusters in contact)	101	100
I-65	16	20.891	16 units in plane	102	102
I-66	27	20.877	Units in 15/16" thick Plexiglas boxes	106	104
I-67	8	20.960	" " " " " 6-in. pa. refl.	108	108
I-68	2	20.960	" Flooded"	116	110
F-69	8	21.008	6-in thick pa-reflector	123	122
I-70	4	20.860	Unreflected mixed arrays	127	124
	4	$UO_2(UO_2)_2$			

## Experiment 1

## Subassemblies:

1/	211			212			
	2470			2457	1.063	4.525	
	2190	4.526		2158			
	111			112			
	2469	1.065	4.520	2473	1.060	4.520	
	2196	4.533		2189			
3/	221			222			
	2290	1.065	4.524	2464	1.06	4.528	
	2195			2205			
	121			122			
	2455	1.060	4.530	2289	1.060	4.524	
	2152	4.533		2193		4.533	

Ave 15.692 kg U(93.2)/unit.

$$V_0 = 51.25222$$

### EXPERIMENT 1

8 units; 15.692 kg U(93.2)/unit : Unreflected, STS = 35/64 in.

Instrument Check on 7-9-68 Source 10 mc δ

PM-1	Low Trip	OK	Alarm Trip	OK	
PM-2			Alarm Trip	OK	
IS-1	$> 3 \times 10^{-11}$	Meter Trip	OK	Fast Trip	OK
IC-2	$> 3 \times 10^{-11}$	Meter Trip	OK	Clock	2446
IC-3		Calibration		H-230	
IC-4	Responds	Calibration	OK	check list	✓
CRM		Meter Trip			

R21 M=3

Reset N-S planes to 0.365 in.

k < 1 M=5

Changed spacing to 3/8"

k < 1 δ1.

Reset N-S plane to 5/16"

$10.85 \times 10^4$

R21 negative period 127.7 sec at closure -15.7 f

#### Summary

8 units 15.692 kg U(93.2)/unit

unreflected  
902 cm.

STS = 0.355 ± 0.005 in

$$V_L = 84.3565 \text{ in}^3$$

$$F = 0.60756$$

$$V_{(low)} = 1.3797$$

$$P_{av} = 11.3735$$

$$\frac{\text{Array ht}}{\text{Array base}} = \frac{7.07}{9.77} = 0.724$$

Experiment 2

Subassemblies:

1/ 311 2456 5.252 15.670 2153 10.418 211 2474 5.233 15.712 2176 10.479 111 2463 5.258 15.666 2164 10.408	2/ 312 2472 5.242 15.686 2202 10.444 212 2289 5.221 15.692 2193 10.471 112 2459 5.244 15.672 2173 10.428	3/ 313 2458 5.259 15.662 2169 10.403 213 2462 5.257 15.717 10.480 2204 113 2452 5.262 15.661 2157 10.399
4/ 321 2457 5.222 15.684 10.467 2158 221 2290 5.213 15.694 2195 10.481 121 2468 5.224 15.684 2200 10.460	5/ 322 2455 5.223 15.691 2152 10.468 222 2469 5.217 15.695 10.478 2196 122 2470 5.247 15.690 2190 10.443	6/ 333 2461 5.223 15.685 2155 10.462 223 2473 5.210 15.695 10.485 2187 123 2287 5.227 15.680 2197 10.453
7/ 331 2288 5.259 15.622 2181 10.403 231 2460 5.250 15.675 10.425 2185 131 2453 5.204 15.704 2180 10.500	8/ 332 2451 5.242 15.680 2167 10.438 2404 5.219 15.693 232 2205 10.474 132 2467 5.251 15.674 2177 10.423	9/ 333 2471 5.226 15.716 2168 10.489 233 2466 5.252 15.674 2166 10.422 133 2454 5.252 15.672 2194 10.420

Ave 15.683 kg U(235)/unit

Experiment 2

27 units 15.6 kg U(93.2)/unit ; Unreflected STS = 1.500 in.

Instrument Check on 7-15-63 Source 10 mc Y

PM-1	Low Trip	OK	Alarm Trip	OK
PM-2			Alarm Trip	OK
IC-1	$> 3 \times 10^{-11}$	Motor Trip	OK	OK
IC-2	$> 3 \times 10^{-11}$	Motor Trip	OK	clock 2448
IC-3		Calibration		M-230
IC-4	JIT Responds	Calibration	JIT	check list ✓
CRM		Motor Trip		

$R > 1$  positive period = 4821 sec at 1.350 in. (17.0 Revs)

$R = 1$  at 1.425 in. (17.65 Revs)  
 $R_{ex} = 4.57$

Changed spacing to  $1 \frac{3}{32}$ "

$R < 1$   $R > 1$

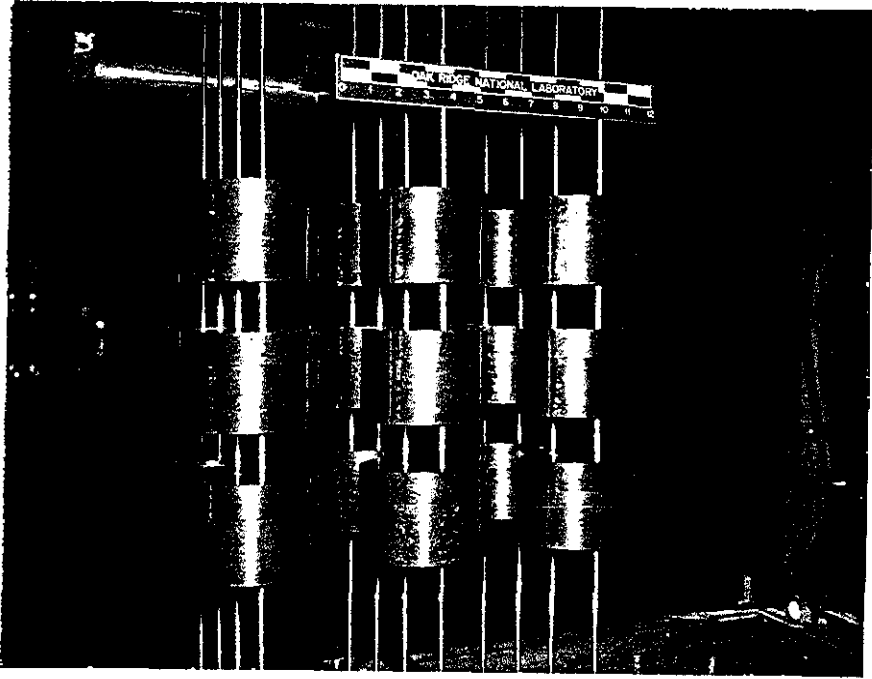
7/16/63 Reset Spacing to  $1 \frac{3}{16}$ "

Instrument Check on 7-16-63 Source 10 mc Y

PM-1	Low Trip	OK	Alarm Trip	OK
PM-2			Alarm Trip	OK
IC-1	$> 3 \times 10^{-11}$	Motor Trip	OK	OK
IC-2	$> 3 \times 10^{-11}$	Motor Trip	OK	clock 2448
IC-3		Calibration		M-230
IC-4	Responds	Calibration	JIT	check list ✓
CRM		Motor Trip		

$R < 1$   $R > 1$





7-16-63

Experiment 2

Reset Spacing to  $1\frac{1}{16}$ "

$p = 10.3 \times 10^{-4}$   $k > 1$  positive Period. 50.18 sec at 0.675 (10.00 Revs)  
 16.094  $k = 1$  at 0.725 in.  $\phi = 0.950$  3.224/in (10.70 Revs)  
 $k_{ex} = 2.33$

Instrument Check on 7-17-63 Source 10 mcV

PM-1	Low Trip	OK	Alarm Trip	OK	
PH-2			Alarm Trip	OK	
IC-1	$> 3 \times 10^{-4}$	Meter Trip	OK	Fast Trip	OK
IC-2	$> 3 \times 10^{-4}$	Meter Trip	OK		Clock 2449
IC-3		Calibration			M-230
IC-4	Responds	Calibration	J11		Check list <input checked="" type="checkbox"/>
CRM		Meter Trip			

Increased spacing between M-J Planes by  $\frac{1}{16}$ "

$p = 6.38 \times 10^{-4}$   $k > 1$  positive period 98.7 sec. at 0.580 (9.00 Revs)  
 9.974  $k = 1$  at 0.620  $\phi = 0.950$  2.494/in (9.45 Revs)  
 $k_{ex} = 1.54$

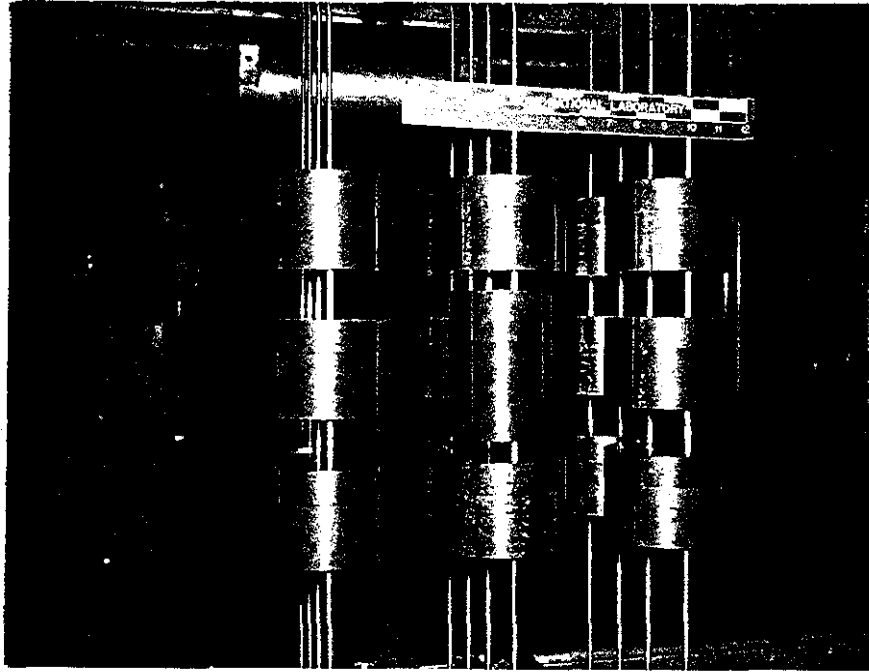
Changed spacing to  $1\frac{5}{8}$ "

$p = 8.5 \times 10^{-4}$   $k > 1$  Positive Period 62.25 sec. at 0.200 in. (3.89 Revs)  
 13.284  $k = 1$  at 0.243  $\phi = 0.950$  3.094/in (4.56 Revs)  
 $k_{ex} = 0.754$  1.655

Summary: 27 units 15.683 kg (1193.2)/unit  
 Unreflected  
 STS =  $1.655 \pm 0.005$  in.

$V_A = 184.95915 \text{ in}^3$   
 $F = 0.27710$

$V_c(\text{cm}) = 3.02483 \text{ l.}$   
 $\rho_{air} = 5.18475$



p 19.5

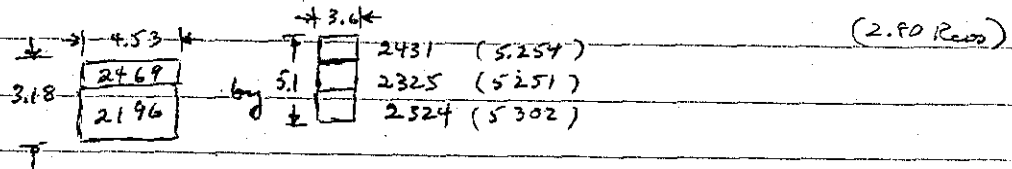
p 8.85x

Experiment 3

Array is that of final setting in Expt 2 p. 11. with N-S plane moved out 0.0625 in.

$p = 10.6 \times 10^{-4}$   
 $16.5 \phi$   
 $R > L$  positive period 49.04 sec at 0.088 in. (2.00 Revs)  
 $R = L$  at ~~0.088~~ 0.1320 in.  $\Delta = 0.044$  (2.90 Revs)  
 $R_{ex} = 50 \phi$  3.76  $\phi$ /in

Have replaced the central unit of the array (2469; 2196) by the three units, each with dia 3.6 in and 1.700 in height, (2431; 2325; 2324). (2.00 Revs)



15.695 kgll. by 15.807 kgll.

$p = 8.85 \times 10^{-4}$   
 $13.83 \phi$   
 $R > L$  positive period 63.67 sec at 0.088 in. (2.00 Revs)  
 $R = L$  at 0.1265 in.  $\Delta = 0.0385$  (2.80 Revs)  
 $R_{ex} = 45 \phi$  3.59  $\phi$ /in

## Experiment 4

8 units 45.692 kg U(93.2)/unit. Repeat Expt. 1. STS =  $11/32$ "Instrument Check on 7-18-63 Source 10 mCi

PM-1	Low Trip	OK	Alarm Trip	OK	
PM-2			Alarm Trip	OK	
IC-1	$> 3 \times 10^{-11}$	Meter Trip	OK	Fast Trip	OK
IC-2	$> 3 \times 10^{-11}$	Meter Trip	OK		Clock 2450
IC-3		Calibration			H-230
IC-4	Responds	Calibration	JH		Check list <input checked="" type="checkbox"/>
CRM		Meter Trip			

$k > 1$  positive period 30.3 sec. at 0.088 in. (2.00 Revs.)

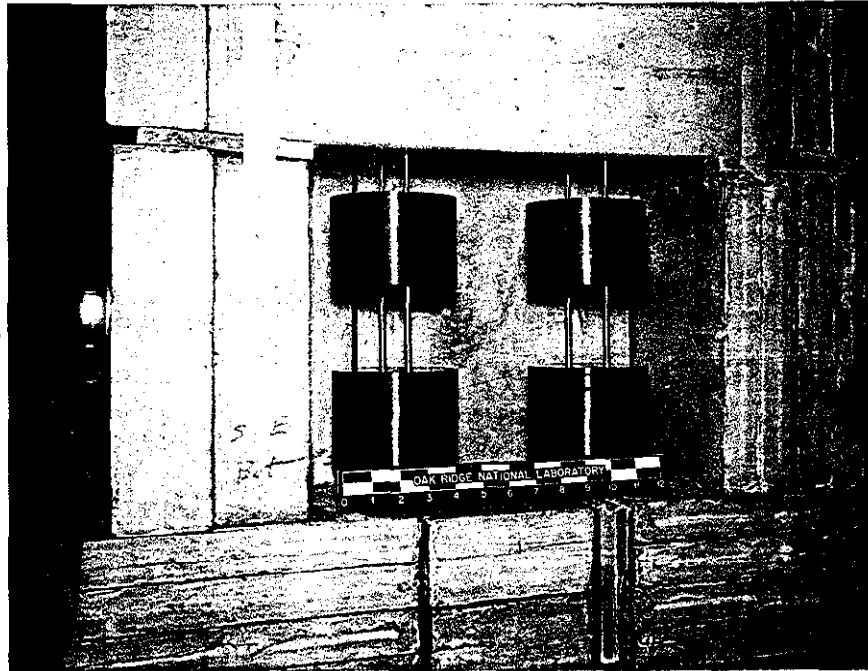
$k = 1$  at 0.108 (2.50 Revs.)

Confirms Experiment 1. Required STS is  $0.355 \pm .005$  in.

Summary 8 units  
 15.962 Kg U(93.2) per unit  
 6-in-thick paraffin reflector  
 S.T.S. =  $3.080 \pm 0.010$  in

$$V_L = 302,532 \text{ in}^3$$

$$F = 0.14137$$



Removed  $\frac{1}{4}$ " of reflector from southeast corner making a slot  
 $\sim 13$  inches long  $\times \frac{1}{4}$  in. wide.

$$p = 5.87 \times 10^{-4}$$

$k > 1$  positive period of  $109.5^{9.174}$  sec at closure (000 Revs)  
 $k = 1$  at 0.095 in. (2.12 Revs)

## Experiment 5

7-18-63 8 units 15.672 kg UC(93.2)/unit in a 6-in-thick paraffin Reflector

STS = 3.500 in.

$k \ll 1$   $M < 2$

7-19-63 Reset spacing to 3.00"

Instrument Check on 7-19-63 Source 10 mcd

PM-1	Low Trip	OK	Alarm Trip	OK	
PM-2			Alarm Trip	OK	
IC-1	$> 3 \times 10^{-4}$	Meter Trip	OK	Fast Trip	OK
IC-2	$> 3 \times 10^{-4}$	Meter Trip	OK		Clock 2450
IC-3		Calibration			M-230
IC-4	Responds	Calibration	OK		check list ✓
CRM		Meter Trip			

$P = 15.8 \times 10^{-4}$

$k > 1$  positive period 25.98 sec at 0.207 in. (4.01 Revs)

Reflector closed on top and sides but open on bottom.

$k = 1$  at 0.335 (5.75 Revs)

9/12/63 Reset Spacing to 3 1/16"

Instrument Check on 9-12-63 Source 10 mcd

PM-1	Low Trip	OK	Alarm Trip	OK	
PM-2			Alarm Trip	OK	
IC-1	$> 3 \times 10^{-4}$	Meter Trip	OK	Fast Trip	OK
IC-2	$> 3 \times 10^{-4}$	Meter Trip	OK		Clock 2466
IC-3	Responds	Calibration	OK		M-230
IC-4		Calibration			check list ✓
CRM		Meter Trip			

$P = 7.72 \times 10^{-4}$

$k > 1$  positive period of 76.4 <sup>2.064</sup> sec at closure (0.00 Revs)

$k = 1$  at 0.110 in. (2.40 Revs)

Reflector closed except at bottom.

$e = 5.5$  $p = 21.4$ 

## Summary

8 units

15.692 kg U(93.2) per unit

6-in-thick paraffin

STS = 3.080 ± 0.010 in

7.823 cm

$V = 36301$

$F = .14118$

$V_{(cm)} = 5.93303 \text{ l}$

$P_{av} = 2.64485$



## Experiment 5

Found top reflector on fixed table  $\sim 3/16$  too close to units.  
 have reset to correct spacing  $1 \frac{17}{32}$ .

$$Q = 5.57 \times 10^{-4}$$

$R > 1$  positive period of  $119.08 \overset{8.59\%}{\text{sec}}$  at closure (0.00 Revs)  
 $R = 1$  at  $0.080 \text{ in.}$  (1.85 Revs)

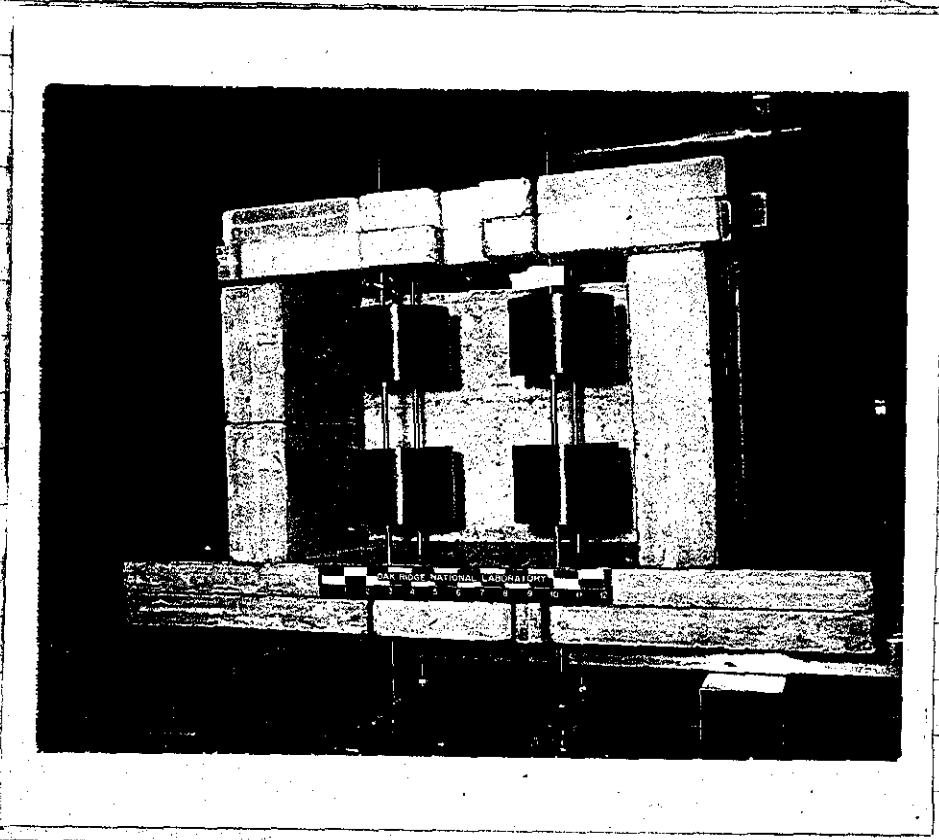
Have placed <sup>two</sup> strips of Plexiglas  $1/8 \times 1 \frac{1}{2} \times 15 \text{ in.}$  across the units.  
 One over each half of the array to simulate reflector  
 supports which have been used in the other series (I-III)

$$P = 11.45 \times 10^{-4}$$

$R > 1$  positive period of  $43.3 \overset{17.89\%}{\text{sec}}$  at closure (0.00 Revs)  
 $R = 1$  at  $0.170 \text{ in.}$  (3.40 Revs)

addition of support plastic contributes 9.3% to  $k$ .

$R = 1$  requires STS be  $3.080 \pm 0.010 \text{ in.}$



$\rho = 1$

$\rho =$

## EXPERIMENT 6

8 units 15.692 kg U per unit, 3-in-thick paraffin reflector STS  $2\frac{2}{32}$ Instrument Check on 9-13-63 Source 10 mc

PM-1	Low Trip	OK	Alarm Trip	OK	
PM-2			Alarm Trip	OK	
IC-1	$> 3 \times 10^{-11}$	Meter Trip	OK	Fast Trip	OK
IC-2	$> 3 \times 10^{-11}$	Meter Trip	OK		clock 2468
IC-3	Responds	Calibration	JH		M-230
IC-4		Calibration			check list ✓
CRM		Meter Trip			

$K \leq 1$  negative period of 163.5 <sup>-10.74</sup> sec at closure (0.00 Revs)

$$P = -6.87 \times 10^{-4}$$

bottom reflector not closed  $\approx \frac{3}{16}$ " gap also East side

Repositioned reflector.

$$P = +1.54 \times 10^{-4}$$

$R \geq 1$  positive period of 1505.6 <sup>+2.44</sup> sec. at closure (0.00 Revs)

$R = 1$  at 0.046 at bottom only. (6.25 Revs)

Summary 8 units

15.692 kg U (93.2) per unit

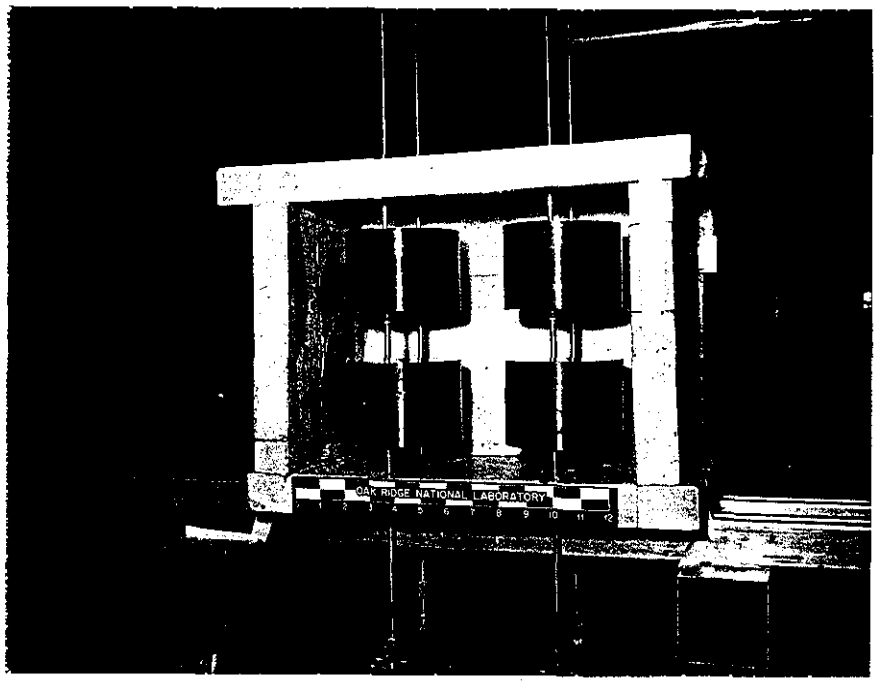
$$V_c = 337.103 \text{ m}^3$$

3-in-thick paraffin reflector

$$F = .15200$$

STS =  $2.910 \pm 0.010$  in.

7.391 cm



## Experiment 7

9-13-63

8 units, 15.692 kg (1193.2) / unit,  $\frac{1}{2}$ -in-thick paraffin reflector STS =  $1\frac{1}{4}$  $k \approx 1$  negative period of 145.8 sec. at closure (0.00 Revs)Reflector has uniform gap of  $\approx \frac{1}{8}$ " when tables are closed. Corrected! $k \geq 1$  positive period of 222.9 sec. at closure (0.00 Revs) $k = 1$  0.094 in. (2.10 Revs)

## Summary

8 units

15.692 kg (1193.2) per unit

 $\frac{1}{2}$ -in-thick paraffin reflectorSTS =  $1.953 \pm 0.010$  in

4.961 cm

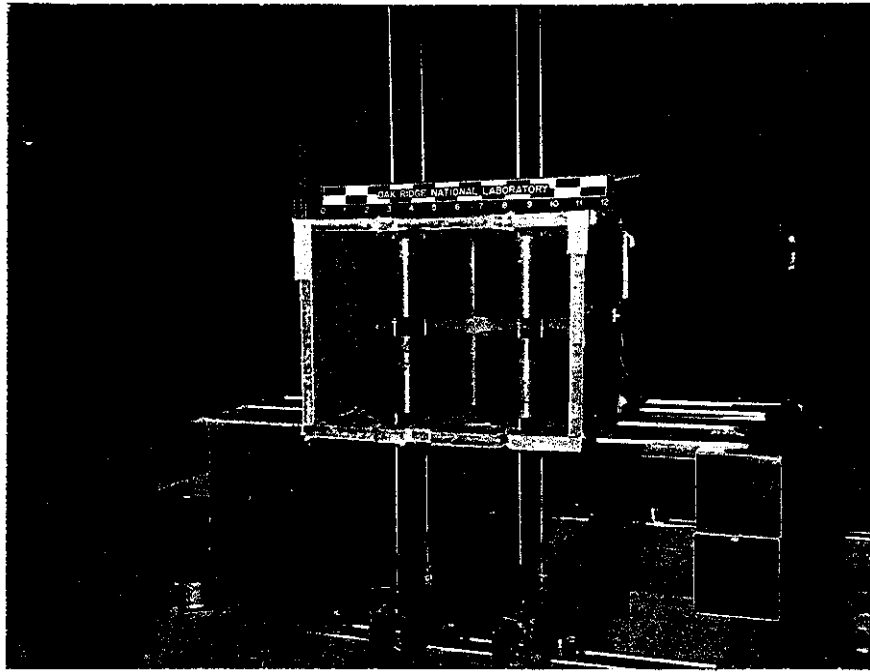
$V_L = 215.74 \text{ in}^3$

$F = 0.23756$

$V_L = 3500 \text{ cm}^3$

$F = 0.23756$

$P_{00} = 2.95 \text{ } \%$



①

2451	5242
2310	244
2473	5210 696
2455	5223
2325	5250
2289	5221 695

②

2472	5242
2326	5241
2280	5213 696
2457	5222
2384	5244
2287	5227 693

③

2462	5237
2383	5238
2469	5217 692
2461	5223
2306	5246
2471	5226 695

④

2474	5233
2283	5248
2464	5219 700
2459	5244
2315	5250
2453	5204 698

18  
9  
7  
11  
8145  
~8

EXPERIMENT 8

Instrument Check on 9-16-63 Source 10mc<sup>8</sup>

PM-1	Low Trip	OK	Alarm Trip	OK	
PM-2			Alarm Trip	OK	
IC-1	$> 3 \times 10^{-11}$	Meter Trip	OK	Fast Trip	OK
IC-2	$> 3 \times 10^{-11}$	Meter Trip	OK		Check 3469
IC-3	Responds	Calibration	JH		11-230
IC-4		Calibration			Check list ✓
CRM		Meter Trip			

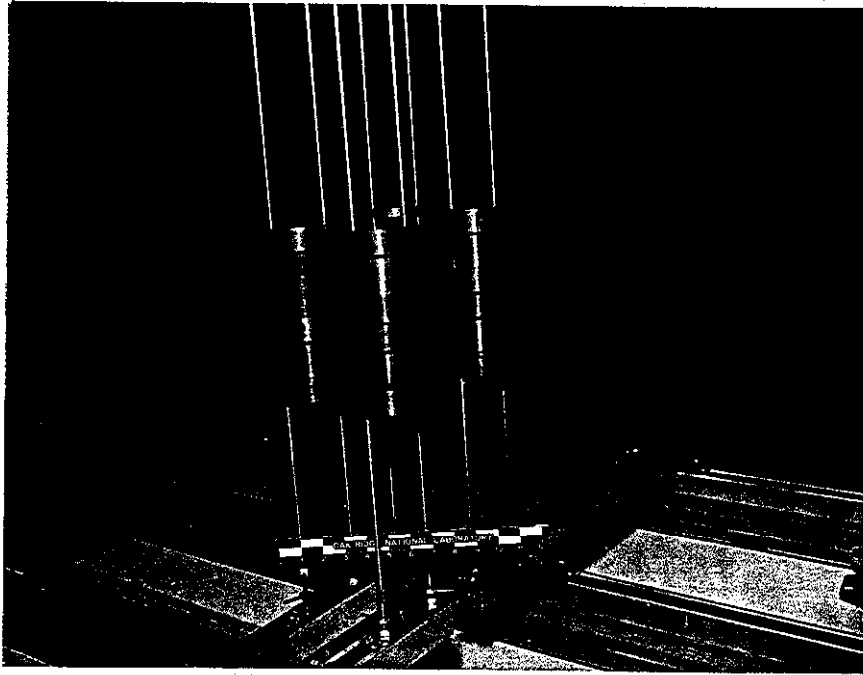
$\rho = -19.3 \times 10^{-4}$  R51 negative period at closure of  $97.4 \text{ sec}$  <sup>-20.14</sup> (0.00 Revs)

Summary  
 8 units  
 15.692 kg (493.2) per unit  
 $\frac{1}{2}$ -in-thick paraffin reflector  
 STS =  $0.750 \pm 0.010$  in  
 $V = 109.56 \text{ in}^3$   
 $F = 0.46780$   
 $V = 1.70210 \text{ L}$   
 $\rho = 8.756 \text{ g/L}$   $F = .46674$



Dia	ht	Subassemblies							
11.494	2.692	① 211		② 212		③ 221		④ 222	
	<del>2.692</del>	2451	S.242	2472	S.244	2462	S.237	2474	S.233
9.116	4.3205	2310	S.244	2326	S.241 15.696	2383	S.238 15.692	2283	S.248 15.700
11.494	<del>2.692</del>	2473	S.210	2290	S.213	2469	S.217	2464	S.219
11.494	9.705	111		112		121		122	
		2455	S.223	2457	S.222 15.693	2461	S.223	2457	S.244
		2325	S.251 15.695	2384	S.244	2306	S.246 15.695	2315	S.250 15.698
		2289	S.221	2287	S.227	2471	S.226	2453	S.204

Ave. 15.696 kg/unit



Summary

8 units

15.696 kg (93.2) per unit

Unreflected

STS = 0.090 ± 0.005 in

→ 9227 cm.

$V_2 = 1.3652$

$R_2 = 11.497$

$F = 0.61284$

## EXPERIMENT 9

8 Dumbbell units unreflected

STS=0

Instrument Check on 11/5/63 Source correct

PM-1	Low Trip	OK	Alarm Trip	OK	
PM-2			Alarm Trip	OK	
IC-1	$> 3 \times 10^{-4}$	Meter Trip	OK	Fast Trip	OK
IC-2	$> 3 \times 10^{-4}$	Meter Trip	OK	Clock	2485
IC-3	Responds	Calibration	JN		
IC-4		Calibration			
CRM		Meter Trip			

N-S spacing not set exactly.

k=1

(2.09 Revs)

Reset spacing to  $1/16$ " - Subassembly (A) location approximate.

k=1

0.104 in.

(2.29 Revs)

Set spacing on Subass. (A) in N-S plane.

R&gt;1

positive period 48.4 sec at 0.128 in. )  $\rho = 16.44$ 

(2.70 Revs)

R=1

0.144 in.

(3.10 Revs)

Set vertical spacing at  $3/32$ "

k=1

0.085 in.

(1.95 Revs)

Set spacing at  $3/32$ " $\rho = 5.74$ 

k=1

positive period 189.1 sec at closure

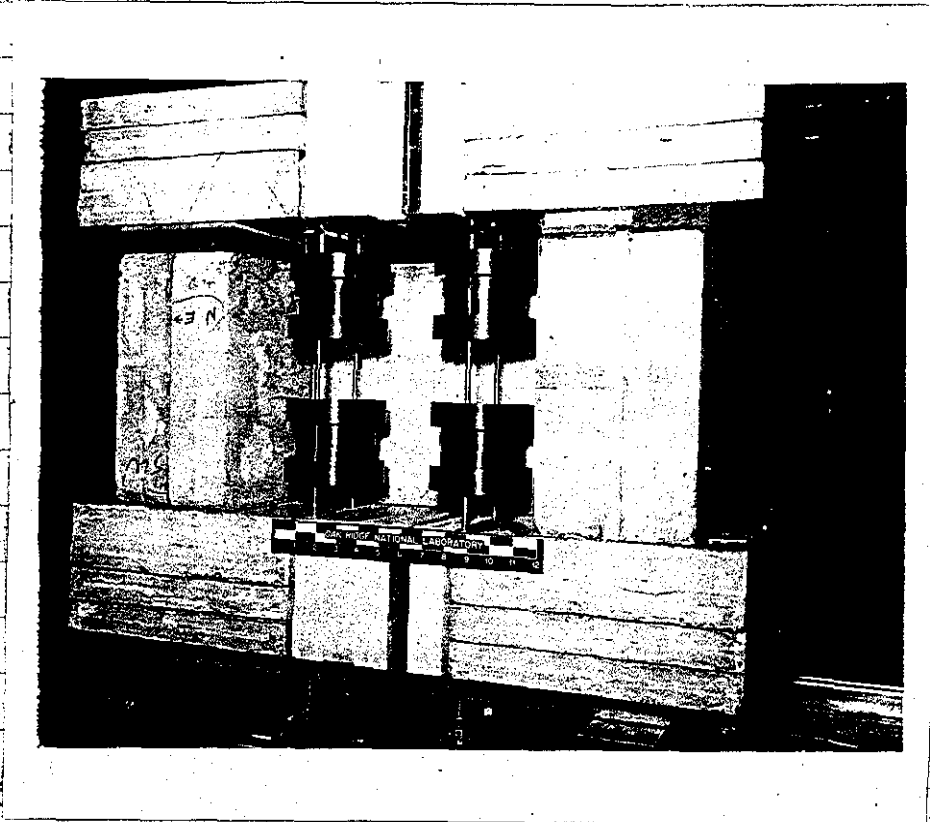
(0.00 Revs)

k=1

0.009 in.

(0.66 Revs)

STS for k=1 in 0.090  $\pm$  0.005 in.



EXPERIMENT 10

8 - Dumbell Units - 15.696 Kg<sup>u</sup>/unit 6-in-thick paraffin refl. STS = 2<sup>3</sup>/<sub>16</sub>

Instrument Check on 11-6-63 Source 10 med

PM-1	Low Trip	OK	Alarm Trip	OK	
PM-2			Alarm Trip	OK	
IC-1	$> 3 \times 10^{-4}$	Meter Trip	OK	Fast Trip	OK
IC-2	$> 3 \times 10^{-4}$	Meter Trip	OK		clock 2487
IC-3	Responds	Calibration	JH		M-230
IC-4		Calibration			check list ✓
CRM		Meter Trip			

R < 1

(0.00 Revs)

Reset Spacing to 2<sup>1</sup>/<sub>16</sub>

Instrument Check on 11-8-63 Source 10 med

PM-1	Low Trip	OK	Alarm Trip	OK	
PM-2			Alarm Trip	OK	
IC-1	$> 3 \times 10^{-4}$	Meter Trip	OK	Fast Trip	OK
IC-2	$> 3 \times 10^{-4}$	Meter Trip	OK		clock 2487
IC-3	Responds	Calibration	JH		M-230
IC-4		Calibration			check list ✓
CRM		Meter Trip			

R > 1 positive period 59.2 sec ( $\Rightarrow 14.254$ ) at 0.088 in. (2.00 Revs)

R = 1 at 0.143 in. 2.59 1/2 in (3.09 Revs)

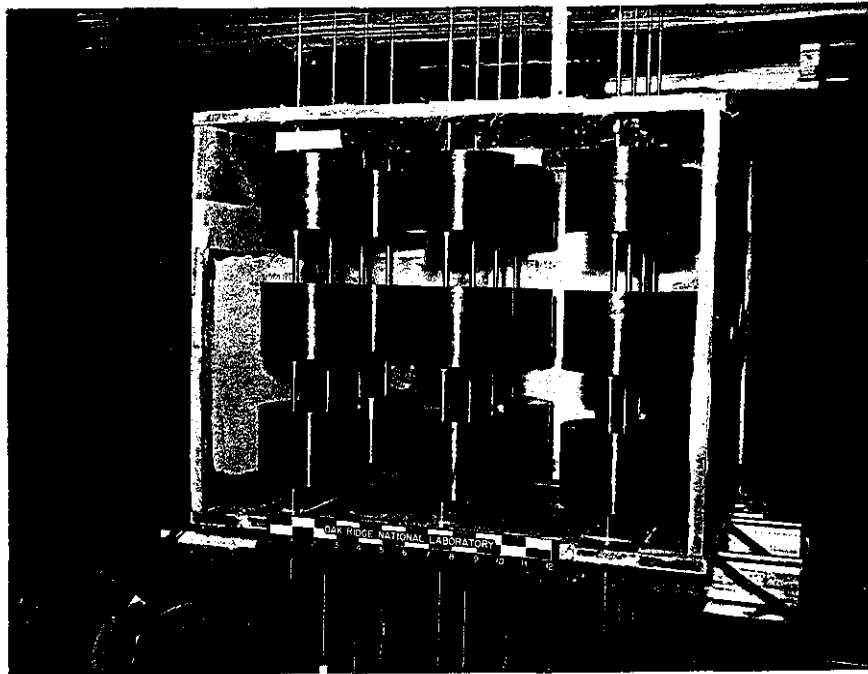
Summary 8 units (Dumbell)  
 15.696 Kg<sup>u</sup>(93.2) per unit  
 6-in-thick Paraffin reflector  
 STS = 2.718 ± 0.010 in  
 6.00 in

$V = 5.6219 \text{ L}$

$R = 2.718$

F = 21-032

See p. 8 for unit arrangement



Summary

27 units

(6.683 kg U<sup>235</sup>) per unit

$\frac{1}{2}$ -in-thick paraffin reflector

STS =  $2.235 \pm 0.010$  in.

5.677 cm

$V_s = 11.053,32$  l.

$\rho_a = 3.8591$  g/cc

$F = 0.20623$

## EXPERIMENT II

27 units  $15.683 \text{ Ry} (93.2) / \text{unit}$   $\frac{1}{2} = \bar{v}$  - thick paraffin refl. STS =  $2\frac{5}{16}$ "

Instrument Check on 12-9-63 Source 10 mCi

PM-1	Low Trip	OK	Alarm Trip	OK	
PM-2			Alarm Trip	OK	
IC-1	$> 3 \times 10^{-11}$	Meter Trip	OK	Fast Trip	OK
IC-2	$> 3 \times 10^{-11}$	Meter Trip	OK		clock 2498
IC-3	Responds	Calibration	JH		M-230
IC-4		Calibration			check list ✓
CRM		Meter Trip			

$k < 1$   $> 1$  -

(0.00 Revs)

Instrument Check on 12-10-63 Source 10 mCi

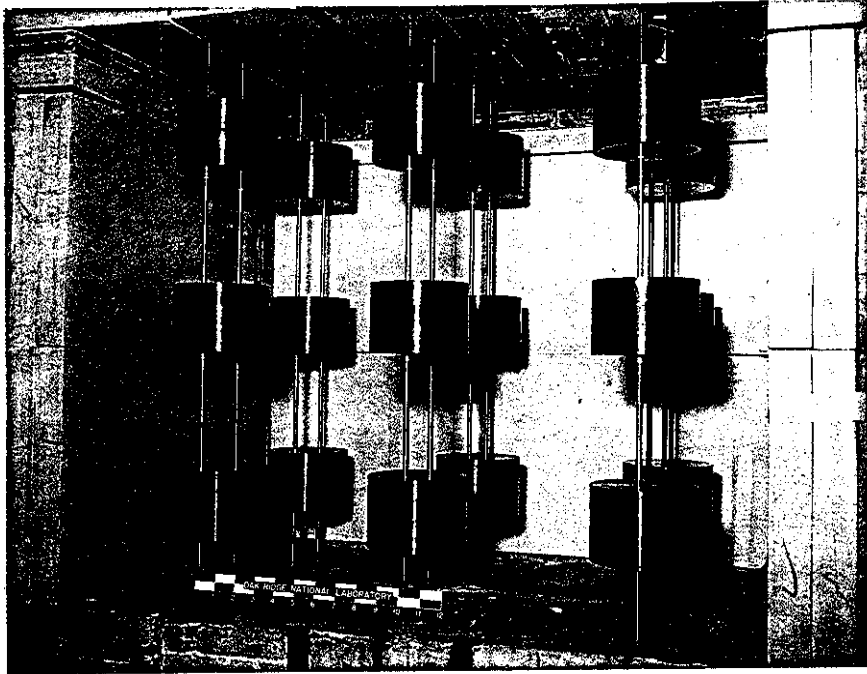
PM-1	Low Trip	OK	Alarm Trip	OK	
PM-2			Alarm Trip	OK	
IC-1	$> 3 \times 10^{-11}$	Meter Trip	OK	Fast Trip	OK
IC-2	$> 3 \times 10^{-11}$	Meter Trip	OK		clock 2498
IC-3	Responds	Calibration	JH		Source M-230
IC-4		Calibration			check list ✓
CRM		Meter Trip			

reset spacing to  $2\frac{1}{4}$ "

$k \sim 1$  negative period of  $129.9 \text{ sec}$  <sup>-15.14</sup> at closure (0.00 Revs)

$k = 1$  at STS =  $2.235 \pm 0.010$  in.

See p. 8 for unit arrangement



Summary

27 units

15.683 kg U(93,2) per unit

6-in-thick Paraffin reflector

STS = 5.588 ± 0.010 in

14.194 m

$k_{eff} = 14.69 \pm 6$

$F = .05687$

$\rho = 1.067$

## EXPERIMENT 12

27 units 15.683 kg U(93.2)/unit 6-in-thick Paraffin Refl. STS =  $5 \frac{25}{64}$ Instrument Check on 12-11-63 Source 10 mcd

PM-1	Low Trip	OK	Alarm Trip	OK	
PM-2			Alarm Trip	OK	
IC-1	$>3 \times 10^{-4}$	Meter Trip	OK	Fast Trip	OK
IC-2	$>3 \times 10^{-4}$	Meter Trip	OK		Clock 2499
IC-3	Responds	Calibration	JIT		M-230
IC-4		Calibration			Checklist ✓
CRM		Meter Trip			

$k > 1$  positive period 101.2 sec ( $\rho = +9.54\%$ )  $1.59 \frac{in}{min}$  0.995 in. (13.60 Revs)  
 $k = 1$  1.055 in. (14.20 Revs)  
 $k < 1$  negative period (12.86 sec.  $\rho = -15.4\%$ )  $1.90 \frac{in}{min}$  1.136 (15.0 Revs)  
 $k > 1$  positive period 218.4 sec ( $\rho = +5.05\%$ )  $2.15 \frac{in}{min}$  1.032 (13.91 Revs)

± 3/16

Instrument Check on 12-13-63 Source 10 mcd

PM-1	Low Trip	OK	Alarm Trip	OK	
PM-2			Alarm Trip	out	
IC-1	$>3 \times 10^{-4}$	Meter Trip	OK	Fast Trip	OK
IC-2	$>3 \times 10^{-4}$	Meter Trip	OK		Clock 2500
IC-3	Responds	Calibration	JIT		M-23
IC-4		Calibration			Checklist
CRM		Meter Trip			

Reset Spacing to  $5 \frac{37}{64}$ 

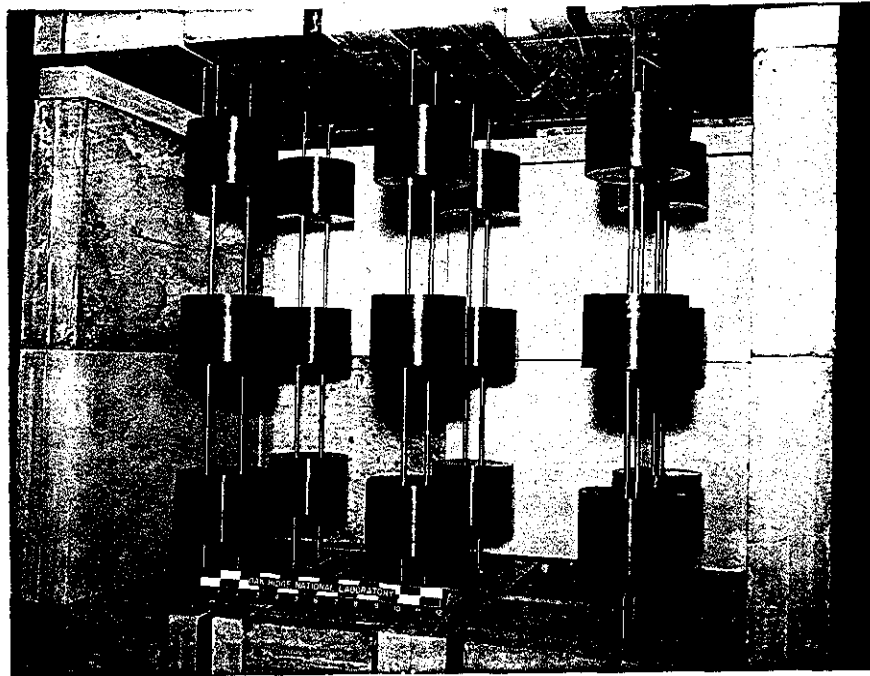
$k > 1$  positive period 71.7 sec ( $\rho = +10.32\%$ ) (0.00 Revs)  
 $k = 1$  0.181 in. (Reflector closed) (3.70 Revs)



Instrument Check on \_\_\_\_\_ Source \_\_\_\_\_

FM-1	Low Trip	Alarm Trip
FM-2		Alarm Trip
IC-1	Meter Trip	Fast Trip
IC-2	Meter Trip	
IC-3	Calibration	
IC-4	Calibration	
CRM	Meter Trip	

*See p. 8 for unit arrangement*



EXPERIMENT 13

27 units 15.683 kg(49.2)/unit 3-in-thick paraffin reflector STS =  $5.39 \pm 0.01$

Instrument Check on 12-12-63 Source  $^{60}\text{Co}$

PM-1	Low Trip	OK	Alarm Trip	OK	
PM-2			Alarm Trip	OK	
IC-1	$> 3 \times 10^{-11}$	Meter Trip	OK	Fast Trip	OK
IC-2	$> 3 \times 10^{-11}$	Meter Trip	OK		Clock 2500
IC-3	Response	Calibration	50		M-230
IC-4		Calibration			Check list ✓
CRM		Meter Trip			

$k \approx 1$  "power failure" (0.00 Revs)

Rechecked instrument response + setup

$k \approx 1$  negative period of 186 sec (0.00 Revs)

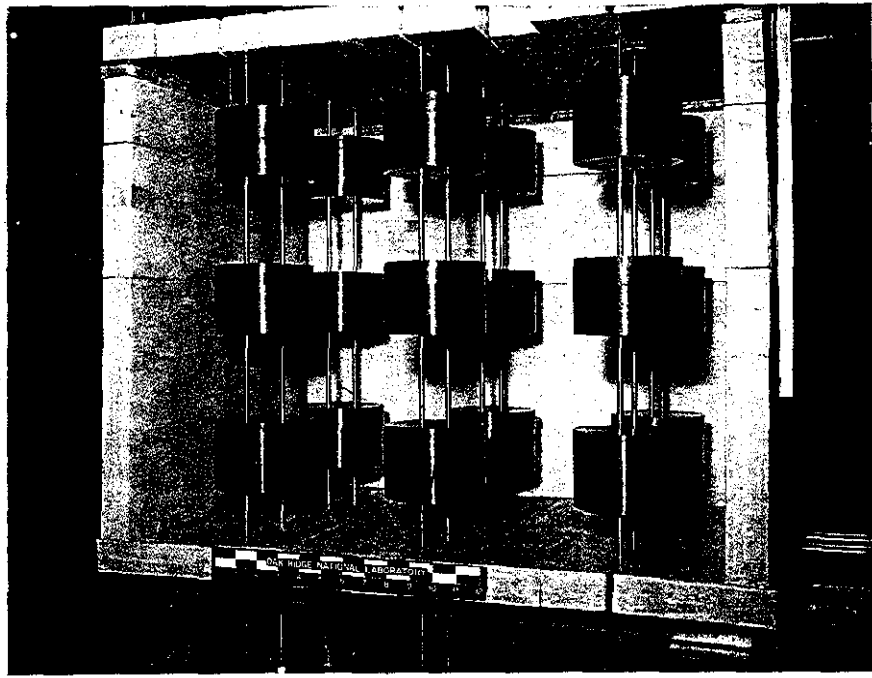
Reflector on movable table disturbed by room

<p>Summary</p> <p>27 units</p> <p>15.683 kg(49.2) per unit</p> <p>3-in-thick paraffin reflector</p> <p>STS = <math>5.391 \pm 0.010</math> in.</p> <p>13.693 cm</p>
--

$V_L = 13.80617$

$\rho = 1.137$

$F = 0.06060$



EXPERIMENT 4

27 units 15.683 kg U(93.2)/unit 1/2-in-thick paraffin refl. STS = 4.00"

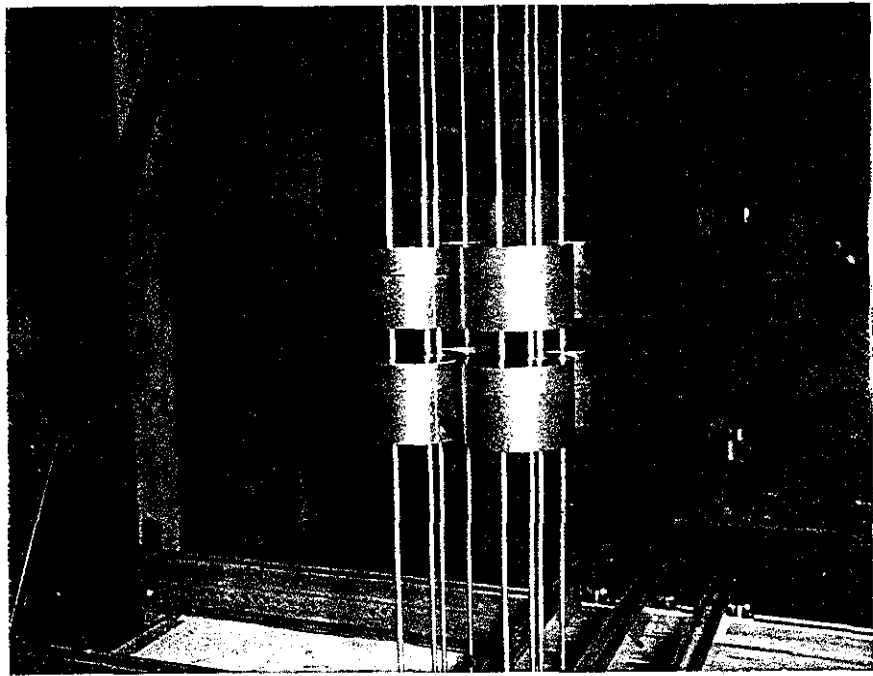
Instrument Check on 12-17-63 Source 10mc

PM-1	Low Trip	OK	Alarm Trip	OK	
PM-2			Alarm Trip	OK	
IC-1	$> 3 \times 10^{-11}$	Meter Trip	OK	Fast Trip	OK
IC-2	$> 3 \times 10^{-11}$	Meter Trip	OK		check 2501
IC-3	Resps	Calibration	JA		M-230
IC-4		Calibration			check list ✓
CRM		Meter Trip			

$k > 1$	positive period	105.1 sec $\Rightarrow$ 9.274	$\sigma$ 0.077	(1.80 Rws)
$k = 1$		$\sigma$		(2.62 Rws) <sup>+</sup>
$k < 1$	negative period	156.9 sec $\Rightarrow$ -11.234	$\sigma$ 1.12	(3.40 Rws)
$k > 1$	positive period	51.6 sec $\Rightarrow$ 15.674	$\sigma$ 0.043	(2.20 Rws)
$k = 1$		114 in		(2.60 Rws) <sup>-</sup>

Summary  
 27 units  
 15.683 kg U(93.2) per unit  
 1/2-in-thick paraffin reflector  
 STS = 4.012  $\pm$  0.010 in.  
 10.190 cm

$V_L = 8.58590$        $F = 0.09738$   
 $\rho = 1.827$



## EXPERIMENT 15

8-15.692 kg U(93.2)/unit - unreflected CTC } STS horizontal = 0  
vertical = 1" / 32

Instrument Check on 2-11-64 Source 10 me $\beta$

PM-1	Low Trip	OK	Alarm Trip	OK	
PM-2			Alarm Trip	OK	
IC-1	$> 5 \times 10^{-11}$	Meter Trip	OK	Fast Trip	OK
IC-2	$> 3 \times 10^{-11}$	Meter Trip	OK		clock 2524
IC-3	Responds	Calibration	JH		M-230
IC-4	Responds	Calibration	JH		check list ✓
CRM		Meter Trip			

R < 1

(0.00 Paws)

Beginning IC-2 1 on  $10 \times 10^{-12}$  scale  
End IC-2 2.7 on  $3 \times 10^{-11}$  scale }  $\Rightarrow H \approx 81$

### Summary

R < 1

8 units

15.692 kg U(93.2)/unit

Unreflected

CTS spacing 11.494

$$V_L = 1.51797 \text{ L.}$$

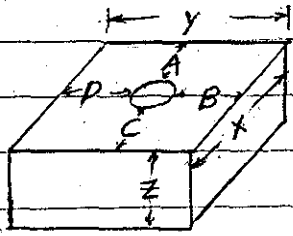
$$\rho_a = 10.337 \text{ g/cc}$$

$$F = 0.55101$$

$$r = 0.999$$

No.	wt kg	A	B	C	D	X	Y	Z	Position	Ho de
↑ 1	37.30	5.024	5.037	5.023	5.016	14.600	14.611	6.102	212	1.0
2	36.87	5.024	5.020	5.025	5.024	14.600	14.595	6.0815	222	1.0
TOP 3	36.62	5.025	5.029	5.023	5.026	14.600	14.600	6.140	112	1.0
4	36.75	5.024	5.026	5.021	5.007	14.600	14.593	6.100	211	1.0
5	36.97	5.024	5.035	5.025	5.019	14.600	14.605	6.104	122	1.0
6	37.00	5.029	5.028	5.027	5.025	14.600	14.600	6.098	121	1.0
7	37.11	5.024	5.026	5.028	5.018	14.599	14.590	6.100	111	1.0
↓ 8	36.85	5.022	5.021	5.022	5.025	14.607	14.587	6.100	221	1.0
↑ 9	36.91	5.024	5.033	5.030	5.020	14.596	14.588	6.102	221	1.0
7 10	36.94	5.027	5.011	5.024	5.017	14.600	14.584	6.100	111	1.0
4 11	36.95	5.028	5.036	5.029	5.019	14.600	14.600	6.091	211	1.0
5 12	36.75	5.028	5.030	5.024	5.017	14.600	14.592	6.100	122	1.0
1 13	36.81	5.029	5.029	5.026	5.019	14.606	14.600	6.097	212	1.0
6 14	36.80	5.024	5.020	5.025	5.026	14.600	14.596	6.097	121	1.0
2 15	36.54	5.024	5.051	5.024	4.999	14.600	14.600	6.098	222	1.0
↓ 3 16	36.80	5.030	5.033	5.024	5.016	14.600	14.602	6.100	112	1.0

73.7485 ± 2.36771 kg/unit      5.024812 ± 0.00661      14.5985      22=12.20137 ± .016247



Dimension

Unit No	5.2 kg	10.5 kg	Position
1	2470	2190	111
2	2469	2196	121
3	2457	2158	211
4	2473	2189	221
5	2290	2195	222
6	2455	2152	212
7	2464	2205	122
8	2289	2193	112

HLM graphite



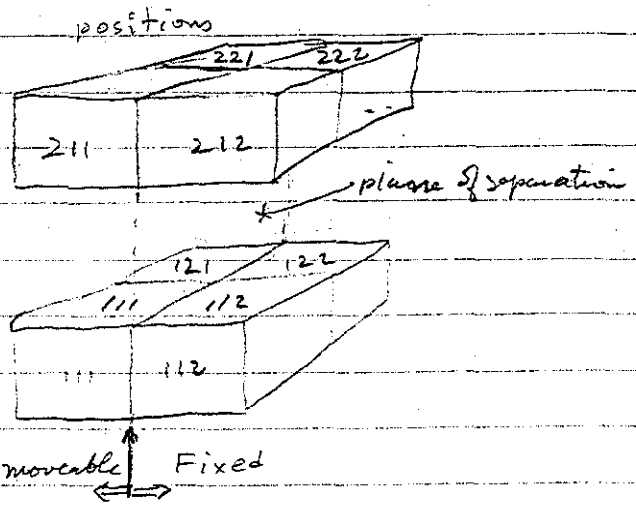
Blocks reduced in size - returned on 11-20-68

Serial	Hole depth	wt kg	A	B	C	D	X	Y	Z	
2	1.60225	22.70	4.023	4.025	4.022	4.023	12.60	12.60	5.10	1
22	1.602	22.72	4.025	4.025	4.022	4.021	12.60	12.60	5.10	2
2	1.602	22.75	4.020	4.022	4.023	4.025	12.60	12.60	5.096	3
11	1.606	22.65	4.026	4.022	4.022	4.024	12.60	12.60	5.10	4
22	1.605	22.54	4.025	4.025	4.023	4.023	12.60	12.60	5.095	5
21	1.604	22.79	4.024	4.024	4.024	4.023	12.60	12.60	5.10	6
1	1.610	22.85	4.025	4.024	4.023	4.023	12.60	12.60	5.10	7
21	1.617	22.70	4.022	4.023	4.021	4.026	12.60	12.605	5.10	8
21	1.623	22.72	4.024	4.025	4.025	4.025	12.60	12.60	5.10	9
1	1.626	22.75	4.025	4.025	4.023	4.023	12.60	12.60	5.10	10
11	1.627	22.72	4.022	4.028	4.025	4.022	12.60	12.60	5.095	11
22	1.628	22.50	4.025	4.024	4.023	4.020	12.60	12.60	5.075	12
12	1.626	22.69	4.024	4.024	4.025	4.023	12.604	12.60	5.10	13
21	1.629	22.70	4.027	4.023	4.020	4.025	12.60	12.60	5.10	14
22	1.628	22.50	4.025	4.025	4.025	4.025	12.65	12.60	5.10	15
12	1.631	22.61	4.024	4.025	4.023	4.023	12.60	12.604	5.10	16

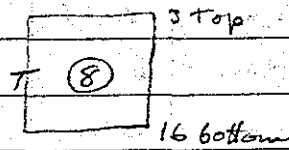
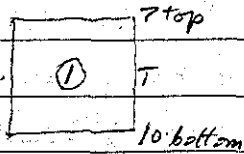
$D_{\text{ave}} = 4.54887 \pm 0.0067$      $\text{ave } m_{\text{blk}} = 45.365 \pm 0.1595 \text{ kg}$      $4.0237 \pm 0.0016$      $12.600$      $12.600$      $10.200$   
 $W = 3.234 \pm 0.003$      $D_{\text{blk}} = 12.60 - 2(4.0237) = 4.5526$

from  $e = 18.76$

Serial	Mass	$\bar{r}$	$h$
1	15.690	5.741(1)	8.027
1	15.696	5.742(2)	8.077
1	15.691	5.741(3)	8.077
21	15.696	5.742(2)	8.077
12	15.696	5.742(2)	8.077
2	15.692	5.741(5)	8.077
2	15.699	5.742(7)	8.077
2	15.694	5.741(8)	8.077

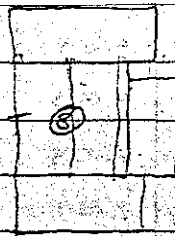
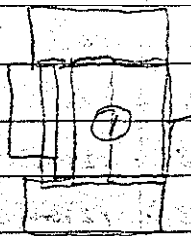


Expr. 1



Plan view

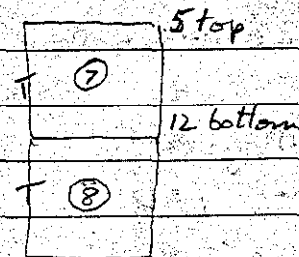
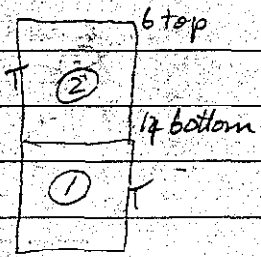
Expr. 2



Polyethylene  
Reflector 6" thick  
on 5 sides of  
Assembly at Closure

Plan view

Expr. 3



Plan view

Expr. 4 as above but with 6" polyethylene reflector on 5 sides - no bottom refl.

15.696 kg U metal units in graphite boxes.

Expt. 1. Safety check assembly of two units.

Instrument Check on 10-25-68 Source 10 mci

PM-1	Low Trip	OK	Alarm Trip	OK
PM-2			Alarm Trip	
IC-1	$> 3 \times 10^{-11}$	Meter Trip	OK	Fast Trip OK
IC-2	$> 3 \times 10^{-11}$	Meter Trip		(Noisy)
IC-3	OK	Calibration	✓	Alarms ✓
IC-4	OK	Calibration	✓	Personnel ✓
CRM		Meter Trip		Pres. - 0.13

No appreciable multiplication observed at table closure.

Rm Temp.

Expt. 2 Safety check - 2 reflected units.

same as Expt. 1 no change.

Instrument Check on 10-28-68 Source 10 mci

PM-1	Low Trip	OK	Alarm Trip	OK
PM-2			Alarm Trip	
IC-1	$> 3 \times 10^{-11}$	Meter Trip	OK	Fast Trip OK
IC-2	$> 3 \times 10^{-11}$	Meter Trip	OK	Personnel ✓
IC-3	Responds	Calibration	FA	Alarms ✓
IC-4	Responds	Calibration	FA	Pres - 0.03"
CRM				

Expt. 3 Safety check 4 units unreflected.

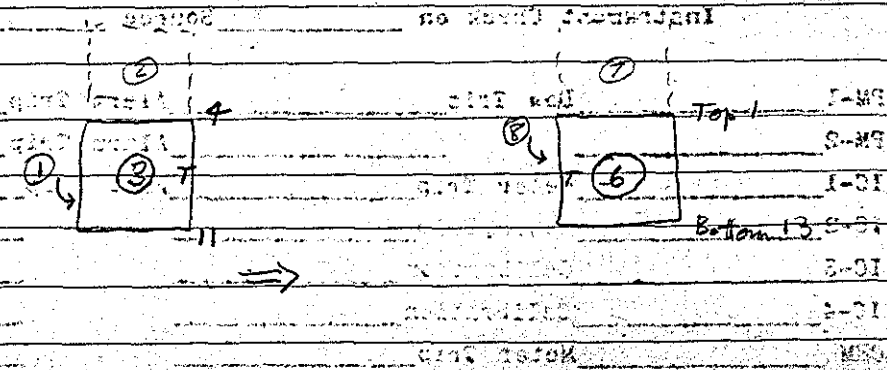
Subcritical Multiplication  $\sim 1.2$  (last 16" of closure)

Expt. 4. 4 units Reflected on five surfaces by 6" polyethylene

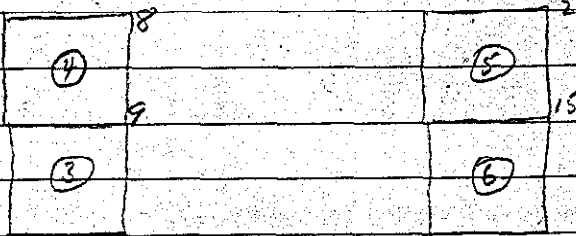
Subcritical  $M \sim 1.6$  (last 16" of closure)

Expt. 5

Bottom tier as in Expt. 4

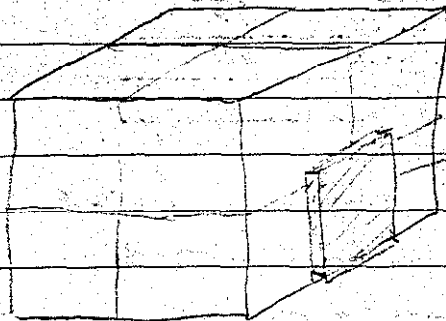


Expt. 6



⇒ Top tier

Bottom as in Expt. 4



plastic

Instrument Check on 10-29-68 Source 10mcV

PM-1	Low Trip	OK	Alarm Trip	OK	
PM-2			Alarm Trip		
IC-1	$> 3 \times 10^{-11}$	Meter Trip	OK	Fast Trip	OK
IC-2	$> 3 \times 10^{-11}$	Meter Trip	OK	Personnel	✓
IC-3	Responds	Calibration	FA	Alarms	✓
IC-4	Responds	Calibration	FA	Pres.	-0.03"
CRM		Meter Trip			

$10^{05}$  / A Expt. 5. 6 units in graphite boxes - unreflected.  
 $R < 1$ , Multiplication of  $\sim 2$  over last 16" of closure.

$11^{05}$  Expt. 6 8 units in graphite boxes - unreflected.  
 $R < 1$  Multiplication  $\sim 20$ .

Instrument Check on 10-30-68 Source 10mcV

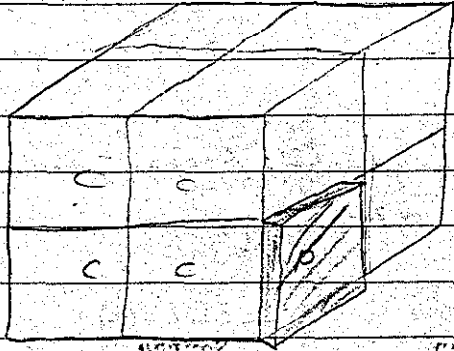
PM-1	Low Trip	OK	Alarm Trip	OK	
PM-2			Alarm Trip		
IC-1	$> 3 \times 10^{-11}$	Meter Trip	OK	Fast Trip	OK
IC-2	$> 3 \times 10^{-11}$	Meter Trip	OK	Personnel	
IC-3	Responds	Calibration	FA	Alarms	✓
IC-4	Responds	Calibration	FA	Pres.	-0.03"
CRM		Meter Trip			

Expt. 7 Determine degree subcritical of unreflected assembly.  
 Have placed 1" thick by 13"x11" piece of plexiglas against  
 south face of assembly.  
 $R > 1$  position period to  $\sim 1$  on log N. Remove  
 plexiglas measure negative period.  $T_+ = 91.3 \text{ sec.}$   
 (IC-3 saturated - defective battery box)  $T_- = 143.4 \text{ sec.}$   
 $\rho \approx -13\%$

Insulation Check on Spines

Spine No.	Insulation	Notes
1-1	OK	
2-1	OK	
3-1	OK	
4-1	OK	
5-1	OK	
6-1	OK	
7-1	OK	
8-1	OK	
9-1	OK	
10-1	OK	

Exhibits



Insulation Check on Spines

Spine No.	Insulation	Notes
1-2	OK	
2-2	OK	
3-2	OK	
4-2	OK	
5-2	OK	
6-2	OK	
7-2	OK	
8-2	OK	
9-2	OK	
10-2	OK	

Instrument Check on 10-31-68 Source 10mc

PM-1	Low Trip	OK	Alarm Trip	OK
PM-2			Alarm Trip	
IC-1	$> 3 \times 10^{-4}$	Motor Trip	OK	Foot Trip OK
IC-2	$> 3 \times 10^{-4}$	Motor Trip	OK	Personnel $\checkmark$
IC-3	Response	Calibration	OK	Alarms $\checkmark$
IC-4	Response	Calibration	OK	Pres - 0.03"
CRM		Meter Trip		Temp 23.6°C

Expt. 8 Repeat Expt. 7

8<sup>45</sup>/A $k > 1$ , positive period w/ plexiglas <sup>4.2 div</sup>  $S_1 = + 91.3 \text{ sec} \Rightarrow \rho = 10$ Removed Plexiglas: negative period <sup>6.5 div</sup>  $S_2 = -141.2 \Rightarrow \rho = -13.44$ 

Expt. 8a Repeat 8 but with plexiglas at S-E corner of assembly.

9<sup>20</sup> $k > 1$ , positive period w/ plexiglas <sup>249.8 div</sup>  $T = +$ Removed Plexiglas, negative period: <sup>6.4 div</sup>  $T = -139.0 \Rightarrow \rho = -13.94$ 

Ave of 3 measurements -13.44

taking  $\beta_{eff} = 0.007 \Rightarrow k_{eff} = .99906$  $- 7 \times 10^3 \times .134 = -.938 \times 10^{-3}$ 

cc. on 1/6/69

 $k = .9973 \pm 5.6 \times 10^{-3}$  for  $30 \times 10^3$  neut.
$$\begin{array}{r} 9991 \\ 9973 \\ \hline 18 \end{array}$$

Prepare for Movies (4-12)

Instrument Check on 11-4-68 Source 10 meV

PM-1	Low Trip	OK	Alarm Trip	OK
PM-2			Alarm Trip	
IC-1	$> 3 \times 10^{-4}$	Meter Trip	OK	Fast Trip OK
IC-2	$> 3 \times 10^{-4}$	Meter Trip	OK	Personnel $\checkmark$
IC-3	Responds	Calibration	OK	Alarms $\checkmark$
IC-4	Responds	Calibration	OK	Press - 0.03"
CRM		Meter Trip		Run Temp 24°C

Expt. 9 Repeat Expt. 8 to check operation for 4-12 Movies.

Exp 10 Repeat of Exp -8 and 9

Blocks sent for machining Returned 11-20-68

Instrument Check on 11-22-68 Source 10 meV

PM-1	Low Trip	OK	Alarm Trip	OK
PM-2			Alarm Trip	
IC-1	$> 3 \times 10^{-4}$	Meter Trip	OK	Fast Trip OK
IC-2	$> 3 \times 10^{-4}$	Meter Trip	OK	Personnel $\checkmark$
IC-3	Responds	Calibration	OK	Alarms $\checkmark$
IC-4	Responds	Calibration	OK	Press - 0.03"
CRM		Meter Trip		Run Temp 21.4°C

Blocks  
(126)  $3 \times 10^2$

Expt. 11 Safety check on assembly of 2 units in graphite block reduced spage. Units ① and ② arranged as in Expt. 1.  $R \ll 1$  no change in multiplication.

Expt. 12 Safety check on assembly of 4 units as in Expt. 3 Same results as Expt. 3  $M \sim 1.2$ .



11-22-68

Expt. 13. 8 unit assembly arranged as in Expt. 6  
 Multiplication  $\sim 15$  on closure.

Expt. 14 Determine degree subcritical. Have placed  
 8" sq. piece of Plexiglas 1-in-thick against south  
 face of assembly to achieve critical and determine  
 negative period when Plexiglas is removed.  
 $k < 1$ ,  $M \sim 20$

Expt. 15 Place 13" x 11" x 1" piece of Plexiglas against  
 south face in place of 8" sq. piece.  
 $k < 1$   $M \sim 90$

Expt. 16 Replace Plexiglas by a piece 22" x 13" x 1"  
 $k > 1$  at 1.75 rev separation  
 Remove Plexiglas & run table together

## Period Summary

Expt. No	fixed/removable	+e <sub>f</sub>	+e <sub>s</sub>	-e <sub>f</sub>	-e <sub>s</sub>
17	11x13 / 11x13 (2.6 new)	16.02	16.40	-4.59	-4.67
18	8x8 / 11x13	8.09	8.28	-	-
19	11x13 / 8x8	8.26	8.46	-4.01	-4.10

(19) ⇒ 8x8 worth is 12.27 f - 12.56

degree subcritical

(17)+(21) fast  $\left\{ \begin{array}{l} 16.02 + 20.15 = 36.17 - 2(40.76) = -45.35 \\ -4.59 - 40.76 = -45.35 \end{array} \right.$

slow  $\left\{ \begin{array}{l} 16.40 + 20.50 = 36.90 - 2(41.57) = -46.24 \\ -4.67 - 41.57 = -46.24 \end{array} \right.$

(19) + (17) + (21) = }  
 f)  $-40.76 - 4.01 = -44.77$

s)  $-41.57 - 4.10 = -45.67$

s)  $-40.76 - 12.27 + 8.26 = -44.77$

s)  $-41.57 - 12.56 + 8.46 = -45.67$

Instrument Check on 11-25-68 Source 10mc ✓

PM-1	Low Trip	OK	Alarm Trip	OK
PM-2			Alarm Trip	
IC-1	$73 \times 10^{-4}$	Meter Trip	OK	Fast Trip OK
IC-2	$73 \times 10^{-4}$	Meter Trip	OK	Personnel ✓
IC-3	Responds	Calibration	5%	Alarms ✓
IC-4	Responds	Calibration	5%	Pres. -0.03"
CRM		Meter Trip		Run Temp. 28°C

Expt. 17. Installed Rohette. Place pieces of Plexiglas  $13 \times 11 \times 1$  on N and S faces of Assembly. Piece on S face can be removed separately.

$k > 1$  at 2.6 nms. Rohette  $+ 14.8 \text{ } \mu$   $\ln N \Rightarrow T = 49.98 \text{ sec}$  <sup>2.3 div/sec.</sup>

Removed Plexiglas - closed tubes, measured negative period with Plexiglas on N side of assembly.

Rohette  $-3.00 \text{ } \mu$   $\ln N \Rightarrow -14.6 \text{ div/sec}; -317.26 \text{ sec.}$

Expt. 18 Change Plexiglas on N face to  $8 \times 8 \times 1$  Repeat 17 with removable Plexiglas  $13 \times 11 \times 1$

$k > 1$  at closure Rohette  $\Rightarrow + 7.24$   $\ln N$  5.75 div/sec; 124.95 sec.

Remove  $11 \times 13$  plexiglas  $k < 1$  Rohette  $\Rightarrow 26.91$   
 $\ln N \Rightarrow \approx 3.2 \text{ div/sec}$  T -

Expt. 19 Interchange Plexiglas pieces  $8 \times 8 \times 1$  now removable.

$k > 1$  at closure Rohette  $\Rightarrow + 7.72$   $\ln N$  5.6 div/sec; 121.7 sec.

Remove  $8 \times 8 \times 1$  plexiglas; Rohette  $\Rightarrow 32$   
 $\ln N \Rightarrow -16.4 \text{ div/sec}$  T = -356.4 sec.

Period summary

Exp. No	fixed/removable	+P <sub>f</sub>	+P <sub>s</sub>	-P <sub>f</sub>	-P <sub>s</sub>
20	11x13/8x8	8.15	8.32	-3.94	-4.01
21	8x8/11x13 (2.6 rows)	8.15	8.32	-12.00	-12.18
22	11x13/11x13 (2.6 rows)	15.64	16.00	-4.29	-4.37

(20)  $\Rightarrow$  worth of 8x8 is 12.09 - 12.33  $\pounds$

(21)  $\Rightarrow$  worth of 2.6 rows open is 20.15 - 20.50  $\pounds$

(21) + (22)  $\Rightarrow$  worth of 11x13 is 40.08 - 40.87  $\pounds$

(21) + (17)  $\Rightarrow$  worth of 11x13 is 40.76 - 41.57  $\pounds$

(20) (21) (22) fast  $\left( \begin{array}{l} -40.08 + 12.09 + 8.15 = -44.08 \\ -40.08 - 3.94 = -44.02 \end{array} \right.$

slow  $\left( \begin{array}{l} -40.87 - 12.33 + 8.32 = -44.88 \\ -40.87 - 4.01 = -44.88 \end{array} \right.$

fast  $(+15.64 - 2(40.08) \neq 20.15 = -44.37)$

slow  $(+16.00 - 2(40.87) + 20.50) = -45.24$

fast  $-40.08 - 4.29 = -44.37$

slow  $-40.87 - 4.37 = -45.24$

Repeat Expts of 11-25-68

Instrument Check on 11-26-68 Source 10mcX

PM-1	Now Trip	OK	Alarm Trip	OK
PM-2			Alarm Trip	
IC-1	$> 3 \times 10^{-4}$	Motor Trip	OK	Fast Trip OK
IC-2	$> 3 \times 10^{-4}$	Motor Trip	OK	Personnel $\checkmark$
IC-3	$> 3 \times 10^{-4}$		OK	Alarms $\checkmark$
IC-4	Responds		FN	Pres - 0.03"
CRM	Responds	Motor	FN	Rm Temp. 21.7°C

Expt. 20 11x13x1 Plexiglas on N face of assembly  
8x8x1 on south face is removable.

R > 1 at closure Rohette  $\Rightarrow$  7.76  $\ln N$  5.7  $\frac{dis}{sec}$  T = 123.86 sec <sup>8.15 - 8.32</sup>

Remove 8x8x1 Plexiglas Rohette  $\Rightarrow$  -3.185  
 $\ln N \Rightarrow$  16.7  $\frac{dis}{sec}$  T = -362.9 sec. <sup>7.94 - 4.01</sup>

Expt. 21 8x8x1 fixed on N-face 11x13x1 removable  
from S-faces

R > 1 at closure Rohette  $\Rightarrow$  7.995  $\ln N$  5.7  $\frac{dis}{sec}$  + 123.9 sec <sup>8.15 8.32</sup>

R = 1 at 1.65 revs. Rohette  $\Rightarrow$  0.0

R < 1 at 2.6 revs. Rohette  $\Rightarrow$  -10.105  $\ln N$  -6.9  $\frac{dis}{sec}$  -149.94 sec. <sup>12 - 12.18</sup>

R > 1 Remove plexiglas Rohette  $\Rightarrow$  25.75

Expt. 22 11x13x1 on both N and S faces of assembly

R > 1 at 2.6 revs. Rohette  $\Rightarrow$  14.44  $\ln N$  2.38  $\frac{dis}{sec}$  T = 51.72 sec <sup>15.6 - 16</sup>

Remove Plexiglas & close table. Rohette  $\Rightarrow$  3.107

$\ln N \Rightarrow$  15.48  $\frac{dis}{sec}$  T = -336.4 sec. <sup>4.29 - 4.37</sup>

## Period summary

Expt No.	fixed/ removable	+P <sub>s</sub>	+P <sub>s</sub>	-P <sub>r</sub>	-P <sub>r</sub>
23	8x8/11x13	8.20	8.40	—	—
24	11x13/8x8	8.57	8.78	-3.62	-3.89
25	8x12/8x8	—	—	-5.32	-5.42
26	8x12/8x12	4.87	4.99	-20.74	-21.09

(24) worth of 8x8      12.19 - 12.47

(26) worth of 8x12      25.61 - 26.08

(23) ~~(24)~~ ~~(25)~~       $-(12.19 + 40.08) + 8.20 = 44.07$

$-(12.47 + 40.87) + 8.40 = 44.94$

(24) (25) (26)       $-(12.19 + 25.61 + 5.32) = 43.12$

$-(12.47 + 26.08 + 5.42) = 43.97$

(26)       $-2(25.61) + 4.87 = 46.35$

$-2(26.08) + 4.99 = 47.17$

Instrument Check on 12-2-68 Source 10mc I

PM-1	Low Trip	OK	Alarm Trip	OK	
PM-2			Alarm Trip		
IC-1	$> 3 \times 10^{-4}$	Meter Trip	OK	Fast Trip	OK
IC-2	$> 3 \times 10^{-4}$	Meter Trip	Rough + Noisy	Personnel	✓
IC-3	Responds	Calibration	FN	Alarms	✓
IC-4	Responds	Calibration	FN	Pres	-0.03"
CRM		Meter Trip		Rm Temp	21°C

Expt. 23. Repeat Series 20-22. Rohette now zeroed,  
 $8 \times 8 \times 1$  on N face  $11 \times 13 \times 1$  on S-face of assembly and  
 removable.

$R > 1$  at closure Rohette 7.39  $\ln N$  <sup>5.7 div/sec.</sup> 122.9 sec 18.6 d  
 Remove Plexiglas: Rohette 26.784 <sup>5.7</sup>  $\ln N$  —

Instrument Check on 12-3-68 Source 10mc I

PM-1	Low Trip	OK	Alarm Trip	OK	
PM-2			Alarm Trip		
IC-1	$> 3 \times 10^{-4}$	Meter Trip	OK	Fast Trip	OK
IC-2	$> 3 \times 10^{-4}$	Meter Trip	OK	Personnel	✓
IC-3	Responds	Calibration	FN	Alarms	✓
IC-4	Responds	Calibration	FN	Pres	-0.03"
CRM		Meter Trip		Rm Temp	21°C

Expt. 24 Repeat series 20-22.  $13 \times 11 \times 1$  fixed  $8 \times 8 \times 1$  removable.

$R > 1$  Rohette 7.923 :  $\ln N$  5.35 <sup>div/sec</sup>  $T = 116.3$   $\rho = 8.57$   
 Remove Plexiglas: Rohette -2.71 :  $\ln N$  18 <sup>div/sec</sup>  $T = 391.1$   $\rho = 3.62$   
 (3.67)

Expt. 25 change  $11 \times 13 \times 1$  to  $8 \times 12 \times 1$   $8 \times 8 \times 1$  removable.

$R \approx 1$  subcritical by ~ 4%  $\ln N$  12.85 <sup>div/sec</sup>  $T = -273.2$   
 $\rho = -5.32 \pm$   
 (5.425)

## Period summary

Expt. No.	fixed/removable	+T <sub>fast</sub>	+T <sub>slow</sub>	-T <sub>fast</sub>	-T <sub>slow</sub>
27	9x12/8x12	9.14	9.35	-15.99	-16.24
	(2.6 rows)			-11.76	-11.98
28	8x12/7x12	8.69	8.90	-21.69	-22.06
29	9x12/9x12	13.36	13.70	-16.50	-16.75
	(2.6 rows)			-6.87	-7.00

(27) worth of 8x12      25.13 - 25.59  
 worth of 2.6 rows      20.90 - 21.31

(28) worth of 9x12      30.38 - 30.96

(29) " " " "      29.86 - 30.45

(27) worth of 2.6 row gap      20.23 - 20.7

(29) worth of 9x12      29.86 - 30.45

(27) (28)  $-(25.13 + 30.38) - 9.14 = -46.37$

$-(25.59 + 30.96) - 9.35 = -48.20$

$-(25.13 + 30.38) - 8.69 = 46.82$

$-(25.59 + 30.96) - 8.90 = 47.65$

(29)  $-2(29.86) + 13.36 = 46.36$

$-2(30.45) + 13.70 = 47.20$

CC

k=



Expt. 26 Use two 8x12x1 pieces of Plexiglas  
 $k > 1$  Rohette 4.214  $\ln N$  10.47  $\frac{dN}{dt}$  4.87-4.99  $T = 227.5 \text{ sec}$

Remove 8x12x1 piece Rohette 15.934

12/4

$\ln N$  5.11  $\frac{dN}{dt}$  -110.8sec  $\rho = -20.65$   
 20.20

Continue evaluation of negative reactivity measurement.

Instrument Check on 12-4-68 Source 10mc  $\delta$

PM-1	Low Trip	OK	Alarm Trip	OK
PM-2			Alarm Trip	
IC-1	$> 3 \times 10^{-4}$	Meter Trip	OK	Fast Trip OK
IC-2	$> 3 \times 10^{-4}$	Meter Trip	OK	Reasoned $\checkmark$
IC-3	Responds	Calibration	OK	Alarm $\checkmark$
IC-4	Responds	Calibration	OK	Res 0.03
CRM		Meter Trip		Rm Temp 22°C

Expt. 27. 8x12x1 removable 9x12x1 fixed (N)  
 $k > 1$  at closure 4.94  $\frac{dN}{dt}$   $T = 107.34 \text{ sec}$  9.14  $\frac{dN}{dt}$  slow 9.35  
 $k < 1$  at 2.6 revs. 6.99  $\frac{dN}{dt}$   $T = -151.9$  -11.76 -11.956  
 $k > 1$  at closure 4.94  $\frac{dN}{dt}$   $T = 107.34$  9.14 9.35  
 $k < 1$  Remove 8x12x1 5.80  $\frac{dN}{dt}$   $T = -126.0$  -15.99 -16.238

Expt. 28 9x12x1 removable 8x12x1 fixed (N)  
 $k > 1$  at closure 5.26  $\frac{dN}{dt}$   $T = 114.3$  8.69 8.899  
 $k < 1$  Remove 9x12x1 5.00  $\frac{dN}{dt}$   $T = -108.7$  -21.685 -22.063

Expt. 29 two 9x12x1 pieces of Plexiglas  
 $k > 1$  at closure 2.98  $\frac{dN}{dt}$   $T = 64.76$  13.36 13.695

$k < 1$  at 2.6 revs 10.40  $\frac{dN}{dt}$   $T = -226.0$  -6.87 -7.00

CC 1/6/69

$k > 1$  at closure 2.98  $\frac{dN}{dt}$   $T = 64.76$  13.36 13.695

$k = .9933 \pm 4.9 \times 10^{-3}$   $k < 1$  Remove 9x12x1 5.90  $\frac{dN}{dt}$   $T = -123.9$  -16.5 -16.748

30x10<sup>3</sup> counts.

Conclude system subcritical by  $(45 \pm 2) \%$   
 $\beta_{eff} = .007 \Rightarrow k = .99685 \pm .00014$

Exp. 30 Cell Vol =  $(12.6+3.25)^2(10.2+3.25)(2.54)^3 = 55.371 \text{ l.}$

$$\bar{\rho} = \frac{15.694}{55.371} = 0.28346 \text{ g/cc} \quad k < 1$$

Exp. 32

Cell Volume:  $(12.6+3)^2(10.2+3)(2.54)^3 = 52.641 \text{ l.} \quad k > 1$

$$\bar{\rho} = \frac{15.696}{52.641} = 0.298179 \text{ g/cc}$$

Instrument Check on 12-9-68 Source Co-60

PM-1	Low Trip	OK	Alarm Trip	OK
PM-2			Alarm Trip	
IC-1	$> 3 \times 10^{-11}$	Meter Trip	OK	Fast Trip OK
IC-2	$> 3 \times 10^{-11}$	Meter Trip	OK	Personnel $\checkmark$
IC-3	Responds	Calibration	OK	Alarms $\checkmark$
IC-4	Responds	Calibration	OK	Pres -0.03"
CRM		Meter Trip		Run Temp 20.8°C

Expt. 30. Assembly Reflected by 15.2-cm-thickness of Polyethylene.  
Boxes separated by 3.25"

$k > 1$  at closure  $M = 2$ .

Expt. 31. Place pieces of plexiglas 1" thick between <sup>(2x20)</sup> E-W faces of blocks

$k < 1$  slightly less sensitive than Expt. 30.

Instrument Check on 12-10-68 Source Co-60

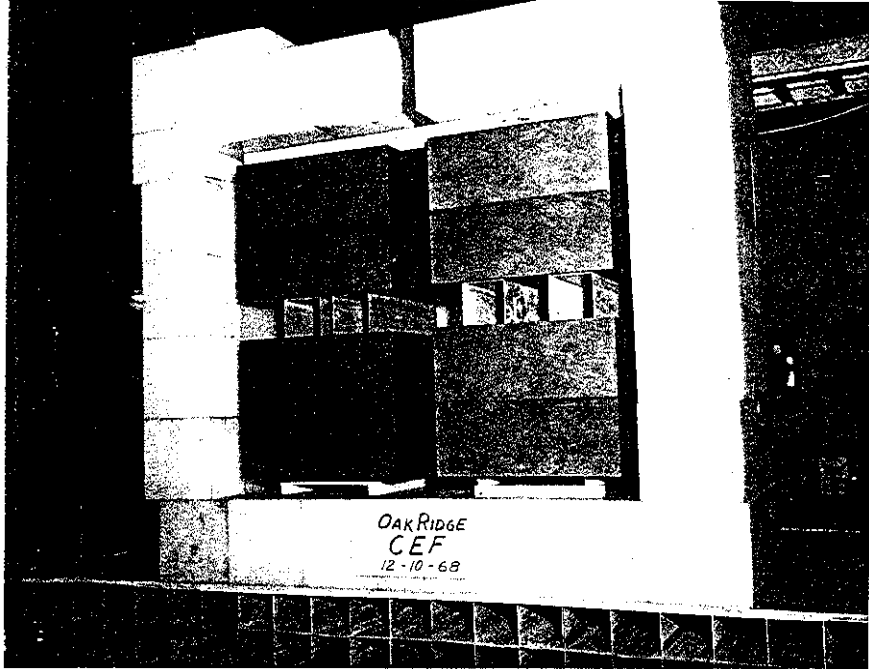
PM-1	Low Trip	OK	Alarm Trip	OK
PM-2			Alarm Trip	
IC-1	$> 3 \times 10^{-11}$	Meter Trip	OK	Fast Trip OK
IC-2	$> 3 \times 10^{-11}$	Meter Trip	OK	Personnel $\checkmark$
IC-3	Responds	Calibration	OK	Alarms $\checkmark$
IC-4	Responds	Calibration	OK	Pres -0.03"
CRM		Meter Trip		Run Temp 21°C

Expt. 32 Reset spacing to 3".00 Reflected U-G systems.

$k > 1$  at 9.65 <sup>(.609)</sup> revs. separation.  $3.8 \text{ div/sec} \Rightarrow T = +82.6 \text{ sec.}$  11.844

$k = 1$  at 10.80 <sup>(.707)</sup> revs.

$k < 1$  at 11.94 <sup>(.807)</sup> revs.  $-6.73 \text{ div/sec} \Rightarrow T = -146.24 \text{ sec.}$ ; 12.874



Expt. 33 Determine effect of  $1/4''$  thick Plexiglas between graphite boxes in N-S plane  $24^{3/4} \times 15''$

$k > 1$  at 10.6 revs (.690")  $3.5 \text{ div/sec} \Rightarrow 76.1 \text{ sec} , 12.1674$

$k > 1$  at 10.1 revs (.647")  $2.015 \text{ div/sec} \Rightarrow 43.8 \text{ sec} , 17.8984$

$k = 1$  at 11.75 revs (.790")

$k < 1$  at 13.30 (1.00")  $5.03 \text{ div/sec} \Rightarrow -109.3 \text{ sec} - 21.7724$

### Box Measures

$31^{1/4} \times 26^{1/4}$

Expt. 34 Determine effect of  $1/8''$  thick <sup>Aluminum</sup>  $24^{3/4} \times 15''$  in N-S plane between boxes.

$k > 1$  at 8.5 revs (.515")  $3.4 \text{ div/sec} \Rightarrow 73.9 \text{ sec} , 12.4344$

$k > 1$  at 8.0 revs (.477")  $2.1 \text{ div/sec} \Rightarrow 45.6 \text{ sec} , 17.4294$

$k = 1$  at 9.78 revs (.620")

$k < 1$  at 11.45 revs (.764")  $5.2 \text{ div/sec} \Rightarrow -112.0 - 20.169$

Expt. 35 Determine effect of  $0.109''$  thick steel  $24 \times 15''$  in N-S plane between boxes.

$k < 1$  at closure  $M \sim 2 \text{ w/source} , 3.2 \times 10^{-3} \text{ on ln N (IC4)}$

Expt. 36 Determine effect of  $1/4''$  Plexiglas adjacent to steel.

$k < 1$  at closure  $M \sim 2^+ \text{ w/source} , 4.4 \times 10^{-3} \text{ on ln N (IC4)}$

Expt. 37 Determine effect of  $1/4''$  Plexiglas + Steel (.109") when steel is in N-S plane + Plexiglas is in E-W plane between boxes.

$k < 1$  at closure  $M \sim 2^+ \text{ w/source} , 4.4 \times 10^{-3} \text{ on ln N (IC4)}$

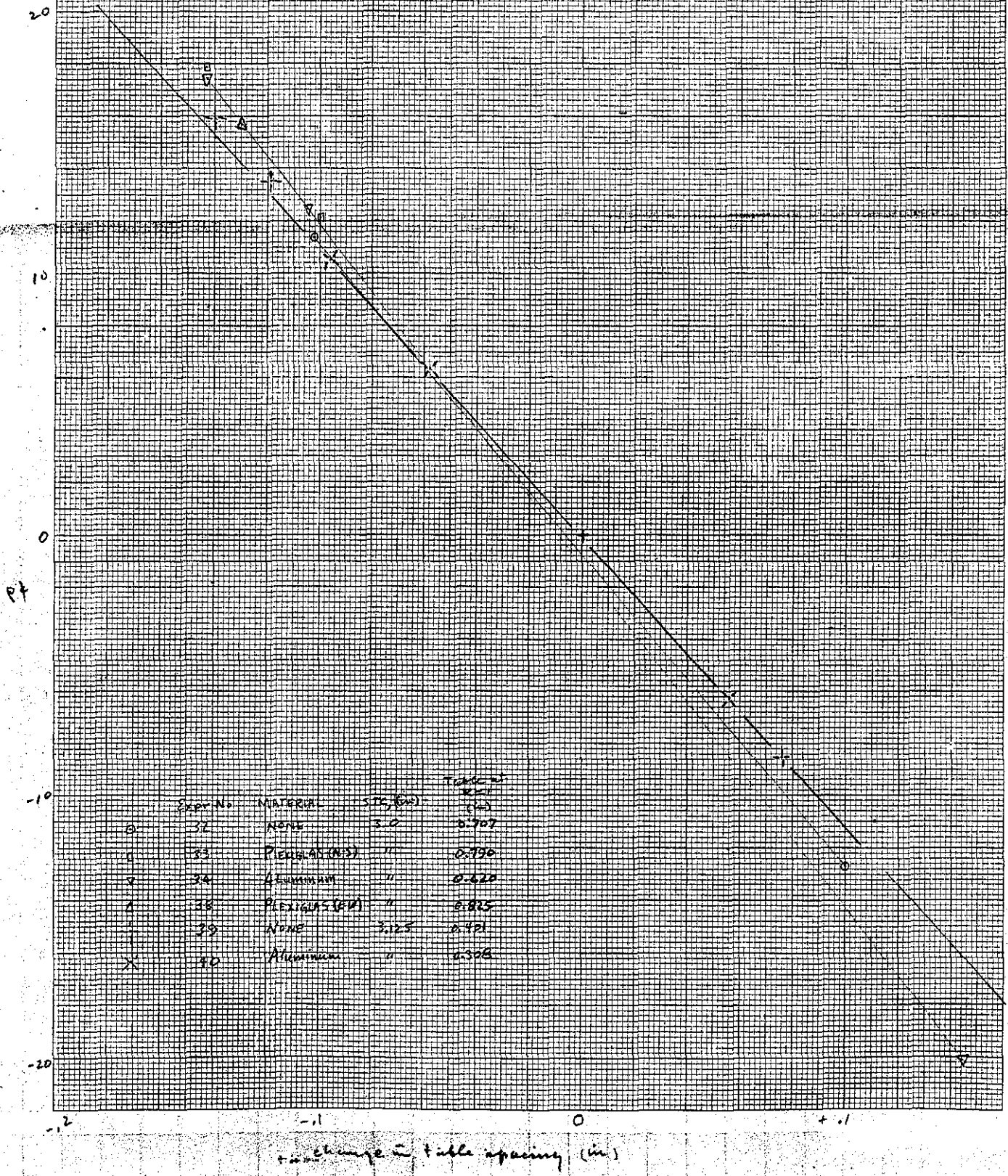
Expt. 38 Remove steel from arrangement in Expt. 37.

$k > 1$  at 10.6 revs (.690")  $2.43 \text{ div/sec} \Rightarrow 52.8 \text{ sec} , 15.7914$

$k \approx 1$  at 11.75 revs (.790")

$k < 1$  at 13.3 revs (1.00")  $5.83 \text{ div/sec} \Rightarrow -126.7 \text{ sec} - 16.076$

Reactivity Summary of Expts. 32-40.



A

Instrument Check on 12-11-68 Source Co-60

PM-1	Low Trip	OK	Alarm Trip	OK
PM-2			Alarm Trip	
IC-1	$> 3 \times 10^{-11}$	Water Trip	OK	Post Trip OK
IC-2	$> 3 \times 10^{-11}$	Water Trip	OK	Personal $\checkmark$
IC-3	Responds	Calibration	JH	Alarms $\checkmark$
IC-4	Responds	Calibration	JH	Pres - 0.03"
CRM		Water Trip		Run Temp. 21°C

Expt. 39 Reset spacing to  $3 \frac{1}{8}$ " between boxes.

$R > 1$  at 5.3 revs (.282") 3.05 div/sec : 66.3 sec 13.4574

$R > 1$  at 5.0 revs (.261") 2.4 div/sec : 52.2 sec 15.9154

$R = 1$  at 7.0 revs (.401")

$R < 1$  at 8.0 revs (.477") 8.87 div/sec : -192.7 sec. -8.5774

Expt. 40 Inserted Al sheets as in Expt. 34 : N-5 planes.

$R > 1$  at 4.8 revs (.250") 7.97 div/sec : 173.2 sec 6.312

$R > 1$  at 4.2 revs (.212") 4.25 div/sec : 92.4 sec 10.5074

$R = 1$  at 5.7 revs (.308")

$R < 1$  at 6.5 revs (.364") 11.35 div/sec : -246.6 sec -6.2904

## Conclusions Exps. 32-40

- ① Introduction of Plexiglas in the N-S plane between U-Graphite boxes contributes 9.5% reactivity to the array. This effect is independent of table separation at critical.
- ② Introduction of Plexiglas in the E-W plane is worth 3.5% more than introduction in N-S plane. (the effect here is moderation plus influence on leakage for gap).
- ③ Aluminum has a negative effect when introduced in N-S plane ( $\approx -9.5\%$ ). This is also independent of gap.
- ④ Steel produces a negative effect - linear extrapolation of gap worth + Plexiglas worth makes estimate  $> 1.00$ .



Instrument Check on 12-12-68 Source Co-60

PM-1	Low Trip	OK	Alarm Trip	OK
PM-2			Alarm Trip	
IC-1	$> 3 \times 10^{-4}$	Meter Trip	OK	Fast Trip OK
IC-2	$> 3 \times 10^{-4}$	Meter Trip	OK	Personnel $\checkmark$
IC-3	Responds	Calibration	JTB	Alarms $\checkmark$
IC-4	Responds	Calibration	JTB	Pres - 0.03
		Meter Trip		Rm Temp $22^{\circ}\text{C}$

Exps. 41 Data from last two spacings indicate a spacing of  $3.25''$  should have been critical i. have reset spacing to  $3.25$  and am repeating Exps. 30.  
 $k < 1$  at closure.

Exps. 42 Insert Plexiglas sheets  $\frac{1}{4}'' \times 24.75'' \times 15''$  in N-S plane.

$k > 1$  at closure:  $17.65 \text{ div/sec}$ ;  $T = 383.5 \text{ sec} \Rightarrow \rho = 3.1174$

$k = 1$  at  $1.72 (.062'')$  Rfl' box closed at top.

$k < 1$  at  $2.50 (.106'')$   $17.0 \text{ div/sec}$   $T = -369.4 \text{ sec} \Rightarrow \rho = -3.9334$

Conclusion:

Worth of introducing plexiglas is  $\sim 9.54$ .

$k > 1$  by 3.1

i. array subcritical by  $6.44$

Assuming  $\beta_{eff} = .007$  then  $k$  for array is  $0.9995$

c.c. on 1/6/69

$k = 1.0057 \pm 5.2 \times 10^{-3}$   $30 \times 10^3 \text{ neut.}$

Rec'd 12/26/68

see p 44 for diagram.

No	wt kg	A	B	C	D	X	Y	Z
1	14.40	3.026	3.026	3.027	3.024	10.60	10.60	4.113
2	14.42	3.025	3.025	3.014	3.023	10.592	10.603	4.112
3	14.32	3.023	3.021	3.027	3.027	10.60	10.60	4.100
4	14.37	3.020	3.022	3.026	3.022	10.596	10.592	4.108
5	14.44	3.028	3.021	3.023	3.027	10.60	10.595	4.100
6	14.45	3.023	3.028	3.027	3.023	10.595	10.595	4.100
7	14.50	3.023	3.025	3.024	3.030	10.60	10.60	4.104
8	14.36	3.023	3.024	3.025	3.025	10.6	10.595	4.110
8 + 9	14.42	3.024	3.025	3.027	3.027	10.603	10.596	4.100
7 + 10	14.45	3.023	3.021	3.027	3.026	10.60	10.60	4.120
4 + 11	14.43	3.024	3.023	3.025	3.024	10.60	10.604	4.110
5 + 12	14.34	3.027	3.025	3.025	3.024	10.590	10.594	4.105
1 + 13	14.40	3.023	3.025	3.025	3.025	10.60	10.592	4.100
6 + 14	14.40	3.028	3.023	3.024	3.023	10.60	10.60	4.100
2 + 15	14.30	3.027	3.026	3.025	3.027	10.60	10.60	4.105
3 + 16	14.35	3.027	3.025	3.025	3.023	10.60	10.597	4.108

28.79375	3.024546	10.59812	22 = 8.211875
± .078092	± .002480	± .003452	± .007235

Dia of hole =  $4.549026 \pm .00345$

Exp.	Plexiglas Size/Removed	Table (revs)	$P_{\text{gear}}$	
			$T_+$	$T_-$
44	9x12/9x12	2.2	9.0754	
	9x12/9x12	1.9	13.773	
	9x12/9x12	2.8	0	
	9x12/0	0		-23.186
45	9x12/8x12	1.9	5.684	
		6.6	9.208	
		2.31	0	
	9x12/0	0		-24.070

Instrument Check on 1-7-68 Source Co-60.

PM-1	Low Trip	OK	Alarm Trip	OK
PM-2				
IC-1	$> 3 \times 10^{-4}$	Motor Trip	OK	Fast Trip OK
IC-2	$> 3 \times 10^{-4}$	Motor Trip	OK	Personnel <input checked="" type="checkbox"/>
IC-3	Responds	Calibration	JN	Alarms <input checked="" type="checkbox"/>
IC-4	Responds	Calibration	JN	Pres. - 0.03"
CRM		Motor Trip		Run Temp.

Exp. 43 Tay eight units in standard location each contained in graphite blocks of dimensions given on p. 72. Blocks are in contact. There is no additional reflector.  $k < 1$  at table closure.

Exp. 44 Have placed  $9 \times 12 \times 1$ " plexiglas pieces on N and S faces of assembly.

$k > 1$  at 2.2 Revs. (0.089")  $4.975 \frac{\text{div}}{\text{sec}}$   $T = 108.2 \text{ sec}$   $\rho_f = 9.075 \%$

$k > 1$  at 1.9 Revs. (0.072")  $2.86 \frac{\text{div}}{\text{sec}}$   $T = 62.1$   $\rho_f = 13.773 \%$

$k = 1$  at 2.8 Revs. (0.124") 0

$k < 1$  at closure with S-plexiglas removed.  $4.87 \frac{\text{div}}{\text{sec}}$   $T = 105.8 \text{ sec}$   $\rho_f = -23.186 \%$

Exp. 45  $9 \times 12 \times 1$  on N face of assembly  $8 \times 12 \times 1$  on S face is removable.

$k > 1$  at 1.9 Revs (0.072")  $8.77 \frac{\text{div}}{\text{sec}}$   $190.6 \text{ sec}$   $\rho_f = 5.684 \%$

$k > 1$  at 1.6 Revs (0.056")  $4.57 \frac{\text{div}}{\text{sec}}$   $99.3 \text{ sec}$   $\rho_f = 9.728 \%$

$k = 1$  at 2.31 Revs (0.095") 0

$k < 1$  Remove  $8 \times 12 \times 1$ " plexiglas and close table.  $4.8 \frac{\text{div}}{\text{sec}}$   $104.3 \text{ sec}$   $\rho_f = -24.07 \%$

Expt. No.	fixed/ removable	Table (new)	T <sub>+</sub>	T <sub>-</sub>
Expt. 46	9x12/8x8	0	3.588	
		1.00	0	
		1.6		-9.064
Expt. 47	11x13 <sup>3/16</sup> /8x8	1.6	9.909	
		2.31	0	
	11x13 <sup>3/16</sup> /0	0		-1.9404
Expt. 48	11x12/6x8	0	7.075	
		1.25	0	
		1.6		-5.525
		0	7.047	
	11x12/0	0		-9.689
Expt. 49	11x12/8x8	1.6	2.125	
		1.8	0	
		0	15.555	
	11x12/0	0		-9.689

1-7-69

Expt 46 9x12x1 on N face of Assembly 8x8x1" on S face and removable

$R > 1$  at closure, 14.75 div/sec ; 320.5 sec  $P_f = 3.588 \text{ f}$

$R = 1$  at 1 Rev (.028") 0

$R < 1$  at 1.6 Revs (.056") 8.40 div/sec ; -182.5 sec  $P_f = -9.064 \text{ f}$

Expt 47 11x13<sup>3</sup>/<sub>16</sub> x1 on N face of Assembly 8x8x1 on S face and removable.

$R > 1$  at 1.6 Revs (.056") 4.45 div/sec 96.7 sec  $P_f = 9.909 \text{ f}$

$R = 1$  at 2.31 Revs (.095") 0

$R < 1$  after removed. 0 Revs. 32 div/sec 695.4 sec  $P_f = -1.940 \text{ f}$

Instrument Check on 1-8-69 Source Co-60

PM-1	Low Trip	OK	Alarm Trip	OK	
PM-2			Alarm Trip		
IC-1	$> 3 \times 10^{-4}$	Motor Trip	OK	Fast Trip	OK
IC-2	$> 3 \times 10^{-4}$		OK		Personnel
IC-3	Responds		OK		Alarms
IC-4	Responds		OK		Pres - 0.03"
IRM					Run Temp.

Expt 48 11x12x1 on N face 6x8x1 on S face - removable.

$R > 1$  at closure, 6.77 div/sec 147.1 sec  $P_f = 7.075 \text{ f}$

$R = 1$  at 1.25 Revs. (.039") 0

$R < 1$  at 1.6 Revs. (.056") 12.45 div/sec -270.5 sec  $P_f = -5.525 \text{ f}$

$R > 1$  at closure 6.8 div/sec 147.8 sec  $P_f = 7.047 \text{ f}$

$R < 1$  remove 6x8x1" Plexiglas, 8.0 div/sec -173.84 sec  $P_f = -9.689 \text{ f}$

## Period summary for value of Plexiglas

from Expt. 49	value of $8 \times 8$	$= 15.555 + 9.688 = 25.244$
48 + 50	" " $6 \times 8$	$= 7.075 + 9.685 = 16.764$
48	value of 1.6 revs	$= 7.075 + 5.525 = 12.600$
46	" " "	$9.064 + 3.588 = 12.652$
47 + 49	$11 \times 13$ is worth	6.954 more than $11 \times 12$
49 + 46	$11 \times 12$ " " "	11.967 " " $9 \times 12$
44 + 45	$9 \times 12$ " " "	8.089 " " $8 \times 12$
45 + 46	$8 \times 12$ " " "	18.772 " " $8 \times 8$

Area (in <sup>2</sup> )	Plexiglas	Value $\phi$
48	$6 \times 8$	16.764
64	$8 \times 8$	25.244
96	$8 \times 12$	44.016

108	$9 \times 12$	52.015	1.04	1.25
132	$11 \times 12$	64.072	1.07	1.6
145	$11 \times 13^{3/16}$	71.026	1.09	1.8
Expt.	Calculated subcritical value		2.31	2.3
44	$2(52.015) = 40.105 = 64.005$	at 1.9 revs	2.01	2.8
45	at 1.6 revs	$52.105 + 44.016 - (9.708 + 12.6) = 73.813$		
46	at 1.6 revs	$52.105 + 25.244 + 9.064 - 12.600 = 73.813$		
	at 0	$52.105 + 25.244 - 3.588 = 73.761$		
47	at 0	$71.026 + 1.94 = 72.966$		
	at 1.6 revs	$71.026 + 25.244 - (9.909 - 12.60) = 73.957$		
48	0	$64.072 + 16.764 - 7.075 = 73.761$		
49	0	$64.072 + 25.244 - 15.555 = 73.761$		

Consistency check: both Expt 45 and 47 are critical at 2.31 revs, separately

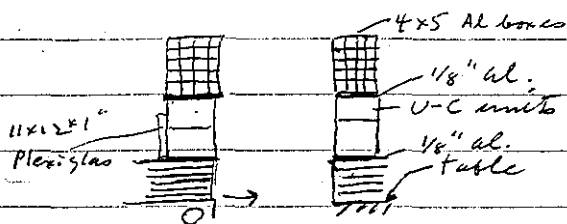
$$\therefore (9 \times 12) + (8 \times 12) = 11 \times 13^{3/16} + 8 \times 8$$

$$52.015 + 44.016 = 71.026 + 25.244$$

$$96.121 = 96.270 \Rightarrow \Delta = 0.149 \phi$$

Expt. 49 11x12x1 on N face 8x8x1 on S face & removable  
 $R > 1$  at 1.6 revs (0.056") 26.0 div/sec <sup>poor period</sup> ~~56.4 sec~~  $P_f = 2.125 \phi$  ? 2.855E  
 $R = 1$  at 1.8 revs (0.067") 0  
 $R > 1$  at closure. 2.4 div/sec 52.15 sec  $P_f = 15.555 \phi$   
 $R < 1$  Remove 8x8x1 Plexiglas. 8.0 div/sec -173.84 sec  $P_f = -9.689 \phi$

Expt. 50 Evaluate reactivity effect of aluminium sheet and boxes which support the assembly.



Revs.	$\rho$	Notes
1.0	3.6	$R > 1$ at 2.7 Revs (0.119") <sup>2.4</sup> 2.462 div/sec; 53.5 sec $P_f = 15.284 \phi$
1.25	7.1	$R = 1$ at 3.66 revs with 6x8 in position
1.6	12.6	$R = 1$ at 2.66 with 6x8x1" Plexiglas removed
1.8	15.6	$R < 1$ at 3.66 " " " "
2.3	22.4	ave value of 6x8 5.65 div/sec -122.8 sec $\equiv -16.725 \phi$
2.8	30.3	$\Rightarrow$ 2.6 revs worth $\approx 30 \phi$ ; 11x12 + structure = 73.7 + 30 = 103.7

Structure contributes  $103.7 - 64.07 = 39.6 \phi$

ave value of degree subcritical is  $\frac{73.7}{39.6} \phi \pm 0.2 \phi$

$\therefore$  assembly is subcritical by  $113.3 \phi$



$$\text{Cell Volume} = (13.6)^2 (11.22) \text{ in}^3$$
$$= 34.007 \text{ liters}$$

$$\rho = \frac{15.492}{34.007} = 0.461 \text{ g/cc}$$

Expts. 51 and 54 show that polyglas is worth 15.207 g

Expts. 51 and 55 show that aluminum is worth -12.442 g

Expts. 53 and 52 indicates expt. 52 was subcritical by ~6.7 g

B<sup>2</sup> units

Polyethylene Reflected Assembly of 8 10.6 graphite cubes.

Instrument Check on 1-9-68 Source Co-60

PM-1	Low Trip	OK	Alarm Trip	OK
PM-2			Alarm Trip	
IC-1	$> 3 \times 10^{-11}$	Water Trip	OK	Fast Trip OK
IC-2	$> 3 \times 10^{-11}$	Water Trip	OK	Personnel <input checked="" type="checkbox"/>
IC-3	Responds	Calibration	JA	Alarms <input checked="" type="checkbox"/>
IC-4	Responds	Calibration	JA	Pres -0.03
RFM		Water Trip		Rm Temp.

Exps. 51 Spacing between graphite blocks is 3.00". Eight units Reflected by 6-in-thickness of Polyethylene.

$k > 1$  at 10.7 revs. (0.698") 3.29 div/sec; 71.5 sec  $\rho_f = 12.442 f$

$150/\text{in}$   $k = 1$  at 11.7 revs. (0.781")

$k < 1$  at 12.55 revs (0.964") 6.97 div/sec; -151.5 sec  $\rho_f = -11.813 f$

Exps. 52. 13.5 x 20.75" x .109" sheet of ~~1018~~ S. steel placed between blocks in N-S plane - one in each half of array.

$k < 1$  at closure slightly sub.

$\sim 6.7 f$  sub.

Exps. 53. Steel sheets plus 1/4" Plexiglas same size adjacent to steel.

$80/\text{in}$   $k > 1$  at closure 5.4 div/sec 117.34 sec  $\rho_f = 8.509 f$

$k = 1$  at 2.5 revs (0.106")

Exps. 54 Remove steels, only plexiglas present.

$140/\text{in}$   $k > 1$  at 11.7 revs (0.781") 2.48 div/sec 53.89 sec  $\rho_f = 15.207 f$

$k = 1$  at 12.82 revs (0.890")

Exps. 55 Remove Plexiglas install 1/8 sheets of Aluminum same size.

$145/\text{in}$   $k > 1$  at 9.5 revs (0.597") 2.62 div/sec 56.98 sec  $\rho_f = 14.647 f$

$k = 1$  at 10.7 revs (0.698")

Continue Reflected Array

Instrument Check on 1-10-69 Source C-60

PM-1	Low Trip	OK	Alarm Trip	OK
PM-2			<del>Alarm Trip</del>	
IC-1	$> 3 \times 10^{-11}$	Meter Trip	OK	Foot Trip OK
IC-2	$> 3 \times 10^{-11}$		OK	Personnel ✓
IC-3	Responds		JA	Alarms ✓
IC-4	Responds		JA	Pres. $-0.03''$
CRM				Rm Temp. $20^{\circ}\text{C}$

Expt. 56 Spacing between boxes is now  $3.25''$

$k \leq 1$  at closure. Near critical but degree unknown

Expt. 57 Filled  $1\frac{1}{8} \times 2''$  recesses in bulk faces of reflector on N+S sides and have inserted  $13\frac{3}{4} \times 20 \times \frac{1}{4}''$  pieces of Plexiglas in N-S plane between boxes.

{ Chart on IC-2 reversed direction of rotation necessary to }  
 { replace motor in recorder. Continue exp. }

$k > 1$  at closure  $4.6 \text{ div/sec}$   $99.96 \text{ sec}$   $P_c = 9.65 \text{ f}$

$k = 1$  at  $2.7 \text{ rev.}$  ( $0.119''$ )

$\therefore$  Assembly is  $15.207 - 9.65 = 5.56 \text{ f}$  subcritical.  
 cf p 71.

Exps. 58-60

Value of  $6 \times 8 \times 1$  pc. of Plexiglas is  $18.2 \text{¢}$   
 compared to  $16.7$  when assembly rests  
 directly on table.  $\therefore$  bias is  $+1.5 \text{¢}$

Exp. 62 gives value of  $8 \times 8 \times 1$  as  $27.4 \Rightarrow +2.2 \text{¢}$  bias

From graph of Plexiglas area vs worth (Exps 44-49)

$\therefore$  value of  $11 \times 12 = 66.3$

$$9 \times 12 = 54.0$$

$$8 \times 8 = 27.4$$

$$6 \times 8 = 18.2$$

$$8 \times 12 = 45.7$$

$$27.4$$

$$17.3$$

Redetermine degree substituted of unrefl. assembly

Instrument Check on 1-13-68 Source 60-60

PM-1	Low Trip	OK	Alarm Trip	OK	
PM-2			Alarm Trip		
IC-1	$> 3 \times 10^{-4}$	Meter Trip	OK	Fast Trip	OK
IC-2	$> 3 \times 10^{-4}$	Meter Trip	OK		Personnel ✓
IC-3	Responds	Calibration	JA		Alarm ✓
IC-4	Responds	Calibration	JA		Pres. - 0.03"
CRM		Meter Trip			Rm Temp. 19.7

Expt. 58 Each half of assembly is resting on Boral plate

$1/4" \times 11 \times 24"$  and backed by  $6" \times 12" \times 24"$  polyethylene.

$11 \times 12 \times 1"$  Plexiglas on N face and  $6 \times 8 \times 1"$  on S-face (removable)

Cf expt. 48 on p 77.

$255 \frac{1}{in}$   $k > 1$  at 4.0 revs ( $0.198"$ )  $3.56 \text{ dis/sec}$   $77.36 \text{ sec}$   $C_f = 11.735$

$k = 1$  at 4.7 revs ( $0.244"$ )

$k = 1$  at 3.65 revs ( $0.176"$ )  $6 \times 8 \times 1"$  removed.

Expt. 59 Same reflector base but now  $8 \times 12 \times 1$  on N face

with  $6 \times 8 \times 1$  on S face of assembly.

$k > 1$  at 2.6 revs ( $0.112"$ )  $3.04 \text{ dis/sec}$   $66.1 \text{ sec}$   $C_f = 13.173$

$k < 1$  at 2.6 revs; remove  $6 \times 8$ .

$214 \frac{1}{in}$   $k = 1$  at 2.2 revs. ( $0.089"$ )  $13.75 \text{ dis/sec} = 298.8 \text{ sec}$   $C_f = 4.915$

Value of  $6 \times 8 = 18.1$

Expt. 60 Same except replace  $8 \times 12 \times 1$  with  $8 \times 8 \times 1$ .

$k > 1$  at closure  $3.68 \text{ dis/sec}$   $79.97 \text{ sec}$   $C_f = 11.4714$

$k < 1$  " " remove  $6 \times 8 \times 1$  plexiglas.  $10.4 \text{ dis/sec} = 22.2 \text{ sec}$

$C_f = 4.274$

Value of  $6 \times 8 = 18.3$

1-13-69

Expt. 61 Same except removed  $8 \times 8 \times 1$  pc of Plexiglas  
and covered top of array with  $1/4$ " Boral plate.  
 $11 \times 14$  on N-half and  $11 \times 14$  on S-half of assembly.

$k > 1$  at 1.1 revs ( $0.032$ " )  $3.18 \text{ di/sec}$   $69.1 \text{ sec}$   $12.755 \text{ f}$

$k < 1$  at 1.1 revs remove  $6 \times 8 \times 1$   $11.25 \text{ di/sec}$   $-244.5 \text{ sec}$   $-6.259 \text{ f}$

$k \leq 1$  at 0. revs.  $21.7 \text{ di/sec}$   $-471.5 \text{ sec}$   $-2.944 \text{ f}$

Instrument Check on 1-14-69 Source Co-60

PM-1	Low Trip	OK	Alarm Trip	OK	
PM-2			Alarm Trip		
IC-1	$> 3 \times 10^{-3}$	Meter Trip	OK	Fast Trip	OK
IC-2	$< 3 \times 10^{-3}$	Meter Trip	OK	Personnel	<input checked="" type="checkbox"/>
IC-3	Responds	Calibration	OK	Alarms	OK
IC-4	Responds	Calibration	OK	Pres	$-0.03$ "
CRM	Meter Trip			Rm Temp.	18.2

Expt. 62 Continue evaluation of reflector effect.

Conditions same as in expt. 60 except  $6 \times 8 \times 1$  on N face  
and  $8 \times 8 \times 1$  on S face removable.

$k > 1$  at closure  $3.54 \text{ di/sec}$   $76.92 \text{ sec}$   $P_f = 11.799 \text{ f}$

$k < 1$  at closure; remove  $8 \times 8 \times 1$ ,  $5.87 \text{ di/sec}$   $-127.6 \text{ sec}$   $P_f = -15.634 \text{ f}$

value of  $8 \times 8 = 27.4 \text{ f}$  (cf 25.2)

Expt. 63 Place mirror of bottom reflector on top of  
assembly; no plexiglas present on N and S faces

$247 \text{ di/min}$   $k > 1$  at 5.2 revs ( $0.276$ " )  $3.32 \text{ di/sec}$   $72.1 \text{ sec}$   $P_f = 12.367 \text{ f}$

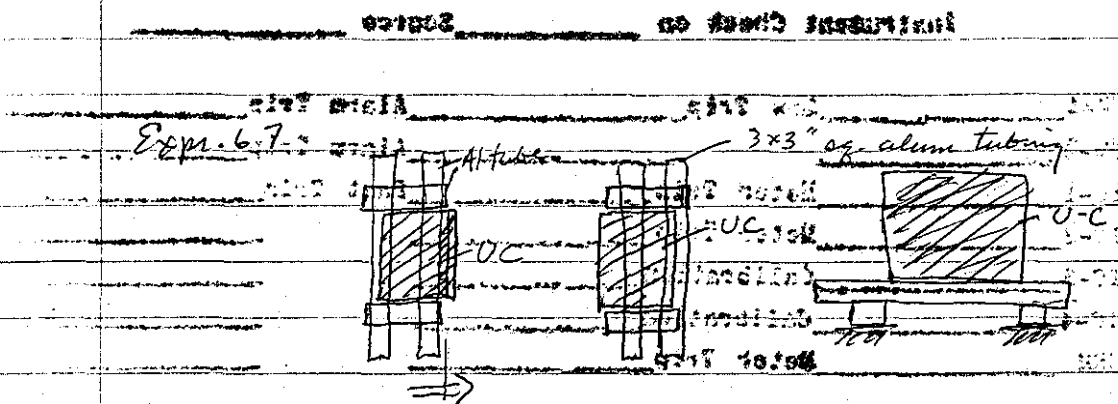
$k = 1$  at 5.95 ( $0.326$ " )

Expt. 64 Inserted 36 mil cd sheet between Boral + Polyethylene on top left.

$k > 1$  at 5.2 revs ( $0.276$ " )  $2.61 \text{ di/sec}$   $56.72 \text{ sec}$   $P_f = 14.680$

$k \approx 1$  at 5.95 revs ( $0.326$ " ) —

$k = 1$  at 6.10 revs ( $0.336$ " )



Exp. 68    3x3 aluminum tubes plus 20 x 13 x 1/8" Alum sheet added to top of assembly halves.

N.B. the location of the Aluminum tubes on top of the assembly was not same as bottom tubes but were more directly over units which causes an over estimate of their worth.

1-14-69

Expt. 65 Removed Boron from top reflector; just Polyethylene + Cd are present.

$k > 1$  at 6.7 revs (0.379") 2.30  $\text{div/sec}$  49.98 sec  $\rho_f = 16.011 \%$   
 $k = 1$  at 7.6 revs (0.446")

Expt. 66 Removed Polyethylene; now Cd +  $6 \times 8 \times 1$  on S-face of Expt. 61 p. 87.

$k \leq 1$  at closure 9.2  $\text{div/sec}$  -199.92 sec.  $\rho_f = -80.35$

Open table 1" replace  $6 \times 8 \times 1$  polyfus by an  $8 \times 8 \times 1$ "

$k \times 1$  at closure. 66  $\text{div/sec}$  -1434.2 sec  $\rho_f = -0.914$

Instrument Check on 1-15-69 Source Co-60

PM-1	Low Trip	OK	Alarm Test	OK
PM-2			Alarm Test	
IC-1	$> 3 \times 10^{-4}$	Motor Trip	OK	Post Trip OK
IC-2	$> 3 \times 10^{-4}$	Motor Trip	OK	Personnel
IC-3	Responds	Calibration	OK	Alarms
IC-4	Responds	Calibration	OK	Pres -2.05"
CRM		Motor Trip		Rm Temp

Expt. 67 Unrefl assembly on  $3 \times 3$ " alum. tubing 6" above table top.

$11 \times 12 \times 1$  on S-face and  $9 \times 12$  on south face this should add

11.6% to assembly and produce a 34 period

$k > 1$  at closure: ... 31  $\text{div/sec}$ ; 673.6 sec  $\rho_f = 1.8994$

$k = 1$  at 1.2 revs (0.037") polyfus adds 10.8%

Expt. 68 Support structure above table top reproduced above assembly.

$k > 1$  at closure 2.88  $\text{div/sec}$ ; 62.6 sec  $\rho_f = 13.6944$

$k = 1$  at 2.0 revs (0.079")

Reactivity addition of top structure is  $13.7 - 1.9 = 11.84$



## Summary Exps. 67-70

Exps. 67-68 Worth of top structure =  $13.7 - 1.9 = 11.8 \text{¢}$

Exps. 69 Worth of  $8 \times 8 \times 1$  Plexiglas 23.2 ¢

Exps. 70 " " " same when top structure is present

this value compares with 25.2 ¢ of exps.

and shows value of Plexiglas as fun of area must be biased ~ 2 ¢ less.

i.  $8 \times 8$  : 23.2

$9 \times 12$  : 49.5

$11 \times 12$  : 61.2

from plot of data

Exps. 68 gives: using 11.8 ¢ for top structure

Worth of bottom + top structure  $2(11.8) = 23.6$

" of  $9 \times 12$  49.5

" "  $11 \times 12$  61.2

134.3

minus excess

13.7

120.6 ¢ subcritical

Better value is had from experiments 69+70

Worth of  $13 \frac{1}{16} \times 14 \frac{5}{8}$  is 100.00

Worth of  $8 \times 8$  is 23.30

Worth of Support is 9.02

131.32

- exp. 11.55

120.87

Check value of Plexiglas

Instrument Check on 1-16-69 Source Co-60

PM-1	Low Trip	Alarm Trip	OK
PM-2		Alarm Trip	
IC-1	$> 3 \times 10^{-4}$	Motor Trip	OK
		Fast Trip	OK
IC-2	$> 3 \times 10^{-4}$	Motor Trip	OK
		Personnel	✓
IC-3	Responds	Calibration	✓
			allows ✓
IC-4	Responds	Calibration	✓
			Pos - 0.05"
CRM	Motor Trip		Run Temp 18.9°C

Expt. 69. Bottom support structure as in '67. Have placed  $13\frac{1}{16} \times 14\frac{5}{8} \times 1$  piece of Plexiglas on N face (value 100¢) and  $8 \times 8 \times 1$  on S face removable.

Determine worth of  $8 \times 8 \times 1$

$R > 1$  at closure ( $13\frac{1}{16} / 8 \times 8$ ): 3.64 dis/sec 79.1 acc;  $P_f = 11.547$

$R < 1$  at closure ( $13\frac{1}{16} / 0$ ): 7.03 dis/sec -152.8 acc  $P_f = 11.6624$

108.7

Expt. 70 Replaced make up of bottom support structure  $13\frac{1}{16} / 8 \times 8$

$R > 1$  at 2.0 acc (0.079") —

change to 1.8 acc (0.067") —

change to 1.5 acc (0.051") : 2.72 dis/sec 59.1 acc  $P_f = 14.263$

$R < 1$  at 1.5 acc remove  $8 \times 8$ : 8.33 dis/sec -181 acc  $P_f = 9.166$

Expt 69  $\Rightarrow$  worth of  $8 \times 8 \times 1$  plexiglas 23.2¢ bottom structure only

Expt 70  $\Rightarrow$  " "  $8 \times 8 \times 1$  " 23.4¢ bottom + Top structure present

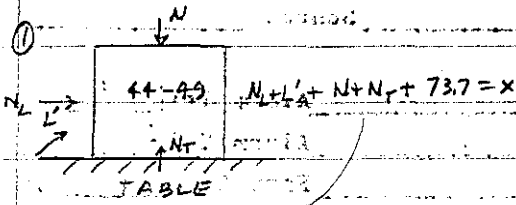
$\therefore$  take worth to be the same  $\sim 23.2$ ¢

$P_f$  for gap of 0.051 is 13¢  $\therefore 100 - 13 + 9.2 = 96.2$  added in plexiglas

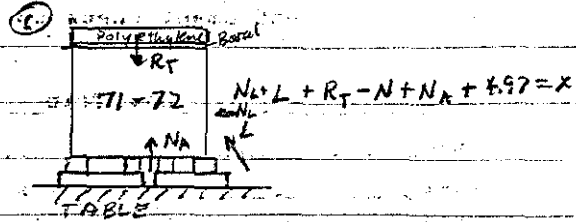
$\therefore$  worth of Al structure on top

is  $14.263 - 11.547 + 6.3 = 9.016$ ¢

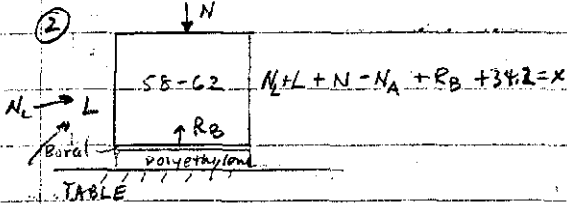
let  $x$  be anti-subcritical



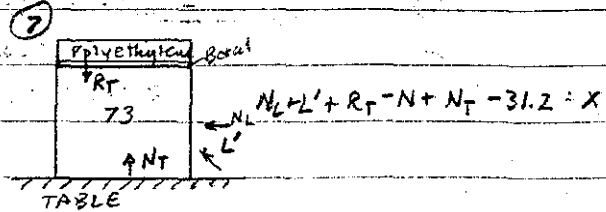
$$N_L + L' + N + N_T + 73.7 = x$$



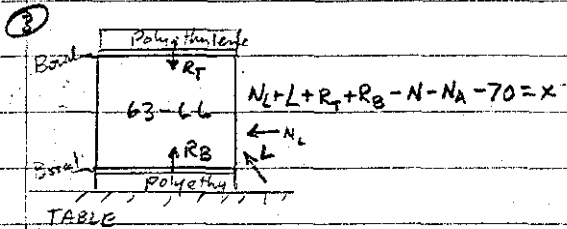
$$N_L + L + R_T - N + N_A + 6.97 = x$$



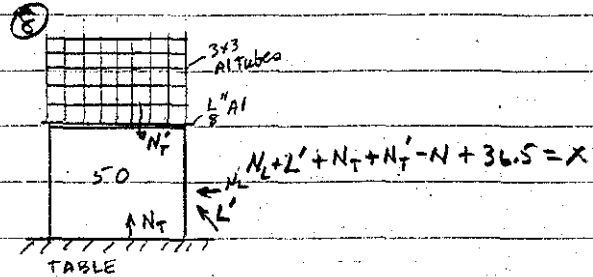
$$N_L + L + N - N_A + R_B + 34.2 = x$$



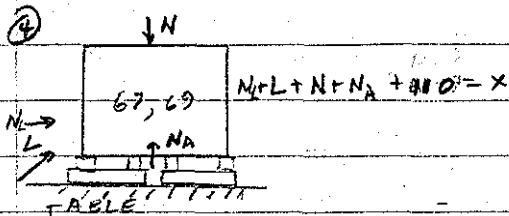
$$N_L + L' + R_T - N + N_T - 31.2 = x$$



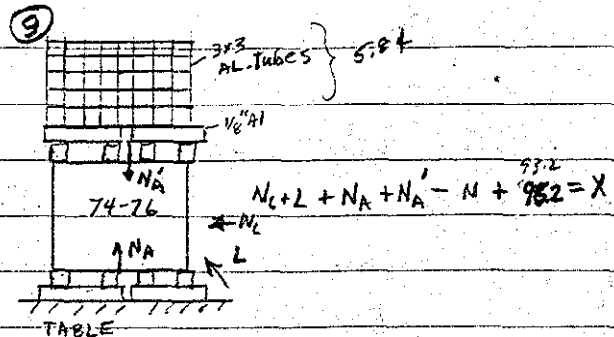
$$N_L + L + R_T + R_B - N - N_A - 70 = x$$



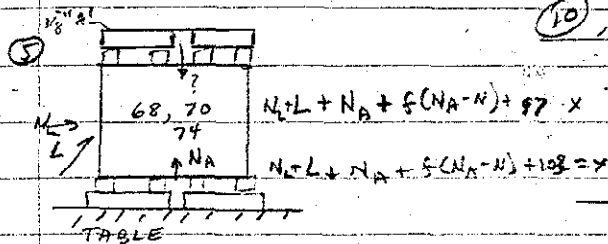
$$N_L + L' + N_T + N_T' - N + 36.5 = x$$



$$N_L + L + N + N_A + 41.0 = x$$

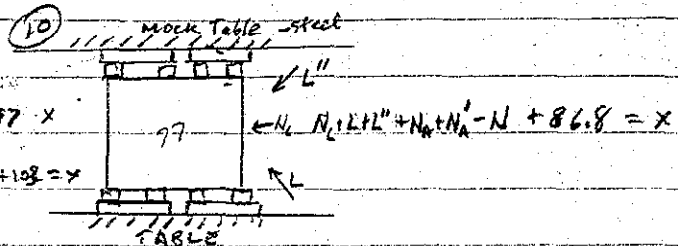


$$N_L + L + N_A + N_A' - N + 95.2 = x$$



$$N_L + L + N_A + 5(N_A - N) + 97 = x$$

$$N_L + L + N_A + 5(N_A - N) + 108 = x$$



$$N_L + L + L' + N_A + N_A' - N + 86.8 = x$$

11 mock Table top + steel

Expt. 78-80

$$N_L + 2L + 2N_A - N + 77.2 = x$$

74.8

77.2

Continue evaluation of Degree out.

Instrument Check on 1-21-69 Source 6060

PM-1		Low Trip	OK	Alarm Trip	OK
PM-2				Alarm Trip	
IC-1	$> 3 \times 10^{-11}$	Meter Trip	OK	Fast Trip	OK
IC-2	$> 3 \times 10^{-11}$	Meter Trip	OK		Personnel ✓
IC-3	Response	Calibration	JK		Alarms OK
IC-4	Response	Calibration	JK		Calor. $-0.03^\circ$
CRM		Meter Trip			Run Temp. $21.7^\circ\text{C}$

Expt. 71.  $\frac{1}{4}$ " Brass Plate + 6" Polyethylene on top.  
 $8 \times 8 \times 1$  on S. face.

$k \approx 1$  at closure: there is a gap  $\sim \frac{1}{8}$ " between halves of assembly.  
 Open Assembly 3" Removed top refl. and adjusted gap.

Expt. 72 Replaced top refl. +  $8 \times 8 \times 1$  pc. of Plexiglas. Try again!

$k > 1$	at 2.3 revs ( $0.095^\circ$ )	$2.46 \text{ disp/sec}$	$53.46 \text{ sec}$	$P_s = 15.292 \text{ f}$
$k < 1$	at 2.3 revs ( $0.095^\circ$ )	narrow gap	$7.43 \text{ disp/sec}$	$-16.145 \text{ sec}$ , $P_s = 10.753$
$k > 1$	at closure			$\left. \begin{matrix} 8 \times 8 = 26.045 \\ \text{cf. } 277 \text{ mps} \end{matrix} \right\}$
$k = 1$	at 1.57 revs ( $0.055^\circ$ )	$10.25 \text{ disp/sec}$	$222.73 \text{ sec}$	$P_s = 4.967 \text{ f}$

Expt. 73 Removed bottom  $3 \frac{1}{4}$ " aluminum support. Assembly now

on Table + Top reflection of Polyethylene + B.C. -- no extra Plexiglas

221.2	$k > 1$	at 2.7 revs ( $0.118^\circ$ )	$3.08 \text{ disp/sec}$	$66.43 \text{ sec}$	$P_s = 13.054 \text{ f}$
220	$k = 1$	at 3.65 revs ( $0.177^\circ$ )	0		
330	$k < 1$	at 3.85 revs ( $0.188^\circ$ )	$16.6 \text{ disp/sec}$	$-320.72 \text{ sec}$	$P_s = -3.962$

from plot of  $P_s$  vs table separation

table pos.	$P$	$P_s$	Rev.
.117	31.7	0	31.7
.118	17.7	13.05	30.75
.189	34.8	-3.96	30.96

ave 31.2

Eqs:

Ave

1-7  $-R_T + 2N + 104.9 = 0$

2-3  $-R_T + 2N + 104.3 = 0$

4-6  $-R_T + 2N + 105.0 = 0$

$-R_T + 2N + 104.7 = 0$

2-4  $-R_B + 2N_A + 75.8 = 0$

3-6  $-R_B + 2N_A + 74.9 = 0$

$-R_B + 2N_A + 75.4 = 0$

2-9  $-R_B + 2N - 2N_A - N_A' = 62 = 0$

$2N - N_A' + 13.4 = 0$

1-8  $-N_T' + 2N + 37.2 = 0$

$-N_T' + N_A' + 23.4 = 0$

4-9  $2N - N_A' + 13.8 = 0$

from above

2-6  $R_B - R_T - 2(N - N_A) - 29.2 = 0$

$R_T - R_B - 2(N - N_A) - 29.3 = 0$

$\therefore R_B = R_T$

6-9  $R_T - N_A' - 91.2 = 0$

$-N_T' + N_A' + 23.5 = 0$

$N + N_A + 14.6 = 0$

7-8  $R_T - N_T' - 67.7 = 0$

$-N_T' + 2N + 37.0 = 0$

$N =$

23.4

$N - N_A' + N_A - 62 = 0$

3-4  $R_T + R_B - 2N - 2N_A - 180 = 0$

$N = 1 \Rightarrow N_A' = N_A$

3-9  $R_T + R_B - 2N_A - N_A' - 166.2 = 0$

4-11  $-L + 2N - N_A + 32.8 = 0$

$2N - N_A + 13.4 = 0 \Rightarrow L = 19.4$

3-11  $-L + R_T + R_B - 3N_A - 147.2 = 0$

$3-9 \Rightarrow L = 166.2 - 147.2 = 19.0$

$(2-9) - (7-8) + (1-8)$

$N_A = 15.5$

$N_T = 39.2$

$(2-4) + (6-9)$

$N_A = 15.8$

$N = 1.2, 1.1, 1$

$R_T + R_B - 2(N - N_A) + 29.3 = 0$

$N_A = 15.9$

take  $N = 1, N_A = 15.7, N_T = 39.2$

$R_T = 106.7$

$R_B = 106.8$

$L = 19.3$

$$\begin{array}{ll}
 1-4 & L' - L + N_T - N_A - 36.3 = 0 & N_T - N_A - 23.5 = 0 \\
 7-6 & L' - L + N_T - N_A - 36.2 = 0 & \\
 8-9 & L' - L + 2(N_T - N_A) - 59.7 = 0 & L' - L = 12.9
 \end{array}$$

$$L' = L + 12.9 = 31.9$$

Reactivity

- ①  $145.8 + N_L (+2.5)$
- ②  $145.2 + N_L$
- ③  $145.7 + N_L$
- ④  $145.7 + N_L$
- ⑤  $5(N_A - N) = 13.9 \rightarrow 19.94$
- ⑥  $145.4 + N_L$
- ⑦  $145.6 + N_L$
- ⑧  $145.8 + N_L$
- ⑨  $145.6 + N_L$
- ⑩ worth of steel table 9.6  $\rightarrow$   $< 14.6$   $\neq$
- ⑪  $145.6 + N_L$

Assume  $N_T - N_A = N'_T - N'_A$   
What?

N.B. Without the use of ③ we can show  $R_B = R_T$

$$(2-9) + (1-7) \Rightarrow R_B - R_T + 4N - 3N_A + 42.9 = 0$$

$$2-6 \Rightarrow R_B - R_T - 2N + 2N_A - 29.2 = 0$$

$$\text{adding these} \Rightarrow 2(R_B - R_T) + 2N - N_A + 13.7 = 0$$

$$\text{but } 4-9 \text{ is } 2N - N_A + 13.8 = 0$$

$$\therefore R_B - R_T = 0$$

thus one can arrive at the same values for  $N, N_T, N_A, R_B + R_T, L, L'$

$\therefore$  expr. ③ could have been predicted.

This shows that partial, symmetric addition of reflectors contribute additively.

Remarks. *th*

- ① There may be an additional 2.5-5¢ because of actual tables.
- ② It appears feasible to place a sheet of board on a steel table that will reduce room return from floor + partially  $\frac{1}{2}$  scattered neutrons from steel.
- ③ Assumption that  $N_A = N_a$  and  $N_f = n_f$  in expro 9 and 8 are valid in view of consistency of analysis and reproducibility.
- ④ <sup>Total</sup> Room return from walls is approximately 6-8¢.

628

 $\frac{1}{2}$  Ass

628

Instrument Check on 1-29-69 Source CS-60

PM-1	Low Trip	OK	Alarm Trip	OK
PM-2			Alarm Trip	
IC-1	$> 3 \times 10^{-4}$	Meter Trip	OK	6" Pass Trip OK
IC-2	$> 3 \times 10^{-4}$	Meter Trip	OK	12" Personnel ✓
IC-3	Responds	Calibration	JK	Calanus OK
IC-4	Responds	Calibration	JK	Pres -0.04"
CRM		Meter Trip		Low Temp. 21.4°C

Expt. 74. Repeat structure of Expt. 70 (Assembly on Aluminum boxes + mock-up on top) have  $13\frac{1}{4} \times 14\frac{5}{8} \times 1$  on N face  $6 \times 8 \times 1$  on S.

Expect about 4¢ period on closure.

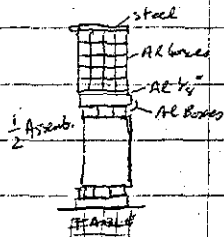
$6 \times 8 = 15.867$

$k > 1$  at closure  $2.82 \text{ dis/sec}$   $61.28 \text{ sec}$   $\rho_f = 13.903$

$k = 1$  at 1.6 revs. (0.056")

$k < 1$  at closure; remove  $6 \times 8$  plexiglas.  $31.6 \text{ dis/sec}$   $-68.67 \text{ sec}$   $\rho_f = -1.9044$

$\rho \rightarrow 99\%$



Expt. 75. Have placed a matrix of  $4 \times 5$  Alum. tubes on top of structure as in Expt. 74 +  $13.5 \times 20.75 \times 0.109$ " sheet of steel. This should add about 2-4¢ to reactivity of assembly.  $13 \times 14 / 6 \times 8$ .

$k > 1$  at closure  $1.7 \text{ dis/sec}$   $36.94 \text{ sec}$   $\rho_f = 18.505\%$

$6 \times 8 = 15.679$

$k > 1$  at closure; remove  $6 \times 8$  plexiglas.  $13.75 \text{ dis/sec}$   $298.8 \text{ sec}$   $\rho_f = 3.826\%$

Expt. 76. Open assembly 3" - Removed SS sheets from top.  $13 \times 14 / 6 \times 8$

$k > 1$  at closure  $1.72 \text{ dis/sec}$   $37.38 \text{ sec}$   $\rho_f = 18.360\%$

$k > 1$  at closure; remove  $6 \times 8$  plexiglas.  $17.5 \text{ dis/sec}$   $315.09 \text{ sec}$   $\rho_f = 3.696\%$

$6 \times 8 = 15.614$

$k = 1$  at 0.9 revs (0.022")

addition of matrix adds  $3.8 + 2.0 = 5.8\%$  reactivity.

presence of steel worth  $.16 - .18\%$



Instrument Check on 1-30-69 Source Co-60

PM-1	Low Trip	OK	Alarm Trip	OK	
PM-2			Alarm Trip		
IC-1	$> 3 \times 10^{-11}$	Water Trip	OK	Fast Trip	OK
IC-2	$> 3 \times 10^{-11}$	Water Trip	OK		Response $\checkmark$
IC-3	Response		JH		Alarm $\checkmark$
IC-4	Response		JH		Pres. = 0.03
CRM					Res Temp $^{\circ}$

Expt. 77 Have reproduced table structure above assembly of

Expt. 74. ~~to~~ L.C. 6" above assembly top. No steel on top of boxes.

$13\frac{1}{4} \times 14\frac{5}{8} \times 41$ " plate glass on N face of assembly.  
assembly together at 1.5 mm. (0.067")

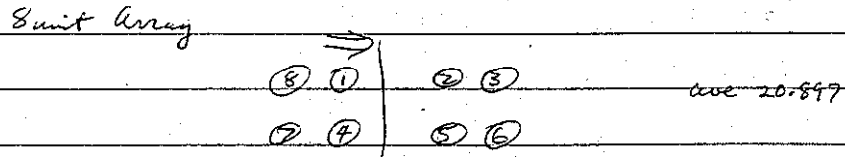
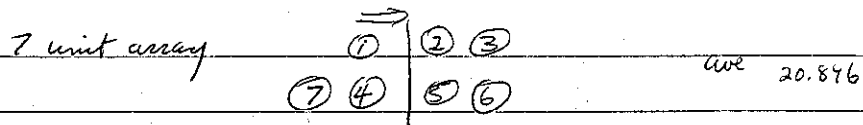
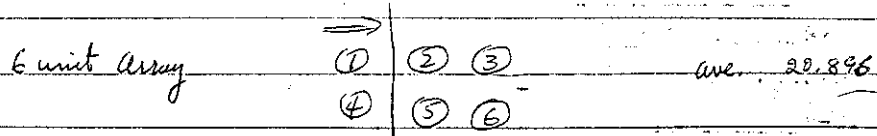
$R > 1$  at closure 3.02  $\mu$ /sec 65.62 sec.  $P_f = 13.241$

$k = 1$  at 1.5 mm (0.067")

Series continued on p. 129. JH

Subassemblies

	①	②	③	④	⑤	⑥	⑦	⑧
	2152	2158	2196	2173	2193	2181	2190	2197
	2166	2177	2153	2155	2185	2205	2200	2202
Max Rpt.	20.891	20.893	20.889	20.890	20.900	20.908	20.904	20.900



EXPERIMENT I-64

6 units 20.896  $\rho$  g U(93.2) per unit STS = 0 Unreflected

Instrument Check on 11-21-63 Source 10 mci

PM-1	Low Trip	OK	Alarm Trip	OK	
PM-2			Alarm Trip	OK	
IC-1	$> 3 \times 10^{-11}$	Meter Trip	OK	Fast Trip	OK
IC-2	$> 3 \times 10^{-11}$	Meter Trip	OK		Clock 2493
IC-3	Responds	Calibration	TU		M-230
IC-4		Calibration			check test ✓
CRM		Meter Trip			

$R < 1$  more than 1. - contact at (2.30 Revs)

Add seventh unit

$R < 1$  by  $\approx 1$  - contact at (2.30 Revs)

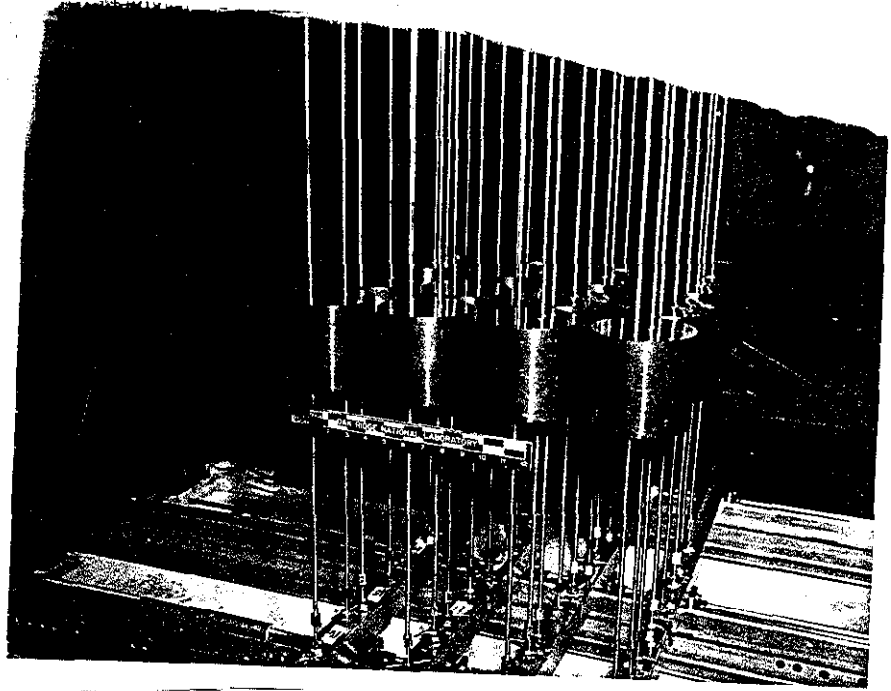
Add eighth unit

$R > 1$	positive period	64.5 sec ( $\rho = 13.41 \%$ )	(.358)	.473 - .105	(7.80 Revs)	4.47 $\rho$ /in
$R > 1$	" "	30.56 sec ( $\rho = 21.92 \%$ )	(.372)	.472 - .105	(7.60 Revs)	4.77 $\rho$ /in
$R = 1$		0.523 - .105 = .418 in			(8.19 Revs)	

$V_c = 1.70844$   $\rho_a = 12.232$   $F = .6202$

STS that would give same average density as 0.012 in.

- Subassemblies
- |                |                |                |                |                |                |                |                |
|----------------|----------------|----------------|----------------|----------------|----------------|----------------|----------------|
| ① 2152<br>2166 | ② 2158<br>2177 | ③ 2196<br>2153 | ④ 2173<br>2155 | ⑤ 2193<br>2185 | ⑥ 2181<br>2205 | ⑦ 2190<br>2200 | ⑧ 2197<br>2202 |
| ⑨ 2154<br>2167 | ⑩ 2184<br>2195 | ⑪ 2168<br>2198 | ⑫ 2170<br>2182 | ⑬ 2189<br>2157 | ⑭ 2169<br>2204 | ⑮ 2179<br>2192 | ⑯ 2164<br>2176 |



Summary:

16 units

20.891 Kg (4622) per unit

Unreflected

STS =  $0.599 \pm 0.005$  in

1.510 cm

F = 0.53419

$\eta = 0.01676$  R.  $\Rightarrow P_A = 12.057$  g/kc

## EXPERIMENT I-65

16 units 20,896

K<sub>g</sub> U(93.2)/unit

STS = 0.900 in.

Instrument Check on 11-22-63 Source 10 mcf

PM-1	Low Trip	OK	Alarm Trip	OK	
PM-2			Alarm Trip	OK	
IC-1	$> 3 \times 10^{-11}$	Meter Trip	OK	Fast Trip	OK
IC-2	$> 3 \times 10^{-11}$	Meter Trip	OK		Clock 2494
IC-3	Responds	Calibration	JIT		M-230
IC-4		Calibration			check list ✓
CRM		Meter Trip			

K < 1  $> \frac{1}{2}$ Instrument Check on 11-26-63 Source 10 mcf

PM-1	Low Trip	OK	Alarm Trip	OK	
PM-2			Alarm Trip	OK	
IC-1	$> 3 \times 10^{-11}$	Meter Trip	OK	Fast Trip	OK
IC-2	$> 3 \times 10^{-11}$	Meter Trip	OK		Clock
IC-3	Responds	Calibration	JN		M-230
IC-4		Calibration			check list ✓
CRM		Meter Trip			

Set EW planes to 0.700" NS planes remain at 0.900 in.

K < 1  $> \frac{1}{2}$ 

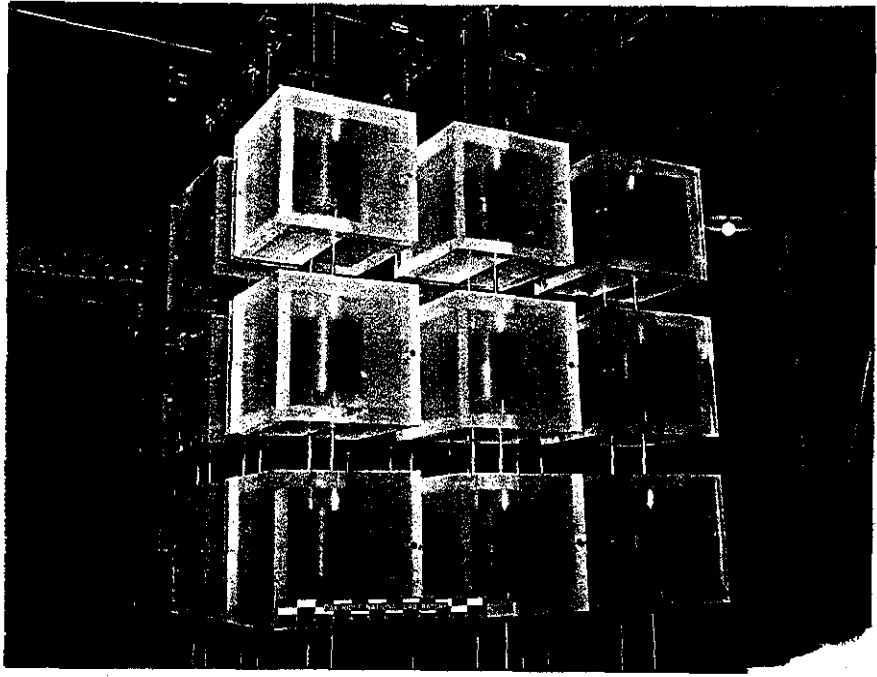
Spacing set to 0.700

K < 1  $> \frac{1}{2}$ 

STS = 0.600 in.

K ≈ 1 negative period 238.2 (p = -6.454) (0.00 revs)

I-66



## EXPERIMENT I-66

27 units 20.877 kg/unit in 15/16" Plexiglas boxes

STS =  $6 \frac{23}{32}$ Instrument Check on 1-3-64 Source 10 mCi

PM-1	Low Trip	OK	Alarm Trip	OK	
PM-2			Alarm Trip	OK	
IC-1	$> 2 \times 10^{-11}$	Meter Trip	OK	Fast Trip	OK
IC-2	$> 3 \times 10^{-11}$	Meter Trip	OK		Check 2504
IC-3	Responds	Calibration	JT		Serial H-230
IC-4		Calibration			check list ✓
CRM		Meter Trip			

R &lt; 1 → M = 10

(0.00 Revs)

Instrument Check on Jan. 6, 1964 Source 10 mCi

PM-1	Low Trip	OK	Alarm Trip	OK	
PM-2			Alarm Trip	OK	
IC-1	$> 3 \times 10^{-11}$	Meter Trip	OK	Fast Trip	OK
IC-2	$> 3 \times 10^{-11}$	Meter Trip	OK		Check 2504
IC-3	Responds	Calibration	JT		H-230
IC-4		Calibration			check list ✓
CRM		Meter Trip			

Reset spacing to  $6 \frac{15}{32}$ 

R &lt; 1 → M = 10

(0.00 Revs)

Summary

27 units

20.877 Kg U(93.2) per unit

Units centered in  $1\frac{5}{16}$ -in - thick Plexiglas

Cores having O.D. of 22.1 x 22.1 x 21.4 cm.

STS =  $6.413 \pm 0.065$  in.

16.289 cm

$$k_2 = 20.86782$$

$$F = 0.05332$$

$$P_2 = 1.00043$$

wall  
5/15/4



EXPERIMENT I-66

Reset Spacing to  $6\frac{1}{16} = 0.438"$

Instrument Check on 1-7-64 Source 10mc

PM-1	Low Trip	OK	Alarm Trip	OK	
PM-2			Alarm Trip	OK	
IC-1	$> 3 \times 10^{-4}$	Meter Trip	OK	Fast Trip	OK
IC-2	$> 3 \times 10^{-4}$	Meter Trip	OK	Clack	2505
IC-3	Respects	Calibration	JH		M-230
IC-4		Calibration			checklist ✓
CRM		Meter Trip			

$R < 1$  negative period 140.7 sec (-13.25 f) (0.00 Revs)

Have placed a sheet of Plexiglas  $27 \times 30 \times \frac{1}{8}$ " on face of plexiglas boxes between fixed and moveable table.

+ 557 f

$R < 1$  negative period 207.0 sec (-7.68 f) (0.00 Revs)

Moved sheet of plexiglas to south face of assembly.

+ 41.25 f

$R > 1$  positive period 96.8 sec (-9.90 f) <sup>1.52 f/in</sup> (0.122") (2.50 Revs)

$R = 1$   $R_{ex} = .28 f$  (0.187") (3.80 Revs)

$R < 1$  negative period 273.2 sec (-5.45 f) <sup>1.050 1.09 f/in</sup> (0.237") (4.60 Revs)

Sheet still on south face. Have replaced center box by one having wall thickness of 1.00 in.

$R > 1$  positive period 213.9 (5.14 f) <sup>1.81 f/in</sup> (0.122") (2.50 Revs)

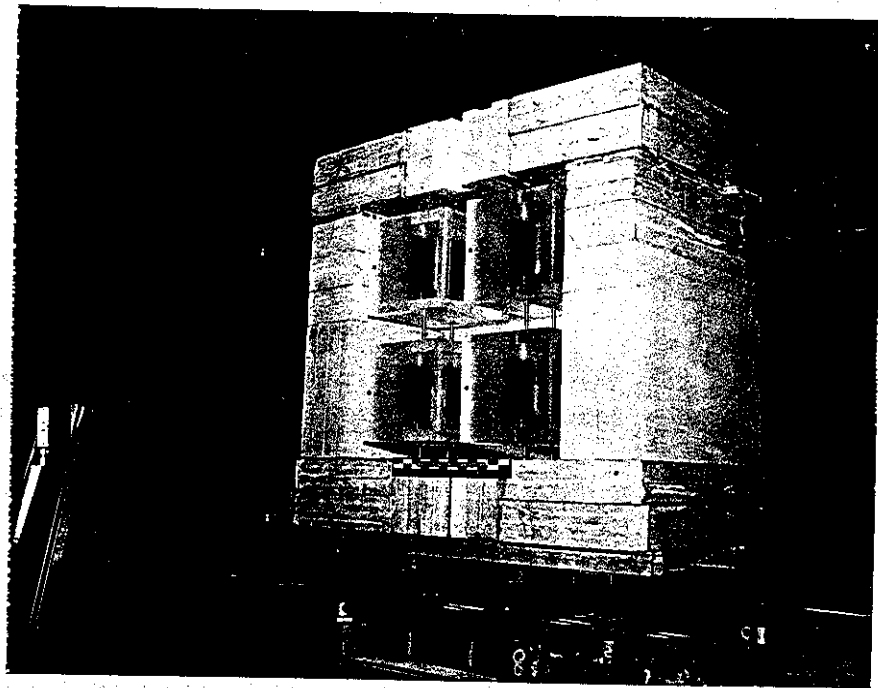
$R = 1$   $R_{ex} = .25 f$  <sup>1.83</sup> (0.154") (3.28 Revs)

$R < 1$  negative period 164.9 sec (-10.43 f) <sup>1.083 1.126 f/in</sup> (0.237") (4.60 Revs)

wall 5.15 f

Removed Plexiglas sheet - center box still 1" thick.

$R < 1$  negative period 117.2 sec (-14.4 f) (0.00 Revs)



Slope of two experiments  $\Rightarrow$  <sup>add</sup> ~~subtract~~ 2.8 mils/cent

### Summary

8 units

20.960 kg U(93.2) per unit

Units in  $1\frac{1}{16}$ "-thick Plexiglas boxes

Array reflected by 6-in.-thick paraffin

STS =  $6.475 \pm 0.010$  in

16.447 cm.

$$V_c = 21.2626 \Rightarrow \rho_c = 0.986 \text{ g/cm}^3 \Rightarrow F = 0.05255$$

EXPERIMENT I-67

8 units 20.960 kg U(93.2)/unit - 1 9/16" thick Plexiglas boxes, 6" thick paraffin Refl.  
 STS = 6 3/64

Instrument Check on 1-8-64 Source 10mc8

PM-1	Low Trip	OK	Alarm Trip	OK	
PM-2			Alarm Trip	OK	
IC-1	$> 3 \times 10^{-4}$	Meter Trip	OK	Fast Trip	OK
IC-2	$> 3 \times 10^{-4}$	Meter Trip	OK	Clock	2507
IC-3	Responds	Calibration	JII	M-230	
IC-4		Calibration		check list	✓
CRM		Meter Trip			

$k > 1$	positive period	59.2 sec ( $P = 14.25 \phi$ )	<sup>1.74 \$/in</sup> 1.238 in (16.00 Revs)
$k = 1$			<sup>1.582</sup> 1.320 in (16.71 Revs)
$k < 1$	negative period	112.8 sec ( $P = -19.9 \phi$ )	<sup>1.078 2.55 \$/in</sup> 1.398 in (17.40 Revs)

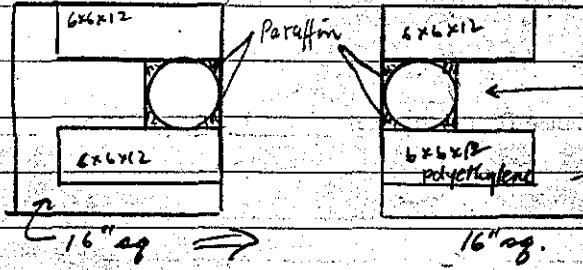
Instrument Check on 1-9-64 Source 10mc8

PM-1	Low Trip	OK	Alarm Trip	OK	
PM-2			Alarm Trip	OK	
IC-1	$> 3 \times 10^{-4}$	Meter Trip	OK	Fast Trip	OK
IC-2	$> 3 \times 10^{-4}$	Meter Trip	OK	Clock	
IC-3	Responds	Calibration	JII	M-230	
IC-4		Calibration		check list	✓
CRM		Meter Trip			

Reset spacing to 6 3/16.

$k > 1$	positive period	68.1 sec (12.894)	<sup>1.87 \$/in</sup> 0.00 in (0.00 Revs)
$k = 1$			0.138 in (2.99 Revs)
$k < 1$	negative period	73.9 sec ( $> 30 \phi$ )	0.420 in (5.90 Revs)

A:



20.960 kg unit

Units in Plexiglas containers P.

no refl. on top or back

6" in thick polyethylene base

Handwritten notes and markings on the lined paper, including some faint numbers and lines, possibly representing a scale or additional measurements.

EXPERIMENT I-68

2 units 20.960 kg U(93.2) / unit in 1/4-in-thick-close-fitting Plexiglas boxes. 6-in-thick ~~wood~~ Polyethylene reflector.

Instrument Check on 1-13-64 Source 10 mcd

PM-1	Low Trip	OK	Alarm Trip	OK	
PM-2			Alarm Trip	OK	
IC-1	$> 3 \times 10^{-4}$	Meter Trip	OK	Fast Trip	OK
IC-2	$> 3 \times 10^{-4}$	Meter Trip	OK		clock 2508
IC-3	Responds	Calibration	JU		M-230
IC-4		Calibration			checklist ✓
CRM		Meter Trip			

A: No top or back reflectors 5.48  $\frac{R}{in}$

k > 1	positive period	79.6 sec	$\rho = 11.504$	0.372	(5.95 Revs)	
k = 1				0.363	(6.20 Revs)	5.81
k < 1	negative period	166.2 sec	$\rho = -10.34$	0.379	(6.40 Revs)	

B: Rotated units 90° - no top or back reflectors 5.95  $\frac{R}{in}$

diff is 824  
units  
rotation

k > 1	positive period	60.5 sec	$\rho = 14.284$	0.477	(7.60 Revs)	
k = 1				0.501	(7.90 Revs)	7.61
k < 1	negative period	131.2 sec	$\rho = -14.854$	0.515	(8.10 Revs)	

C: Full 6-in-thick Polyethylene reflector 1" air gap 5" sq. between flat surfaces of units - units in Plexiglas boxes. 2.74  $\frac{R}{in}$

k > 1	positive period	62.4 sec	13.74	1.91	(21.70 Revs)	
k = 1				1.96	(22.10 Revs)	309
k < 1	negative period	119.1 sec	-17.84	2.012	(22.50 Revs)	

D: Filled 1-in-air gap with Plexiglas 1.48  $\frac{R}{in}$

k > 1	positive period	70.0 sec	12.64	2.14	(23.60 Revs)	1.90
k = 1				2.225	(24.06 Revs)	
k < 1		142 sec	-13.04	2.275	(24.40 Revs)	

## Experiment I-68 cont'd

Instrument Check on 1-14-64 Source 10 mci

PM-1	Low Trip	OK	Alarm Trip	OK	
PM-2			Alarm Trip	OK	
IC-1	$> 3 \times 10^{-11}$	Meter Trip	OK	Fast Trip	OK
IC-2	$> 3 \times 10^{-11}$	Meter Trip	OK	Clock	2510
IC-3	Reps	Calibration	JN		M-230
IC-4	Reps	Calibration	JN		
CRM		Meter Trip			Checklist ✓

E (Same as exp D) <sup>arrangement</sup> <sub>except</sub> Space between Plexiglas boxes filled with

$1\frac{1}{2}$ -in of Plexiglas

$k > 1$	positive period	61.1 sec ( $p = 13.934$ )	1.985 <sup>1.86</sup>	(21.90 Revs)	
$k = 1$			2.01 <sup>.075</sup>	(22.45 Revs)	2.04
$k < 1$	negative period	163.2 sec ( $p = -10.534$ )	2.055 <sup>.045</sup>	(22.80 Revs)	2.34

F Removed  $1\frac{1}{2}$ -in of Plexiglas from between boxes

$k > 1$	positive period	61.8 sec ( $p = 13.824$ )	1.69 <sup>2.30</sup>	(20.00 Revs)	
$k = 1$			1.75 <sup>.96</sup>	(20.45 Revs)	2.91
$k < 1$	negative period	177 sec ( $p = -9.454$ )	1.77 <sup>.02</sup>	(20.70 Revs)	4.73

G Placed 2" of Plexiglas between unit boxes

$k > 1$	positive period	76.7 sec ( $p = 11.814$ )	1.69 <sup>1.79</sup>	(20.00 Revs)	
$k = 1$			1.756 <sup>.066</sup>	(20.55 Revs)	1.73
$k < 1$	negative period	159.2 sec ( $p = -5.814$ )	1.790 <sup>.036</sup>	(20.80 Revs)	1.61

H: Removed 2" of Plexiglas

$k > 1$	positive period	48.4 sec ( $p = 16.364$ )	1.480 <sup>3.27</sup>	(18.00 Revs)	
$k = 1$			1.530 <sup>.050</sup>	(18.60 Revs)	2.78
$k < 1$	negative period	114.3 ( $p = -10.89$ )	1.570 <sup>.040</sup>	(18.90 Revs)	2.67

I-68

I. Have placed 3-in of Plexiglas between boxes

$R > 1$	positive period	73.2 sec ( $p = 12.234$ )	.750	<sup>1.57 <math>\frac{1}{in}</math></sup>	(11.00 Revs)
$R = 1$			.078		(11.89 Revs) 1.44
$R < 1$	negative period	256 sec ( $p = -5.904$ )	.928		(12.20 Revs)
			.032	<sup>1.84</sup>	
			.960		

J. Removed 3 in of Plexiglas

$R > 1$	positive period	56.2 sec ( $p = 14.704$ )	.881	<sup>1.83 <math>\frac{1}{in}</math></sup>	(12.5 Revs)
$R = 1$			.109		(13.20 Revs) 2.23
$R < 1$	negative period	192.3 sec ( $p = -8.464$ )	.960		(13.50 Revs)
			.025	<sup>3.38</sup>	
			.985		

K. Placed 4" of Plexiglas between boxes.

$R < 1$   $M = 2-4$

L. Placed 3 1/2" of Plexiglas between boxes

$R > 1$	positive period	28.3 sec ( $p = 11.634$ )	.787	<sup>1.44 <math>\frac{1}{in}</math></sup>	(6.50 Revs)
$R = 1$			.081		(7.49 Revs) 1.51
$R < 1$	negative period	440.6 sec ( $p = -3.174$ )	.468		(7.70 Revs)
			.017	<sup>1.86</sup>	
			.485		

M. Removed 3 1/2" of Plexiglas

$R > 1$	positive period	48.4 sec ( $p = 16.364$ )	.721	<sup>2.48 <math>\frac{1}{in}</math></sup>	(10.60 Revs)
$R = 1$			.064		(11.45 Revs) 2.35
$R < 1$	negative period	207.6 sec ( $p = -7.654$ )	.787		(11.80 Revs)
			.036	<sup>2.13</sup>	
			.823		

## "2-Flooded Units"

## Summary

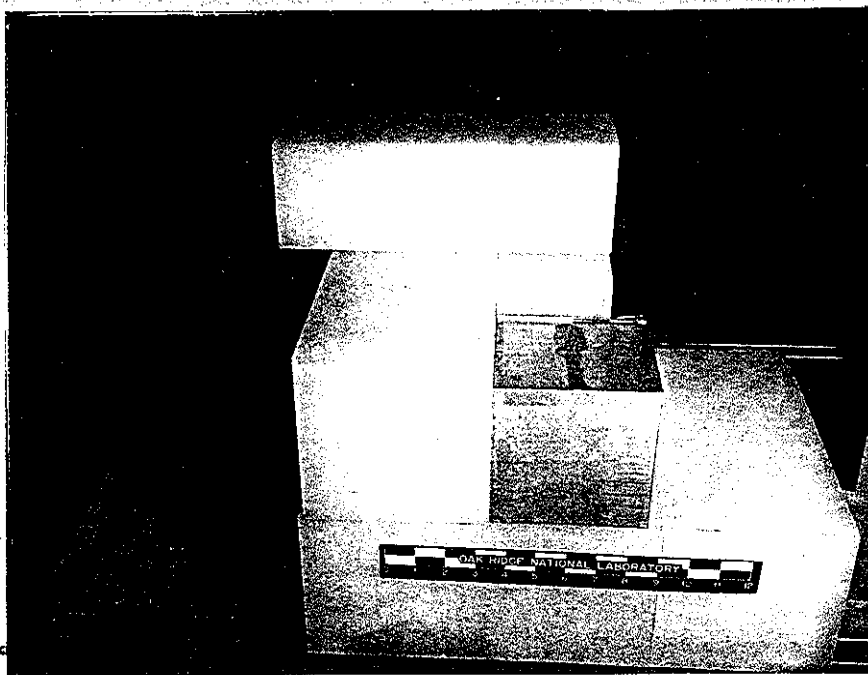
1. 2 units in P' containers - <sup>corner</sup>voids filled with paraffin.  
20,960 kg U(93.2) per unit

At least 6-in-thick Polyethylene reflector

$k=1$  when flat surfaces of <sup>4.3</sup>~~4.3~~ in - Plexiglas (STS of unit)

2.  $k=1$  when flat surfaces are faced by  $\frac{1}{4}$ -in-thick Plexiglas and separated by  $3\frac{1}{16}$ -in. (STS of unit)  
Tunnel area is  $5 \times 5$  in<sup>2</sup>

3.  $k \ll 1$ ;  $M \sim 1\frac{1}{2}$  when P' containers wrapped with 25 mil cadmium. Containers in contact, assembly in Polyethylene.





Size			WT Kg		Size		WT Kg
12 <sup>9</sup> / <sub>16</sub> X 25 <sup>3</sup> / <sub>16</sub> X 1"	1		9.4		8 <sup>3</sup> / <sub>16</sub> X 10 <sup>5</sup> / <sub>16</sub> X 2	1	5.05
	2		9.36			2	4.85
	3		9.35			3	5.04
	4		9.35			4	4.95
10 <sup>9</sup> / <sub>16</sub> X 21 <sup>3</sup> / <sub>16</sub> X 1"	1		6.54				
	2		6.34		8 <sup>3</sup> / <sub>16</sub> X 10 <sup>5</sup> / <sub>16</sub> X 2	1	2.45
10 <sup>9</sup> / <sub>16</sub> X 21 <sup>3</sup> / <sub>16</sub> X 1/2"	1		3.25			2	2.55
	2		3.29			3	2.50
	3		3.20			4	2.56
	4		3.20			5	2.45
8 <sup>3</sup> / <sub>16</sub> X 25 <sup>3</sup> / <sub>16</sub> X 1	1		6.03			6	2.51
	2		6.13			7	2.55
	3		5.97			8	2.50
	4		6.00				
	5		5.94				
	6		5.97				
	7		6.02				
	8		6.01				
10 <sup>3</sup> / <sub>16</sub> X 25 <sup>3</sup> / <sub>16</sub> X 2"	1		14.75				
	2		14.80				
	3		14.68				
	4		15.12				
12 <sup>9</sup> / <sub>16</sub> X 25 <sup>3</sup> / <sub>16</sub> X 2	1		18.65				
	2		18.66				
14 <sup>9</sup> / <sub>16</sub> X 20 <sup>9</sup> / <sub>16</sub> X 2	1		17.50				
	2		17.10				
	3		17.42				
	4		17.40				
14 <sup>9</sup> / <sub>16</sub> X 29 <sup>3</sup> / <sub>16</sub> X 2	1		24.55				
	2		24.62				
	3		24.65				
	4		24.60				

-1  
 -7  
 -4  
 +2  
 -4  
 -8  
 -16  
 -12  
 -13  
 -10  
 +5  
 -7  
 46  
 149  
 22/46  
 140  
 126  
 220

11.532  
 11.48  
 .0516 cm.

	wt. kg e	unit (kg u 493.2)	X	Y	Z
14.600 147 145 598 53	111	45.60	15.690		
-2	112	45.36	15.694		
0					
-5	121	45.49	15.696		
(-1)					
0	122	45.04	15.699		
-1					
0	+3 -12	211	45.37	15.691	
-3					
-1	(-14 16)	212	45.42	15.692	<div style="border: 1px solid black; padding: 5px; width: fit-content;">           15.69425            ± .002861         </div>
0		221			
-3		221	45.42	15.696	
0		222	45.22	15.696	

$(45.365 \pm .15953)$

12.6  
 8.02  
 4.5

Position in Array	Mean kg C	Dimensions			Centered Cylindrical Cavity	
		X	Y	Z	Diam.	Height
111		12.600	12.600	10.200	4.0237	3.234
112		12.600			± .0016	± .003
121						
122						
211						
222						
221						
222						

.99906  
 996  
 .00306  
 .00306  
 structure known return

43.74

Graphite blocks.

ht = 3.234 ± .003

Block	Mass kg	X = Y	Z	dia	ht
①	72.7485 ± .23677	14.5885 32.080	12.2014 ± .01625 30.992 .041	4.5489 5.0067	11.554 ± .017
②	45.365 ± .1585	12.1600 ± .002 32.004 ± .005	10.188 ± .002 25.803 ± .004	4.5526 ± .0016	11.5636 ± .004
③	28.79395 ± .078092	10.58812 ± .003452 26.919 ± .009	8.211875 I .00724 20.858 ± .008	4.54926 I .00345	11.554 I .009

Ave dia 4.55016" ± .005

11.557 cm ± .002

Ave wt of units 15.69425 ± .002861 (kg UG3-2)

isotopic composition

wt = 8.077

C = 18.26 g/cc

dia = 11.484 cm

5.742  
2  
11.484

235U	93.2 w%
234	1.0
236	0.2
238	5.6

## Experiment I-68 cont'd.

Instrument Check on 1-15-64 Source 10 mcd

PM-1	Low Trip	OK	Alarm Trip	OK	
PM-2			Alarm Trip	OK	
IC-1	$> 3 \times 10^{-4}$	Meter Trip	OK	Fast Trip	OK
IC-2	$> 3 \times 10^{-4}$	Meter Trip	OK		Clock 2514
IC-3	Responds	Calibration	OK		11-230
IC-4	Responds	Calibration	OK		check list ✓
CRM		Meter Trip			

- N Plexiglas thickness between unit boxes is  $3 \frac{3}{4}$ "
- |         |                                  |                            |                              |
|---------|----------------------------------|----------------------------|------------------------------|
| $k > 1$ | positive period                  | 82.8 sec. ( $P = 11.164$ ) | (0.00 Revs)                  |
| $k = 1$ | table sep. greater than assembly | .138                       | (3.05 Revs) $9 \frac{1}{16}$ |
| $k < 1$ | negative period                  | 461 sec. ( $P = -3.024$ )  | .156 (3.30 Revs)             |
- O. Plexiglas thickness between units is  $3 \frac{13}{16}$ "
- |            |                 |                             |                                   |
|------------|-----------------|-----------------------------|-----------------------------------|
| $k \leq 1$ | negative period | 439.4 sec. ( $P = -3.184$ ) | .156 (0.00 Revs) $9 \frac{1}{16}$ |
|------------|-----------------|-----------------------------|-----------------------------------|
- P. Air gap between unit boxes is  $4 \frac{1}{16}$ " across  $5 \times 5$  in. (at closure)
- |         |                 |                              |             |
|---------|-----------------|------------------------------|-------------|
| $k > 1$ | positive period | 66.9 sec. ( $P = 13.064$ )   | (6.80 Revs) |
| $k = 1$ |                 |                              | (7.70 Revs) |
| $k < 1$ | negative period | 157.3 sec. ( $P = -11.184$ ) | (8.30 Revs) |
- Q. Air gap between unit boxes is  $4 \frac{9}{16}$ "
- |         |  |  |             |
|---------|--|--|-------------|
| $k = 1$ |  |  | (0.00 Revs) |
|---------|--|--|-------------|
- R. Wrapped Plexiglas boxes with .25 mil Cd. No space between boxes at closure
- |           |                     |  |             |
|-----------|---------------------|--|-------------|
| $k \ll 1$ | $M = 1 \frac{1}{2}$ |  | (0.00 Revs) |
|-----------|---------------------|--|-------------|

5' containers: 5" schedule 40 iron pipe  $\frac{1}{4}$ " wall  $5\frac{5}{8}$ " OD  $5\frac{3}{16}$ " high.

## EXPERIMENT I-68

Instrument Check on 1-16-64 Source 10mc

PM-1	Low Trip	OK	Alarm Trip	OK	
PM-2			Alarm Trip	OK	
IC-1	$>3 \times 10^{-11}$	Meter Trip	OK	Fast Trip	OK
IC-2	$>3 \times 10^{-11}$	Meter Trip	OK		Clock 2516
IC-3	Responds	Calibration	JH		M-230
IC-4	Responds	Calibration	JH		check list ✓
CRM		Meter Trip			

S 1" thick Foamglas surrounding unit boxes

 $R \ll 1$      $M \leq 1$ 

(0.00 Revs)

Instrument Check on 1-17-64 Source 10mc

PM-1	Low Trip	OK	Alarm Trip	OK	
PM-2			Alarm Trip	OK	
IC-1	$>3 \times 10^{-11}$	Meter Trip	OK	Fast Trip	OK
IC-2	$>3 \times 10^{-11}$	Meter Trip	OK		Clock 2517
IC-3	Responds	Calibration	JH		M-230
IC-4	Responds	Calibration	JH		check list ✓
CRM		Meter Trip			

T 1/2" thick Foamglas surrounding unit boxes

 $R \ll 1$      $M \leq 1$ 

(0.00 Revs)

A. Placed units in S' containers (axes colinear) when containers are in contact unit surfaces are 7/8" apart.

(C<sup>2</sup> → S')<sub>2</sub> in Polyethylene reflector with 2-in-Plaxglas between surfaces of S' containers $R \ll 1$      $M \leq 1$ 

(0.00 Revs)

## EXPERIMENT I-68 cont'd

- B 1-in-thickness of Plexiglas between S' containers  
 $k \ll 1$   $M \sim 1$  (0.00 Revs)
- C  $\frac{1}{2}$ -in-thickness of Plexiglas between S' containers  
 $R \ll 1$   $M \sim 3$  - contact (0.30 Revs)
- D  $\frac{3}{8}$ -in-thickness of Plexiglas between S' containers  
 $R \ll 1$   $M \sim 5$  - contact (0.90 Revs)

Instrument Check on 1-20-64 Source 10 in

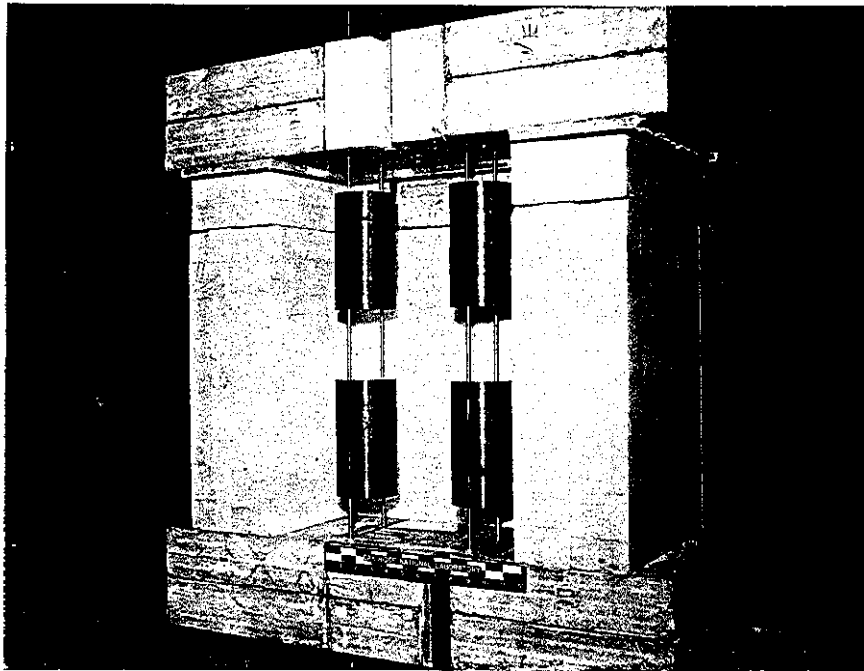
PM-1	Low Trip	OK	Alarm Trip	OK	
EM-2			Alarm Trip	OK	
IC-1	$> 3 \times 10^{-11}$	Meter Trip	OK	Fast Trip	OK
IC-2	$> 3 \times 10^{-11}$	Meter Trip	OK		Glock-2519
IC-3	out	Calibration			
IC-4	Responds	Calibration	OK		
CRM		Meter Trip			

- E No material between S' containers  $\rightarrow$  Containers in contact when tables closed.  
 $k > 1$  positive period 40.7 sec ( $p = 18.34\%$ ) 0.134" (2.80 Revs)  
 $k = 1$  0.174" (3.60 Revs) 4.94 ft/min  
 $k < 1$  negative period 131.8 sec ( $p = -14.8\%$ ) 0.201" (4.00 Revs)  
 864 ex. revs
- F Insert:  $\frac{1}{4}$ -in-thick Plexiglas between S' containers.  
 $R > 1$  pos. period 156.1 sec ( $p = 6.9\%$ ) 0 (0.00 Revs)  
 $R = 1$  0.128" (2.70 Revs) 9.1 ft/min  
 $R < 1$  neg. period 247.1 sec ( $p = -6.16\%$ ) 0.144" (3.10 Revs)  
 124 ex. revs  
 Removed  $\frac{1}{4}$ -in-thick plexiglas  
 $R < 1$   $M \sim 2-3$  0.00 Revs.

units for I-69

①	②	③	④
2306	2317	2326	2574
2312	2384	2300	2431
2323	2571	2289	2280
2572	2277	2314	2278
2302	2383	2315	2432
2316	2308	2313	2304
2303	2283	2328	2434
2275	2281	2322	2276

ave. 210078 kg/unit





## EXPERIMENT I-69

8 unit 21.008 kg U(93.2)/unit - 6-in-thick Paraffin reflector STS =  $4\frac{1}{16}$ "

Instrument Check on 1-30-64 Source 10mc

PM-1	Low Trip	OK	Alarm Trip	OK	
PM-2			Alarm Trip	OK	
IC-1	$>3 \times 10^{-4}$	Meter Trip	OK	Fast Trip	OK
IC-2	$>3 \times 10^{-4}$	Meter Trip	OK		Clock 2522
IC-3	Responds	Calibration	JIT		M-230
IC-4	Responds	Calibration	no pen		
CRM		Meter Trip			check list <input checked="" type="checkbox"/>

R ≥ L positive period 204.4 sec (P = 5344) (0.00 Revs)

R = L 0.083 in (2.05 Revs)

## Summary

8 units

21.008 kg U(93.2)/unit

6-in-thick paraffin reflector

STS =  $7.066 \pm 0.010$  in

10.328 in

$V_c = 10.4385$  l.

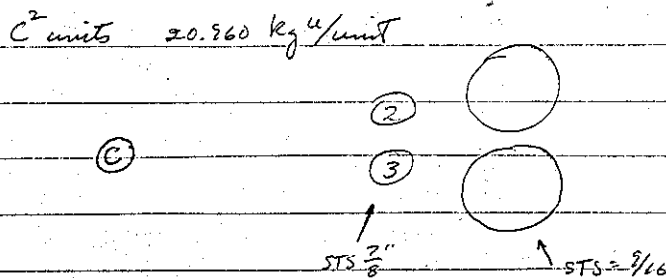
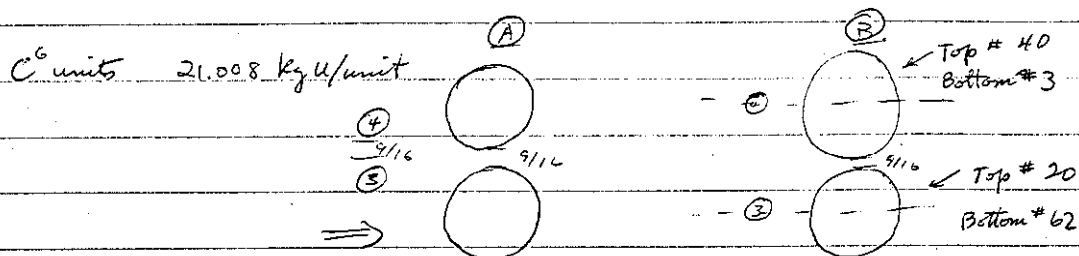
$r = 1.42$

$P_c = 2.0125$  g/cc

$F = 0.70727$

Four Solution Containers:  $UO_2(NO_3)_2$  sp. gr. = 1.553

Container #	Tare	Gross	Net (kg)	kg U
62	1.293	9.058	7.765	2.0663
3	1.290	9.052	7.762	2.0655
40	1.278	9.043	7.765	2.0663
20	1.268	9.033	7.765	2.0663



## Experiment I-70

4 units,  $C^6$ , 2(1.008 kg  $U_3O_8$ )/unit } unreflected STS:  $\frac{9}{16}$  cell Bldg.  
 4 units 5 liter  $UO_2(NO_3)_2$   
 Instrument Check on 2-4-64 Source 10 mcd

PM-1	Low Trip	OK	Alarm Trip	OK	
PM-2			Alarm Trip	OK	
IC-1	$> 3 \times 10^{-11}$	Meter Trip	OK	Fast Trip	OK
IC-2	$> 3 \times 10^{-11}$	Meter Trip	OK		clock 2522
IC-3	Responds	Calibration	JIT		M-230
IC-4	Responds	Calibration			check list ✓
CRM		Meter Trip			

A: matched half arrays

$R \ll 1$   $M \sim 20$  at closure (0.00 Revs)  
 $\rightarrow \frac{1}{2}$

B:  $C^2$  units on centerline of 5 liter units

$R \ll 1$   $M \sim 2$  at closure (0.00 Revs)

4  $C^2$  units 4 ( $UO_2(NO_3)_2$ ) units

Instrument Check on 2-5-64 Source 10 mcd

PM-1	Low Trip	OK	Alarm Trip	OK	
PM-2			Alarm Trip	OK	
IC-1	$> 3 \times 10^{-11}$	Meter Trip	OK	Fast Trip	OK
IC-2	$> 3 \times 10^{-11}$	Meter Trip	OK		clock 2522
IC-3	Responds	Calibration	JIT		M-230
IC-4	Responds	Calibration	JIT		check list
CRM		Meter Trip			

C:  $R \ll 1$ ,  $\frac{1}{2}$   $M \sim 20$  at closure (0.00 Revs)

D: Set STS on  $C^2$  units to  $\frac{3}{4}$

$R < 1$   $\frac{1}{2}$   $M \sim 90$  at closure (0.00 Revs)

Sample sent to X-10

results (Control No. S.F. A 234)

$$266.10 \frac{\text{mg U}}{\text{g}}$$

1.5502 sp. gr. at 25°C

$$\text{UO}_2(\text{NO}_3)_2 \quad 4\text{O}_2 + 2\text{N} + 235 = 391$$

$$\text{salt factor} \cdot \frac{391}{235.2} = 1.6633$$

$$\frac{\text{g H}_2\text{O}}{\text{g}} = 1 - \frac{\text{gm salt}}{\text{gm}} = 1 - 1.6633 \times .26610 = .5574$$

$$\frac{\text{H}}{\text{U}235} = \frac{2(.5574)}{18} \cdot \frac{.26610 \times .932}{235} = 58.686$$

Experiment I-70

Set STS on C<sup>2</sup> units to  $\frac{1}{16}$ "

k ≤ 1 negative period 90 sec r304 (0.00 Rev)

Instrument Check on 2-6-67 Source 10 mcf

PM-1	Low Trip	OK	Alarm Trip	OK
PM-2			Alarm Trip	OK
IC-1	$> 3 \times 10^{-11}$	Meter Trip	OK	Fast Trip OK
IC-2	$> 3 \times 10^{-11}$	Meter Trip	OK	Clock 2824
IC-3	Responde	Calibration	JH	M-230
IC-4	Responde	Calibration	JH	Check list ✓
CRM		Meter Trip		

STS on C<sup>2</sup> units  $\frac{5}{8}$ "

R > 1 positive period 51.6 sec (P=15.67f) 0.115 (2.49 Rev) <sup>3.73 1/min</sup>  
 k=1 .042 0.157 (3.18 Rev) 4.27 1/min  
 R < 1 negative period 142.6 sec (P=-12.96f) 0.182 (3.61 Rev) <sup>.025 5.14 1/min</sup>

k=1 STS for C<sup>2</sup> =  $0.665 \pm 5 \times 10^{-3}$  in.  
 1.689 cm

V = 2.16834  
 P<sub>12</sub> = 9.666 8 1/cc  
 P = 0.51524  
 r = 0.943

Summary - mixed system

$\frac{1}{2} C_8^2 \{ 0; 1.689; 9.666; 0.94 \} (k \gg 1)$

$\frac{1}{2} [UO_2(NO_3)_2]_8 \{ 0; 1.43; 0.214; 0.94 \} (k=1)$

yielded array with k=1

Instrument Check on 1-31-69 Source Co-60

PM-1	Low Trip	OK	Alarm Trip	OK
PM-2			<del>Alarm Trip</del>	
IC-1	$> 3 \times 10^{-4}$	Meter Trip	OK	Past Trip OK
IC-2	$> 3 \times 10^{-4}$	Meter Trip	OK	Personnel <input checked="" type="checkbox"/>
IC-3	Responds	Calibration	SA	Alarms <input checked="" type="checkbox"/>
IC-4	Responds	Calibration	SA	Pres 0.03"
TRM		Meter Trip		Run Temp. 21.8

12 1/2 x 14 5/8 x 1" Plexiglas on N-Source.

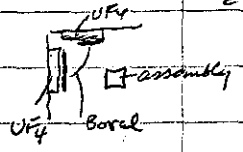
Expt. 78 Repeat Expt. 77 as reference for today's measurements.

$k > 1$  at closure.  $3.22 \text{ dis/sec}$   $69.97 \text{ sec}$   $C_F = 12.649$   
 $k = 1$  1.8 (revs)  $C_F$  Expt. 77 where  $C_F = 13.241$   
 Plexiglas add 84.54 to  $k=1$   $\Delta = .5924$

Expt. 79 Have suspended a 4'x4'x1" thick steel plate above the N-half of assembly (by the crane.).

$k > 1$  at closure.  $2.02 \text{ dis/sec}$   $43.89 \text{ sec}$   $C_F = 17.460$   
 $k = 1$  at 2.15 revs. worth of steel is 4.81 over 1/2 ang  
 Plexiglas  $97.1 - (17.46 + 4.81) = 74.8$   $\therefore 9.62$  over entire

Expt. 80 Assembly as in Expt. 79 - Have placed 3'x7'x1/4" Boral plates against UF<sub>4</sub> - Paraffin blocks stored against wall.



$k > 1$  at closure.  $2.10 \text{ dis/sec}$   $45.63 \text{ sec}$   $C_F = 17.022$   
 $k = 1$  at 2.15 revs.

Contribution of UF<sub>4</sub> ~ 4.44

$$8 \times 12 = 42$$

$$9 \times 12 = 50$$

$$\text{need: Price/gal} = 92¢ - 7.5 = 84.5¢ \text{ to } k=1$$

$$\therefore 13^{1/2} \times 14^{5/8} \times 1 \text{ has a value of } 92.0 + 5.1 = 197.1¢$$

$$\text{other hand if } 13 \times 14 \text{ is } 100 \text{ then } 8 \times 12 = 44$$

$$\text{and } 9 \times 12 = 51 \text{ these original values}$$

Instrument Check on 2-3-69 Source Co-60

PM-1	Low Trip	OK	Alarm Trip	OK
PM-2			Alarm Trip	
IC-1	$> 3 \times 10^{-4}$	Meter Trip	OK ( $\sim 6''$ )	Fast Trip OK
IC-2	$> 3 \times 10^{-4}$	Meter Trip	OK ( $\sim 12''$ )	Personnel $\checkmark$
IC-3	Responds	Calibration	JN	Alarms $\checkmark$
IC-4	Responds	Calibration	JN	Pres. - 0.0%
CRM		Meter Trip		Env Temp. 21.8°C

Expt. 81 Assembly as in Expt. 78 but with  $9 \times 12 \times 1$  Plyozinc on N-face and  $8 \times 12 \times 1$  on S face.

$k > 1$  at closure.  $6.3 \text{ div/sec}$   $136.90 \text{ sec}$   $C_f = 7.507$

$k = 1$  at 1.35 revs. ( $0.044''$ )

Expt. 82. As above - add  $4 \times 4 \times 1''$  sheet of steel over N-half of assembly suspended from crane.

$k > 1$  at closure  $3.46 \text{ div/sec}$   $75.19 \text{ sec}$   $C_f = 11.989 \text{ f}$

$k = 1$  at 1.72 revs. ( $0.063''$ )

Steel adds  $4.482 \text{ f}$

Expt. 83. As Expt. 82 but add  $1'' \times 18 \frac{1}{2}'' \times 10 \frac{1}{4}''$  above steel plate directly over assembly.

$k > 1$  at closure  $3.38 \text{ div/sec}$   $73.45 \text{ sec}$   $C_f = 12.195$

$k = 1$  at 1.80 revs. ( $0.066''$ )

additional steel adds  $0.21 \text{ f}$

Expt. 84 Place  $11 \times 24 \times \frac{1}{4}$  Boral between Steel ( $4 \times 4 \times 1''$ ) and top of Aluminum boxes.

$k > 1$  at closure.  $3.48 \text{ div/sec}$   $75.62 \text{ sec}$   $C_f = 11.940 \text{ f}$

$k = 1$  at 1.75 revs. ( $0.064''$ )

Boral takes away  $0.258 \text{ f}$



Instrument Check on 2-5-69 Source Co 60

IC-1	Low Trip	OK	Alarm Trip	OK	
IC-2			Alarm Trip		
IC-1	$> 3 \times 10^{-11}$	Water Trip	OK	Fast Trip	OK
IC-2	$> 3 \times 10^{-11}$	Water Trip	OK		Personnel ✓
IC-3	Responds	Calibration	JH		Alarms ✓
IC-4	Responds	Calibration	JH		Pres. -0.04"
CRM		Water Trip			Run Temp.

Expt. 85. add 1" graphite between units in 2 directions.

$$9 \times 12 \times 1 / 8 \times 8 \times 1 \quad (e = 77.2)$$

$R < 1$  at closure.

Expt. 86 try with  $4 \times 12 / 9 \times 12$  ( $e = 116$ )

$R < 1$  at closure.

Expt. 87 try with  $11 \times 12 / 11 \times 13$  ( $e = 135$ )

$R < 1$  at closure

Expt. 88 try with  $13 \times 14 / 11 \times 13$  ( $e = 171$ )

$R < 1$  at closure

Expt. 89 try with  $13 \times 14 / 8 \times 12 + 9 \times 12$  ( $e \sim 196$ )

$R < 1$  at closure

Expt. 90 try with top reflector 6" polyethylene + Boral

and  $11 \times 12 / 9 \times 12$  ( $e \sim 223$ )

$R \sim 1$  at closure subcritical by  $\sim 3\%$

$$\sim 17 \text{ dis/sec} \Rightarrow -3.69 \text{ sec} \sim -3.4 \%$$

degree sub.  $2.23 + 3.8 \sim 2.27$   
 $\frac{-74}{153}$  more than Expt. 89

2-5-69

Expr. 91 as Expr. 90 but with  $13 \times 14/8 \times 8$  ( $\rho \approx 232$ ) -

$k > 1$  at closure  $12.1$  div/sec  $262.93$   $\rho_f = 4.2904$

$k < 1$  at closure remove  $8 \times 8$  plexiglas.  $5.4$  div/sec  $117.34$  sec  $\rho_f = -18.3354$

worth of  $8 \times 8$  is, therefore,  $\approx 22.624$

Comparing with Expr. 73 on p. 93

for which  $x = N_c + L' + R_T - N + N_T = 31.2$

this experiment  $y = N_c + L' + R_T - N + N_T + (98 + 23)$

additional loss in reactivity due to 1" separation in z direction

is  $y - x = 98 + 23 + 31.2$

$= 152.2$

$\gamma = 152.2 + 145.6 = 297.8$

$\beta = .007 \Rightarrow k = 1 - 2.978(.007)$

$= .9804 \pm .0007$

cc.  $\pm 10\%$

Instrument Check on 3-11-69 Source Co-60

PM-1	Low Trip	OK	Alarm Trip	OK	
PM-2			Alarm Trip	<del>OK</del>	
IC-1	$> 3 \times 10^{-11}$	Meter Trip	OK	Fast Trip	OK
IC-2	$> 3 \times 10^{-11}$	Meter Trip	OK	Personnel	✓
IC-3	Responds	Calibration	FX	alarms	✓
IC-4	Responds	Calibration	FX	Pres.	-0.05
GM		Meter Trip		Rm Temp.	21°C

Expr. 92.

Have placed  $1/2$ " thick pc. of graphite on top and bottom of assembly. Units separated by 1" thick pc. vertically. These are machined slabs of graphite.

$k < 1$  at closure  $M \approx 12!$

Expr. 93 Same as 92 but with  $9 \times 12 \times 1$ " Plexiglas on S face.

$k \approx 1$  at closure meas. neg. Period.  $21.4$  div/sec  $T = 465.02$  sec

$\rho_f \approx 2.98944$

Exp. 94.

Comparison of Exp. 94 to Exp. 48

48:  $11 \times 12 + 6 \times 8 - 7.075 = 73.76 \text{ } \phi$

94:  $11 \times 12 - 6.812 = 58.26 \text{ } \phi$

$11 \times 12 = 64.072 \text{ } \phi$

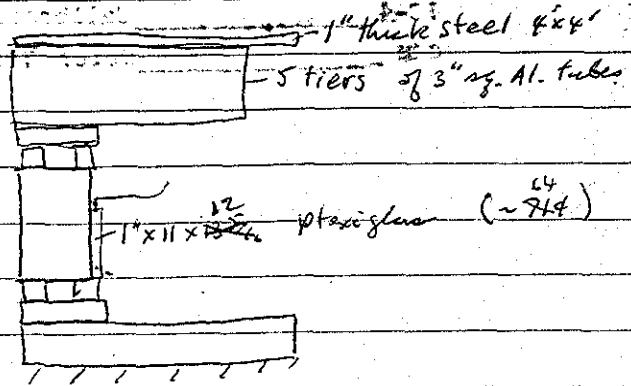
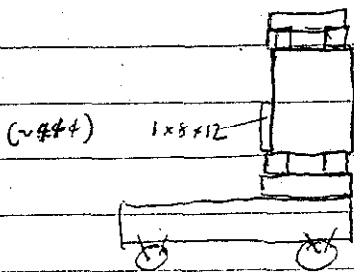
$73.76 - 16.764 \approx 57.00 \text{ } \phi$

$6 \times 8 = 16.764$

i. Conclude assembly is  $\sim 130. \text{ } \phi$  subcritical when corrected for support structure & room return.

Exp. 94

Description:



$8 \times 12 = 44.024$

$11 \times 12 = 64.072$

Added  $\rho = 108.1$

$\rho \text{ to } k=1 \text{ is } 74.7 \text{ } \phi$

Expt. 93

Instrument Check on 3-12-69 Source Co-60

FM-1	Low Trip	OK	Alarm Trip	OK
PM-2			Alarm Trip	
IC-1	$> 3 \times 10^{-11}$	Meter Trip	OK	Fast Trip OK
IC-2	$> 3 \times 10^{-11}$		OK	Personnel ✓
IC-3	Responds		JA	Alarms ✓
IC-4	Responds		JA	Pres. -0.05"
PRM	Meter Trip			RmTemp. 20.4°C

Replaced 9x12 by 11x12. Use Rhocette for reactivity meas.

$k > 1$  at closure Rho: +6.3¢ @  $5 \times 10^{-9}$  5.9¢ @  $9 \times 10^{-9}$   
 $k < 1$  pull away plexiglas Rho: -76.6¢ }  $\lambda_{eff}$ : +7.07 d/s/dec  
 $T = 153.6$   $\rho_f = 6.824¢$

Expt. 94 Repeat 93. Moved ion chamber for Rhocette closer to assembly.

$k > 1$  at closure Rho: 6.4¢ at  $5 \times 10^{-9}$  6.4¢ @  $9 \times 10^{-9}$   
 $\lambda_{eff}$ : 6.67 d/s/dec  $T = 144.87$  sec  $\rho_f = 7.124¢$

∴ moving chamber added 0.3¢

$k < 1$  at closure: Remove plexiglas

Rho: -58.76¢

Instrument Check on 3-13-69 Source Co-60

FM-1	Low Trip	OK	Alarm Trip	OK
PM-2			Alarm Trip	
IC-1	$> 3 \times 10^{-11}$	Meter Trip	OK	Fast Trip OK
IC-2	$> 3 \times 10^{-11}$	Meter Trip	OK	Personnel
IC-3	Responds	Calibration	JA	Alarms ✓
IC-4	Responds	Calibration	JA	Pres. -0.05
PRM	Meter Trip			RmTemp.

Expt. 94. See description on p.136

$k > 1$  at closure: Rho: +13.4¢ @  $9 \times 10^{-9}$

$k < 1$  at closure: Remove Plexiglas 11x12"x1" Rho: -51.37¢

worth of 11x12 = 51.37 + 13.4 = 64.77¢

ion chamber  $\frac{.3}{64.47¢}$  of 64.07¢

Exp. 95 Result of this experiment compared to  
case ④ on p. 72 shows contribution of  $\frac{1}{2}$  top structure cover  
to be worth  $\approx 12.3\text{¢}$  which is about  $4\text{¢}$  less than  
previously evaluated. This is due to scatter from  
top structure into top  $\frac{1}{2}$  surface of uncovered array.  
Therefore, <sup>it is</sup> concluded that must use entire structure  
make up <sup>on</sup> of top.

Exp. 95 Remove Al tubes from moveable half of assembly

Place 8x12 on fixed half and 4x12 on moveable half.

$k > 1$  at closure:  $Rho = +10.2 \text{¢}$

$k < 1$  at closure: remove 8x12" Plexiglas  $Rho = -33.2 \text{¢}$

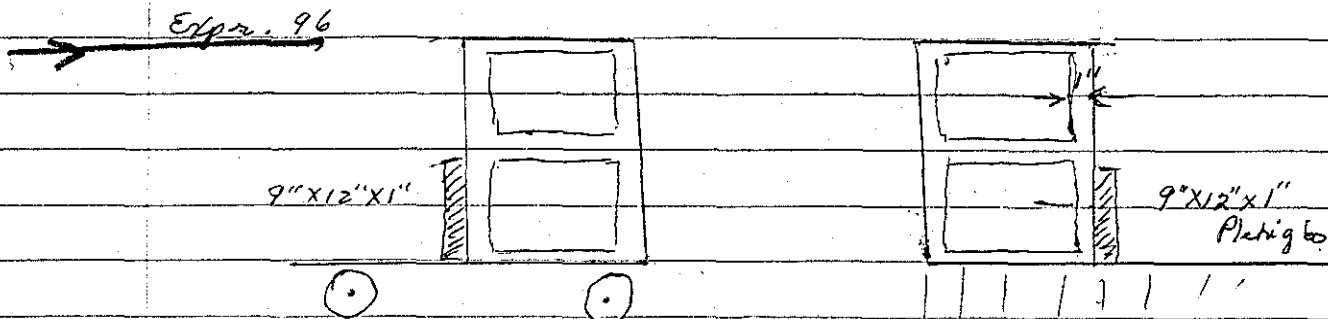
worth of 8x12 = 43.4 ¢ cf to 44 on p. 78.

+ p to  $k=1$  is  $108.1 - 10.2 = 97.9$

Worth of Al tubes on moveable table is  $97.9 - 94.7 = 3.2 \text{¢}$

Instrument Check on 3-14-69 Source Co-60

PM-1	Low Trip	ok	Alarm Trip	✓
PM-2				
IC-1	$> 3 \times 10^{-11}$	Meter	ok	Fast Trip ok
IC-2	$> 3 \times 10^{-11}$	Meter	ok	
IC-3	Responds	Call	cc	Personal ✓
IC-4	Responds	Call	cc	alarm
CRM		Meter		Pres



$k > 1$  at closure:  $P = +17.16 \text{¢}$

$k < 1$  " : Remove 12x9" plexiglas,  $P = -9.7 \text{¢}$

\* worth of 12"x.9." = 26.86 ¢

Bare Stack = -36.56 ¢ ✓

see p 147

\* Vertical dimension written first

3-14-67  
10:30 AM

Expr 97 - Removed two (2) 9x12 plexiglas  
 added  $\frac{1}{8}$ " x 12" x 36" Al on each table  
 " 4 x 5 al matrix " "  
 " 12" x 8" plexiglas on fixed table only  
 $k > 1$  at closure:  $P = +9.58\text{¢}$   
 $k < 1$  " : Removed 8 x 12 plexiglas  $P = -13.82\text{¢}$   
 worth of 12" x 8" Plexiglas =  $23.4\text{¢}$

Expr 98 - Same as Expr 96 units raised off  
 tables (6") by Al box method.  
 $11\frac{1}{16}$ " x  $13\frac{5}{16}$ " x 1" Plexiglas on Fixed table  
 $14\frac{5}{8}$ " x  $12\frac{3}{4}$ " x 1" Moveable "  
 $k > 1$  at closure:  $P = +19.44\text{¢}$   
 $k < 1$  " :  $P = -16.48\text{¢}$ , Plexiglas off  
 worth of  $11\frac{1}{16}$ " x  $13\frac{5}{16}$ " =  $35.92\text{¢}$

Expr 99 - Same as 98.  
 $11\frac{1}{16}$ " x  $13\frac{5}{16}$ " Plexiglas each table.  
 $k > 1$  at closure:  $P = +4.38\text{¢}$   
 $k < 1$  at closure: Plexiglas off  $P = -33.09\text{¢}$   
 Worth of  $11\frac{1}{16}$ " x  $13\frac{5}{16}$ " =  $37.47\text{¢}$   
 Bare Stack =  $-70.56\text{¢}$

Expr 99 vs Expr 96 =  $-34\text{¢}$

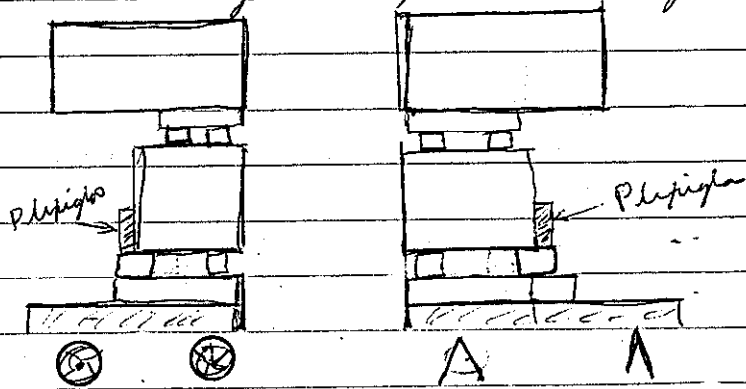
Instrument Check on 3-17-69 source Co 60

M-1	Low Trip	OK	Alarm Trip	OK
M-2			Alarm Trip	
IC-1	$> 3 \times 10^{-11}$ Meter	OK	Fast Trip	OK
IC-2	$> 3 \times 10^{-11}$ Meter	OK	Personal	✓
IC-3	Responds Cal	cc	Alarms	✓
IC-4	Responds Cal	cc	Pres.	-0.04"
M	Meter Trip		Rm Temp	21.1°C

Expr-100 - mock up base -  
 Expr. 98 with  $\frac{1}{2}$  Al plate and Al matrix on top.  
 $11 \frac{1}{16}$ " x  $13 \frac{5}{16}$ " Plexiglas each table.  
 $k > 1$  at closure:  $P = +13.61 \text{ } \Phi$   
 $k < 1$  at closure, Plexiglas off:  $P = -22.51 \text{ } \Phi$

Bare stack =  $-58.63 \text{ } \Phi$  ✓  
 $\therefore$  Top structure =  $10.58 \text{ } \Phi$  (ave value of 11+13)

Expr 101 - mock-up base, less steel plate



$11 \frac{1}{16}$ " x  $13 \frac{5}{16}$ " Plexiglas each table  
 $k > 1$  at closure:  $P = +17.40 \text{ } \Phi$   
 $k < 1$  at closure, Plexiglas off:  $P = -18.71 \text{ } \Phi$

Bare stack =  $-58.63 \text{ } \Phi$  -54.82  
 Top structure =  $14.38 \text{ } \Phi$  ✓



Expr 102 - added the steel plate to movable table, 4' x 4' x 1"

11.92 because }  $R > 1$  at closure:  $P = +11.92^\circ$   $\phi$  Pluglas of center  
 } Pluglas placed near edge of }  $R < 1$  at closure, Pluglas of  $P = -18.90^\circ$   
 } stack.

closure of stack no good - maybe

Instrument Check on 3-18-69 Source Co 60

PM-1	Low Trip	OK	Alarm Trip	OK
PM-2			Alarm Trip	
IQ-1	$> 3 \times 10^{-11}$	Meter Trip	Fast Trip	OK
IQ-2	$> 3 \times 10^{-11}$	Meter Trip		Personnel
IQ-3	Responds	Calibration	CC	Alarms OK
IQ-4	Responds	Calibration	CC	Pres. -0.04
CR-1		Meter Trip		Rm Temp $21^\circ\text{C}$

Expr 103 - Repeat of 102 after an attempt at better alignment.

$k > 1$  at closure:  $P = 12.45^\circ$

$k < 1$  at closure, Pluglas of  $P = -18.47^\circ$

Run 102 was good

VS 10.1 Fe Plate = 0.24  $\phi$

" Fe Plate = -

SEE P. 145

Exper 104 - Base unit enclosed in 2" Carbon.

Stacks as p. 139

11 $\frac{7}{16}$ " X 13 $\frac{7}{16}$ " X 1" Plexiglas on fixed table

$k > 1$  at closure  $\mathcal{P} = +11.28 \text{ } \Phi$

$k < 1$  at closure, Plexiglas off  $\mathcal{P} = -10.02 \text{ } \Phi$

Plexiglas = 21.30  $\Phi$

Exper 105 -  $\frac{1}{8}$ " X 15" X 36" Al with 5x5 Al matrix on each table.

12" X 8" Plexiglas on fixed table.

$k > 1$  at closure  $\mathcal{P} = 20.52 \text{ } \Phi$

$k > 1$  at closure Plexiglas off  $\mathcal{P} = +7.57 \text{ } \Phi$

12" X 8" = 13.0  $\Phi$

Top structure = 17.67  $\Phi$

Instrument Check on 19 MAR 69 Source  $Co^{60}$ 

PM-1	Low Trip	OK	Alarm Trip	OK
PM-2			Alarm Trip	
IC-1	$73 \times 10^{-11}$	Meter Trip	Fast Trip	OK
IC-2	$73 \times 10^{-11}$	Meter Trip		PERSONNEL OK
IC-3	RESPONDS	Calibration	CC	ALARMS OK
IC-4	RESPONDS	Calibration	CC	PRESS. = -0.04
CRM	Meter Trip			Rm. TEMP = 21°C

Expr 106 - stack raised off the tables (6") by the al box method.

$11\frac{1}{16}$ "  $\times$   $13\frac{5}{16}$ " Plexiglas each table.

$k > 1$  at closure:  $P = +9.05 \phi$

$k < 1$  at closure, Plexiglas off:  $P = -11.28 \phi$

$11\frac{1}{16}$ "  $\times$   $13\frac{5}{16}$ " Plexiglas =  $20.33 \phi$

Base stack =  $-31.61 \phi$

Expr 107

Added  $\frac{1}{8}$ " al plate and  $5 \times 5$  al matrix to top.

$11\frac{1}{16}$ "  $\times$   $13\frac{5}{16}$ " Plexiglas each table.

$k > 1$  at closure:  $P = +18.07 \phi$

$k < 1$  at closure, Plexiglas off:  $P = -2.16 \phi$

Plexiglas =  $20.33 \phi$

Stack with Top =  $-22.39 \phi$

Top Structure =  $9.12 \phi$

Expr 108

Mock-up base added to Expr 106

11 1/2" x 13 5/8" Plexiglas

 $k > 1$  at closure,  $P = +13.17$  $k > 1$  at closure, Plexiglas off  $P = +0.75$ Top structure = 12.03  $\phi$ 

Instrument check on 3-24-69 source Co 60

PM-1	Low Trip	OK	Alarm Trip	OK	
PM-2	$> 3 \times 10^{-11}$		Alarm Trip		
IC-1	$> 3 \times 10^{-11}$	Meter Trip	OK	Fast Trip	OK
IC-2	$> 3 \times 10^{-11}$	Meter Trip	OK	Alarms	OK
IC-3	Responds	Calibration	CC	Pressure	OK
IC-4	Responds	Calibration	CC	Pres.	-0.04
CRM		Meter Trip		Temp.	21°C

Expr 109

Repeat Expr 108 as a base run for the steel plate evaluation.

 $k > 1$  at closure, Plexiglas off  $P = 1.01$   $\phi$ 

Expr 110

Fe 48" x 48" x 1" on top of fixed table,

 $k > 1$  at closure, Plexiglas off  $P = 4.79$   $\phi$ Fe Plate = 3.78  $\phi$

Instrument Check on 3-16-69 Source Co 60

PM-1	Low Trip	OK	Alarm Trip	
PM-2				
IC-1	$3 \times 10^{-11}$	Water Trip	OK	Fast Trip
IC-2	$3 \times 10^{-11}$		OK	
IC-3	Responds		Alarm	OK
IC-4	Responds		Personnel Check	
CRM		Water Trip	Pressure	0.04
			Temp	23.6

At 4<sup>00</sup> PM

Exp

Exp

EXPT 111 - Repeat of EXPT # 110

Mock up with Al Boxes on top with  
 $48" \times 48" \times 1"$  Steel Plate on fixed table  
 $11\frac{1}{16} \times 13\frac{5}{16}$  Plexyglas Shim on Movable table

K > 1 AT Closure with  $11\frac{1}{16} \times 13\frac{5}{16}$  Plexyglas Shim  
 on fixed table Removed + 4.79  $\phi$

Exp

EXPT # 112 - Remove steel plate and Run same as

EXPT 111

K > 1 AT Closure with Shim Removed from  
 Fixed table + 1.15  $\phi$

EXPT # 113 Repeat of EXPT # 96 see page 139

$R > 1$  at closure  $P = +16.07$

$R < 1$  at closure Remove 12" x 9" ply glass shim  $P = -11.57$

WORTH OF 12" x 9" x 1" PLY GLASS SHIM = 27.64

BARE STACK = -39.21

EXPT # 114 SAME AS # 113 ABOVE EXCEPT NOW USING ONLY ONE SHIM 14 $\frac{5}{8}$ " x 13 $\frac{1}{4}$ " x 1"

$R > 1$  @ CLOSURE  $P = +20.23$

$R < 1$  @ CLOSURE  $P = -42.75$

WORTH OF 14 $\frac{5}{8}$ " x 13 $\frac{1}{4}$ " x 0.97" SHIM = 62.98

BARE STACK = -42.75

EXPT # 115 4 → 6-INCHES C BOXES (WITHOUT ANY ADDITIONAL C)

(a) SHIM 11 $\frac{1}{16}$ " x 13 $\frac{5}{16}$ " x 1" = SUB-CRITICAL

(b) SHIM 14 $\frac{5}{8}$ " x 13 $\frac{1}{16}$ " x 0.97" (centered) (ONE SHIM ONLY)

$R > 1$  @ CLOSURE  $P = +19.18$

$R < 1$  @ CLOSURE (SHIM OFF)  $P = -92.61$

WORTH OF SHIM = 111.79

BARE STACK = -92.61

Instrument Check on 27 MAR 69 Source  $Co^{60}$ 

PM-1	Low Trip	OK	Alarm Trip	
PM-2			Alarm Trip	
IC-1	$3 \times 10^{-11}$	Water Trip	OK	Fast Trip OK
IC-2	$3 \times 10^{-11}$	Water Trip	OK	
IC-3	RESPONDS	Calibration	✓ T&C	BLDG-ALARM-OK
IC-4	RESPONDS	Calibration	✓ T&C	PRESS = 0.04
CRM		Meter Trip		TEMP = 23.6°C

EXP# 116a - REPEAT OF EXP# 115 (b) SAME SHIM @ ARBITRARY POSITION.

$R > 1$  AT CLOSURE  $RHO = +18.88\%$  (VERY SLIGHT CRACK VISIBLE)

$R < 1$  AT CLOSURE  $RHO = -86.06\%$  (SHIM AWAY)

Repeat 3/28 = -86.63

116b - REPEAT AGAIN AFTER CLOSING THE CRACK. (SHIM @ ARBITRARY POS.)

$R > 1$  AT CLOSURE  $P = +17.73\%$

$R < 1$  (SHIM AWAY)  $P = -89.06\%$

EXP# 117 EVALUATE REACTIVITY EFFECT OF AL SHEET AND AL BOXES

(4 WIDE NES) & (5 HIGH) WHICH SUPPORT THE ASSEMBLY.

SAME SHIM ( $14\frac{5}{8}'' \times 13\frac{1}{16}'' \times 1''$ ) PROTRUDES EASTWARD FROM EDGE  $3\frac{1}{2}''$

$R > 1$  AT CLOSURE  $P = +13.35\%$

$R < 1$  (SHIM AWAY)  $P = -41.91\%$

EXP# 118 RAISE CONFIGURATION ("BARE" BLOCKS) UP OFF TABLE

2 AL BOXES HIGH. USING SAME SHIM BUT WITH  $8'' \times 8'' \times 1''$

@ CENTER TAPED ONTO SAME AND ALL CENTERED (E, V, W).

$R > 1$  @ CLOSURE  $P = +10.82\%$

$R < 1$  (SHIM OFF)  $P = -139.55\%$

WIDTH OF SHIM = 150.37%

\* EXP # 119A EVALUATE AL SHEET & AL BOXES (4 WIDE & 5 HIGH EACH),  
 USING SAME LARGE SHIM BUT WITH 8" X 6" X 1" TAPED TO CENTER OF SAME.  
 EDGE OF BIG SHIM IS 1 1/2" WEST OF EAST EDGE OF C.

R > 1 @ CLOSURE  $p = +33.36\%$  (VERY SLIGHT CRACK VISIBLE)

R < 1 (SHIM OFF)  $p = -89.63\%$

\* EXP 119B REPEAT (A) AFTER CLOSING CRACK AND MOVING SHIM  
 EVEN WITH EDGE OF C.

R > 1 @ CLOSURE  $p = +23.29\%$

R < 1 (SHIM OFF)  $p = -85.01\%$

\* NOTE: EXP # 119A & 119B NEITHER HAD THE BOXES RAISED UP A DISTANCE  
 OF 2 BOXES, I.E. THE MOCK UP BOXES AND AL SHEET WERE  
 IN CONTACT WITH THE CARBON ON TOP.

Instrument Check on 28 MAR 69 Source B<sup>60</sup>

PM-1	Low Trip	OK	Alarm Trip		
PM-2			Alarm Trip		
IC-1	3 X 10 <sup>-1</sup> "	Meter Trip	OK	Fast Trip	OK
IC-2	3 X 10 <sup>-1</sup> "	Meter Trip	OK		BLDG. ALARM-01C
IC-3	OK	Calibration	JRT & CC		PRESS = 0.04
IC-4	OK	Calibration	JRT & CC		TEMP = 21.8°C
CRM		Meter Trip			

EXP # 120 EVALUATE AL SHEET & AL BOXES (4 WIDE & 5 HIGH EACH) WHICH IS RAISED  
 2 AL BOXES HIGH ABOVE C. SHIM = SAME LARGE 8" X 6" @ <sup>2" FROM</sup> EDGE OF C.

R > 1 @ CLOSURE  $p = +15.01\%$

R < 1 (SHIM AWAY)  $p = -112.55\%$

(120b) Repeat  $p = -108.34$  readjust stack.



Expt. 121 Repeat 120

$\rho = -108.3$

Expt. 122 Repeat 116

$\rho = -86.63$

Instructional Check on Source

1-1	1st Trip	1st Trip
2-1	2nd Trip	2nd Trip
3-1	3rd Trip	3rd Trip
4-1	4th Trip	4th Trip
5-1	5th Trip	5th Trip
6-1	6th Trip	6th Trip
7-1	7th Trip	7th Trip
8-1	8th Trip	8th Trip
9-1	9th Trip	9th Trip
10-1	10th Trip	10th Trip