

Irradiation test with thermal neutrons at LNL on 18/05/99 and 3-4/06/99
Neutron flux without DUT is $\Phi=2.3 \times 10^6$ n/cm²/μC, uniformity is better than 10%

DAY	BEAM	NOTES	TIME	Δt (hh.mm)	t (s)	CHARGE (C)	Φ (n/cm ²)	SEU
18/05/99	18nA		10.42	0	0	0,00E+00	0,00E+00	0
			11.05	0.23	1380	1,99E-05	4,57E+07	0
	100nA		11.07	0.02	1500	2,22E-05	5,11E+07	0
			11.10	0.03	1680	2,52E-05	5,80E+07	0
	250nA		11.15	0.05	1980	6,27E-05	1,44E+08	0
			11.26	0.11	2640	1,50E-04	3,44E+08	0
			11.43	0.17	3660	2,82E-04	6,48E+08	0
			12.03	0.20	4860	5,08E-04	1,17E+09	1
			12.09	0.06	5220	6,00E-04	1,38E+09	1
			13.24	1.15	9720	1,68E-03	3,85E+09	8
			13.35	0.11	10380	1,83E-03	4,21E+09	8
			13.50	0.15	11280	1,89E-03	4,36E+09	8
			13.54	0.04	11520	1,92E-03	4,42E+09	8
			14.23	0.29	13260	2,39E-03	5,49E+09	9
	250nA		14.43	0.20	14460	2,72E-03	6,25E+09	9
			15.03	0.20	15660	3,04E-03	7,00E+09	9
			15.18	0.15	16560	3,27E-03	7,51E+09	9
			15.30	0.12	17280	3,45E-03	7,94E+09	10
			15.48	0.18	18360	3,73E-03	8,58E+09	12
			16.02	0.14	19200	3,95E-03	9,08E+09	13
16.16		0.14	20040	4,14E-03	9,52E+09	13		
16.40		0.24	21480	4,48E-03	1,03E+10	15		
16.54		0.14	22320	4,69E-03	1,08E+10	17		
03/06/99		300nA		10.36	0	0	0,00E+00	0,00E+00
	10.48			0.12	720	2,30E-04	5,29E+08	0
	11.18			0.30	2520	8,00E-04	1,84E+09	0
	11.52			0.34	4560	1,51E-03	3,46E+09	1
	12.21			0.29	6300	2,07E-03	4,76E+09	3
	13.33			1.12	10620	3,59E-03	8,25E+09	6
	14.31			0.58	14100	4,89E-03	1,13E+10	9
	15.26			0.55	17400	5,99E-03	1,38E+10	11
	16.18			0.52	20520	7,05E-03	1,62E+10	11
	17.15			0.57	23940	8,48E-03	1,95E+10	16
04/06/99	300nA	Execution Error -> Reboot	17.28	0.13	24720	8,78E-03	2,02E+10	16
			9.18	0.00	0	0,00E+00	0,00E+00	0
			10.29	1.11	4260	1,54E-03	3,55E+09	1
			10.54	0.25	5760	2,17E-03	5,00E+09	4
			11.08	0.14	6600	2,51E-03	5,76E+09	4
			12.07	0.59	10140	3,93E-03	9,05E+09	6
			13.38	1.31	15600	6,15E-03	1,41E+10	9
			14.32	0.54	18840	7,36E-03	1,69E+10	12
			15.15	0.43	21420	8,24E-03	1,89E+10	13
			16.06	0.51	24480	9,24E-03	2,13E+10	15
			16.12	0.06	24840	9,33E-03	2,15E+10	15
			16.37	0.25	26340	9,79E-03	2,25E+10	15
			17.00	0.23	27720	1,03E-02	2,37E+10	15
			17.05	0.05	28020	1,04E-02	2,39E+10	16
			17.10	0.05	28320	1,05E-02	2,42E+10	16
17.15	0.05	28620	1,06E-02	2,45E+10	16			

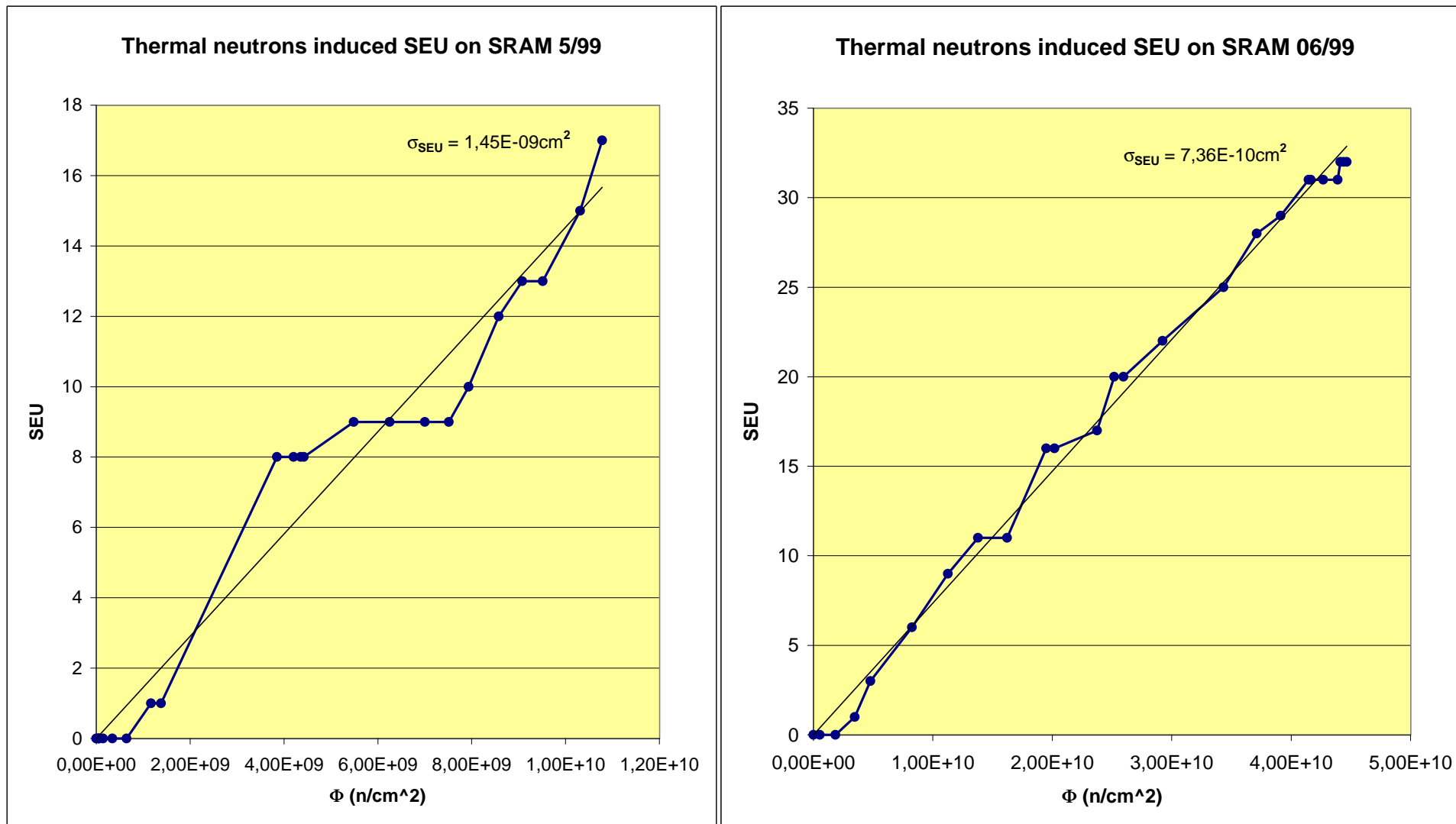
DAY	CHARGE (C)	Φ (n/cm ²)	SEU
18/05/99	0,00E+00	0,00E+00	0
	1,99E-05	4,57E+07	0
	2,22E-05	5,11E+07	0
	2,52E-05	5,80E+07	0
	6,27E-05	1,44E+08	0
	1,50E-04	3,44E+08	0
	2,82E-04	6,48E+08	0
	5,08E-04	1,17E+09	1
	6,00E-04	1,38E+09	1
	1,68E-03	3,85E+09	8
	1,83E-03	4,21E+09	8
	1,89E-03	4,36E+09	8
	1,92E-03	4,42E+09	8
	2,39E-03	5,49E+09	9
2,72E-03	6,25E+09	9	
3,04E-03	7,00E+09	9	
3,27E-03	7,51E+09	9	
3,45E-03	7,94E+09	10	
3,73E-03	8,58E+09	12	
3,95E-03	9,08E+09	13	
4,14E-03	9,52E+09	13	
4,48E-03	1,03E+10	15	
4,69E-03	1,08E+10	17	

SEU data on 18/05/99

DAY	CHARGE (C)	Φ (n/cm ²)	SEU
03/06/99	0,00E+00	0,00E+00	0
	2,30E-04	5,29E+08	0
	8,00E-04	1,84E+09	0
	1,51E-03	3,46E+09	1
	2,07E-03	4,76E+09	3
	3,59E-03	8,25E+09	6
	4,89E-03	1,13E+10	9
	5,99E-03	1,38E+10	11
	7,05E-03	1,62E+10	11
	8,48E-03	1,95E+10	16
	8,78E-03	2,02E+10	16
	1,03E-02	2,37E+10	17
	1,10E-02	2,52E+10	20
	1,13E-02	2,60E+10	20
04/06/99	1,27E-02	2,92E+10	22
	1,49E-02	3,43E+10	25
	1,61E-02	3,71E+10	28
	1,70E-02	3,91E+10	29
	1,80E-02	4,15E+10	31
	1,81E-02	4,16E+10	31
	1,86E-02	4,27E+10	31
	1,91E-02	4,39E+10	31
	1,92E-02	4,41E+10	32
	1,93E-02	4,44E+10	32
	1,94E-02	4,47E+10	32

SEU data on 03-04/06/99

BEAM Deuterium nominal beam current
 TIME Day time of CHARGE measurement
 Δt Differential day time
 t Irradiation time
 CHARGE Beam current integrated on target
 Φ Estimated neutron flux on DUT
 SEU Total number of SEU



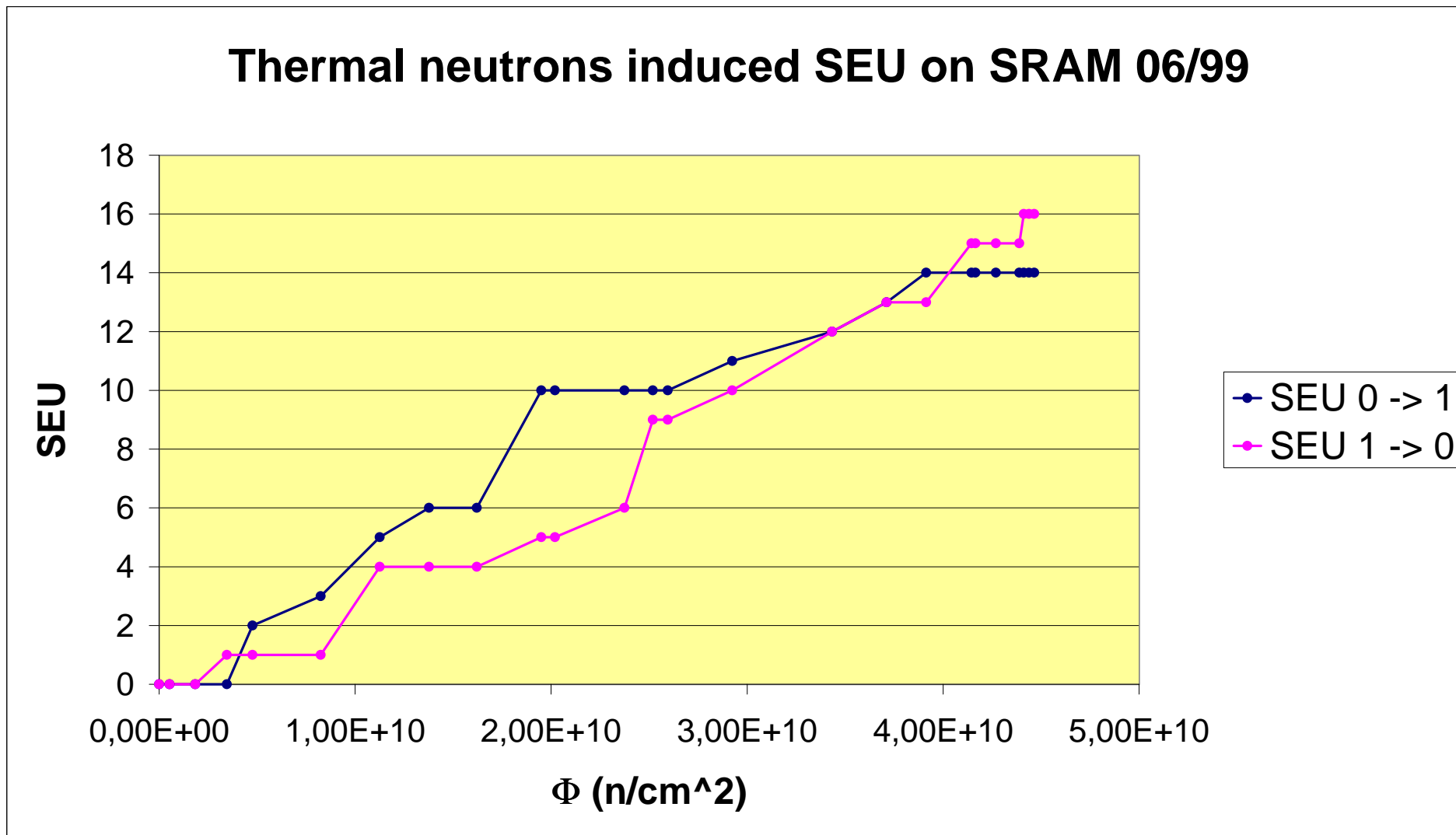
Neutron flux is calculated using the nominal yield of $2.3 \times 10^6 n/cm^2/mC$

SRAM SEU distinguishing 0-to-1 from 1-to-0 upsets

1Mbit SRAM type SONY CXK581000AM-70LL (SN. 445J93E S) package SOIC-32

DAY	BEAM	NOTES	TIME	Δt (hh.mm)	t (s)	CHARGE (C)	Φ (n/cm ²)	SEU 0 -> 1	SEU 1 -> 0			
03/06/99	300nA	start	10.36	0	0	0,00E+00	0,00E+00	0	0			
			10.48	0.12	720	2,30E-04	5,29E+08	0	0			
			11.18	0.30	2520	8,00E-04	1,84E+09	0	0			
			11.52	0.34	4560	1,51E-03	3,46E+09	0	1			
			12.21	0.29	6300	2,07E-03	4,76E+09	2	1			
			13.33	1.12	10620	3,59E-03	8,25E+09	3	1			
			14.31	0.58	14100	4,89E-03	1,13E+10	5	4			
			15.26	0.55	17400	5,99E-03	1,38E+10	6	4			
			16.18	0.52	20520	7,05E-03	1,62E+10	6	4			
			17.15	0.57	23940	8,48E-03	1,95E+10	10	5			
			17.28	0.13	24720	8,78E-03	2,02E+10	10	5			
			04/06/99	300nA	start 9.18	10.29	1.11	28980	1,03E-02	2,37E+10	10	6
						10.54	0.25	30480	1,10E-02	2,52E+10	10	9
						11.08	0.14	31320	1,13E-02	2,60E+10	10	9
12.07	0.59	34860				1,27E-02	2,92E+10	11	10			
13.38	1.31	40320				1,49E-02	3,43E+10	12	12			
14.32	0.54	43560				1,61E-02	3,71E+10	13	13			
15.15	0.43	46140				1,70E-02	3,91E+10	14	13			
16.06	0.51	49200				1,80E-02	4,15E+10	14	15			
16.12	0.06	49560				1,81E-02	4,16E+10	14	15			
16.37	0.25	51060				1,86E-02	4,27E+10	14	15			
17.00	0.23	52440	1,91E-02	4,39E+10	14	15						
17.05	0.05	52740	1,92E-02	4,41E+10	14	16						
17.10	0.05	53040	1,93E-02	4,44E+10	14	16						
17.15	0.05	53340	1,94E-02	4,47E+10	14	16						

BEAM *Deuterium nominal beam current*TIME *Day time of CHARGE measurement* Δt *Differential day time*t *Irradiation time*CHARGE *Beam current integrated on target* Φ *Estimated neutron flux on DUT*SEU *Total number of SEU*



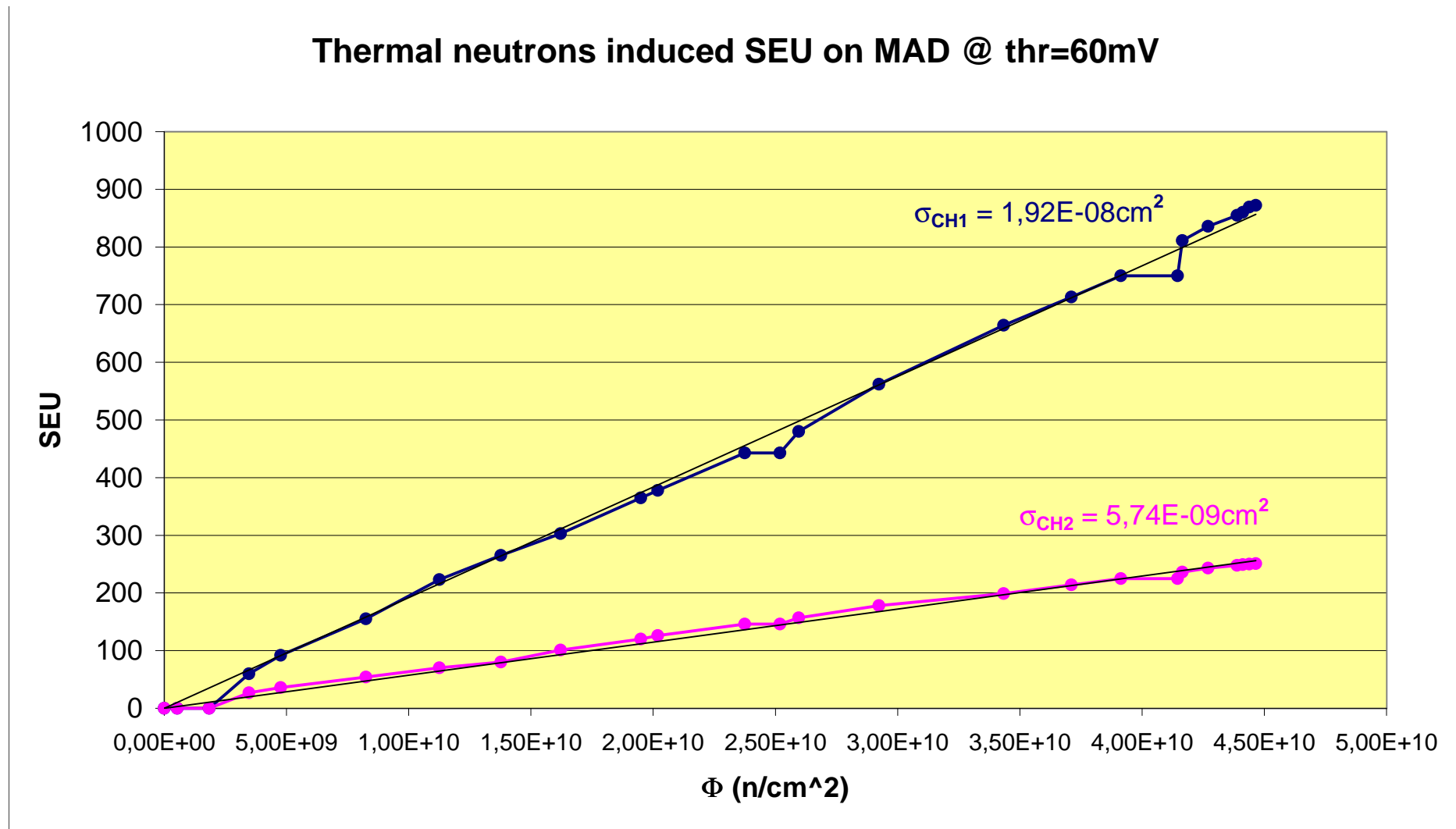
Neutron flux is calculated using the nominal yield of $2.3 \times 10^6 \text{ n/cm}^2/\text{mC}$

Irradiation test with thermal neutrons at LNL on 18/05/99 and 3-4/06/99

Neutron flux without DUT is $\Phi=2.3 \times 10^6$ n/cm²/μC, uniformity is better than 10%

DAY	BEAM	NOTES	TIME	Δt (hh.mm)	t (s)	CHARGE (C)	Φ (n/cm ²)	MAD Ch1	MAD Ch2	CHARGE (C)	Φ (n/cm ²)	MAD Ch1	MAD Ch2			
03/06/99	300nA	Illegal Instruction -> Reboot System crash	10.36	0	0	0,00E+00	0,00E+00	0	0	0,00E+00	0,00E+00	0	0			
			10.48	0.12	720	2,30E-04	5,29E+08	0	0	2,30E-04	5,29E+08	0	0			
			11.18	0.30	2520	8,00E-04	1,84E+09	0	0	8,00E-04	1,84E+09	0	0			
			11.52	0.34	4560	1,51E-03	3,46E+09	60	27	1,51E-03	3,46E+09	60	27			
			12.21	0.29	6300	2,07E-03	4,76E+09	92	36	2,07E-03	4,76E+09	92	36			
			13.33	1.12	10620	3,59E-03	8,25E+09	155	54	3,59E-03	8,25E+09	155	54			
			14.31	0.58	14100	4,89E-03	1,13E+10	223	70	4,89E-03	1,13E+10	223	70			
			15.26	0.55	17400	5,99E-03	1,38E+10	265	80	5,99E-03	1,38E+10	265	80			
			16.18	0.52	20520	7,05E-03	1,62E+10	303	101	7,05E-03	1,62E+10	303	101			
			17.15	0.57	23940	8,48E-03	1,95E+10	365	120	8,48E-03	1,95E+10	365	120			
			17.28	0.13	24720	8,78E-03	2,02E+10	378	126	8,78E-03	2,02E+10	378	126			
			04/06/99	300nA	Execution Error -> Reboot	9.18	0.00	0	0,00E+00	0,00E+00	0	0	1,03E-02	2,37E+10	443	146
						10.29	1.11	4260	1,54E-03	3,55E+09	65	20	1,10E-02	2,52E+10	443	146
10.54	0.25	5760				2,17E-03	5,00E+09	65	20	1,13E-02	2,60E+10	480	157			
11.08	0.14	6600				2,51E-03	5,76E+09	102	31	1,27E-02	2,92E+10	562	178			
12.07	0.59	10140				3,93E-03	9,05E+09	184	52	1,49E-02	3,43E+10	664	199			
13.38	1.31	15600				6,15E-03	1,41E+10	286	73	1,61E-02	3,71E+10	713	214			
14.32	0.54	18840				7,36E-03	1,69E+10	335	88	1,70E-02	3,91E+10	750	225			
15.15	0.43	21420				8,24E-03	1,89E+10	372	99	1,80E-02	4,15E+10	750	225			
16.06	0.51	24480				9,24E-03	2,13E+10	372	99	1,81E-02	4,16E+10	811	236			
16.12	0.06	24840				9,33E-03	2,15E+10	433	110	1,86E-02	4,27E+10	836	243			
16.37	0.25	26340				9,79E-03	2,25E+10	458	117	1,91E-02	4,39E+10	855	248			
17.00	0.23	27720				1,03E-02	2,37E+10	477	122	1,92E-02	4,41E+10	860	249			
17.05	0.05	28020				1,04E-02	2,39E+10	482	123	1,93E-02	4,44E+10	869	250			
17.10	0.05	28320	1,05E-02	2,42E+10	491	124	1,94E-02	4,47E+10	872	251						
17.15	0.05	28620	1,06E-02	2,45E+10	494	125										

BEAM *Deuterium nominal beam current*
 CHARGE *Beam current integrated on target*
 Φ *Estimated neutron flux on DUT*
 MAD *MAD board channels SEU*
 TIME *Day time of CHARGE measurement*
 Δt *Differential day time*
 t *Irradiation time*



Neutron flux is calculated using the nominal yield of $2.3 \times 10^6 n/cm^2/mC$