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

Neutron flux without DUT is Φ=2.3x10^6 n/cm^2/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
			11.15	0.05	1980	6,27E-05	1,44E+08	0
			11.26	0.11	2640	1,50E-04	3,44E+08	0
	250nA		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
		scarica	13.24	1.15	9720	1,68E-03	3,85E+09	8
			13.35	0.11	10380	1,83E-03	4,21E+09	8
	250nA		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
			14.43	0.20	14460	2,72E-03	6,25E+09	9
		SEU LD regulator	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	0
			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
		Illegal Instruction -> Reboot	14.31	0.58	14100	4,89E-03	1,13E+10	9
		System crash	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
			17.28	0.13	24720	8,78E-03	2,02E+10	16
04/06/99	300nA		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
		Execution Error -> Reboot	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

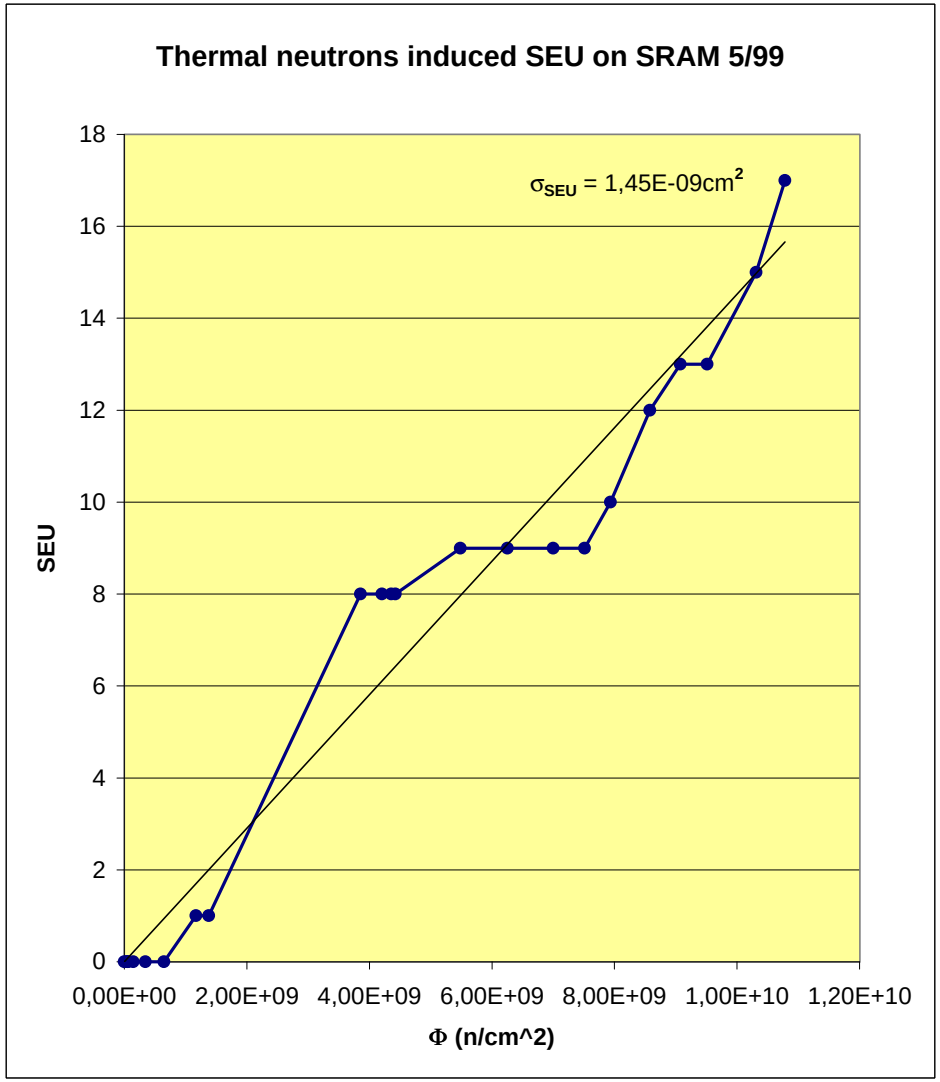
DAY	CHARGE (C)	Φ (n/cm^2)	SEU
18/05/99	0,00E+00	0,00E+00	0
	1,99E-05	4,57E+07	0
	2,22E-05	5,11E+07	0
	2,52E-05	5,80E+07	0
	6,27E-05	1,44E+08	0
	1,50E-04	3,44E+08	0
	2,82E-04	6,48E+08	0
	5,08E-04	1,17E+09	1
	6,00E-04	1,38E+09	1
	1,68E-03	3,85E+09	8
	1,83E-03	4,21E+09	8
	1,89E-03	4,36E+09	8
	1,92E-03	4,42E+09	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

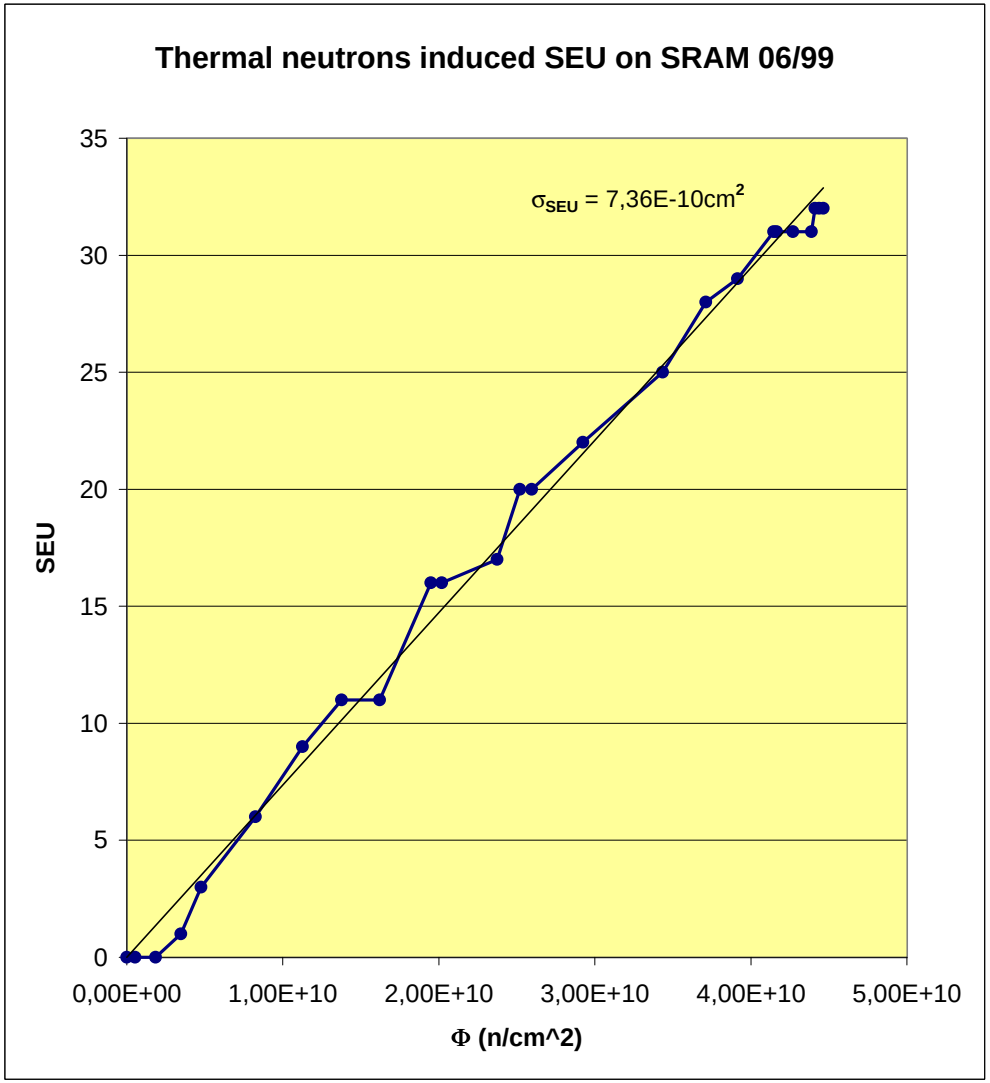
SEU data on 18/05/99

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
04/06/99	1,03E-02	2,37E+10	17
	1,10E-02	2,52E+10	20
	1,13E-02	2,60E+10	20
	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 2.3x10^6n/cm^2/μC

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*

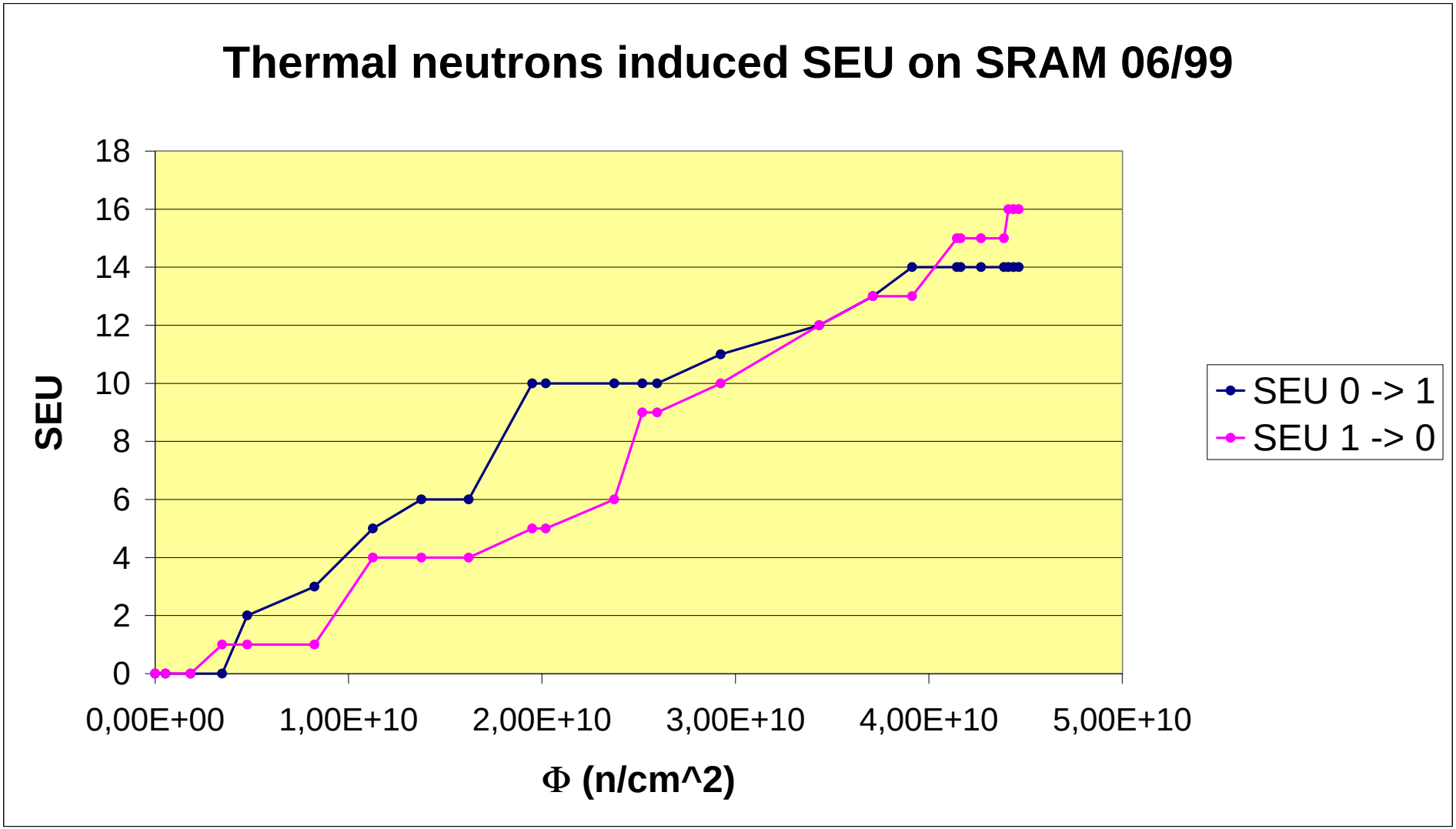
Δt *Differential day time*

t *Irradiation time*

CHARGE *Beam current integrated on target*

Φ *Estimated neutron flux on DUT*

SEU *Total number of SEU*



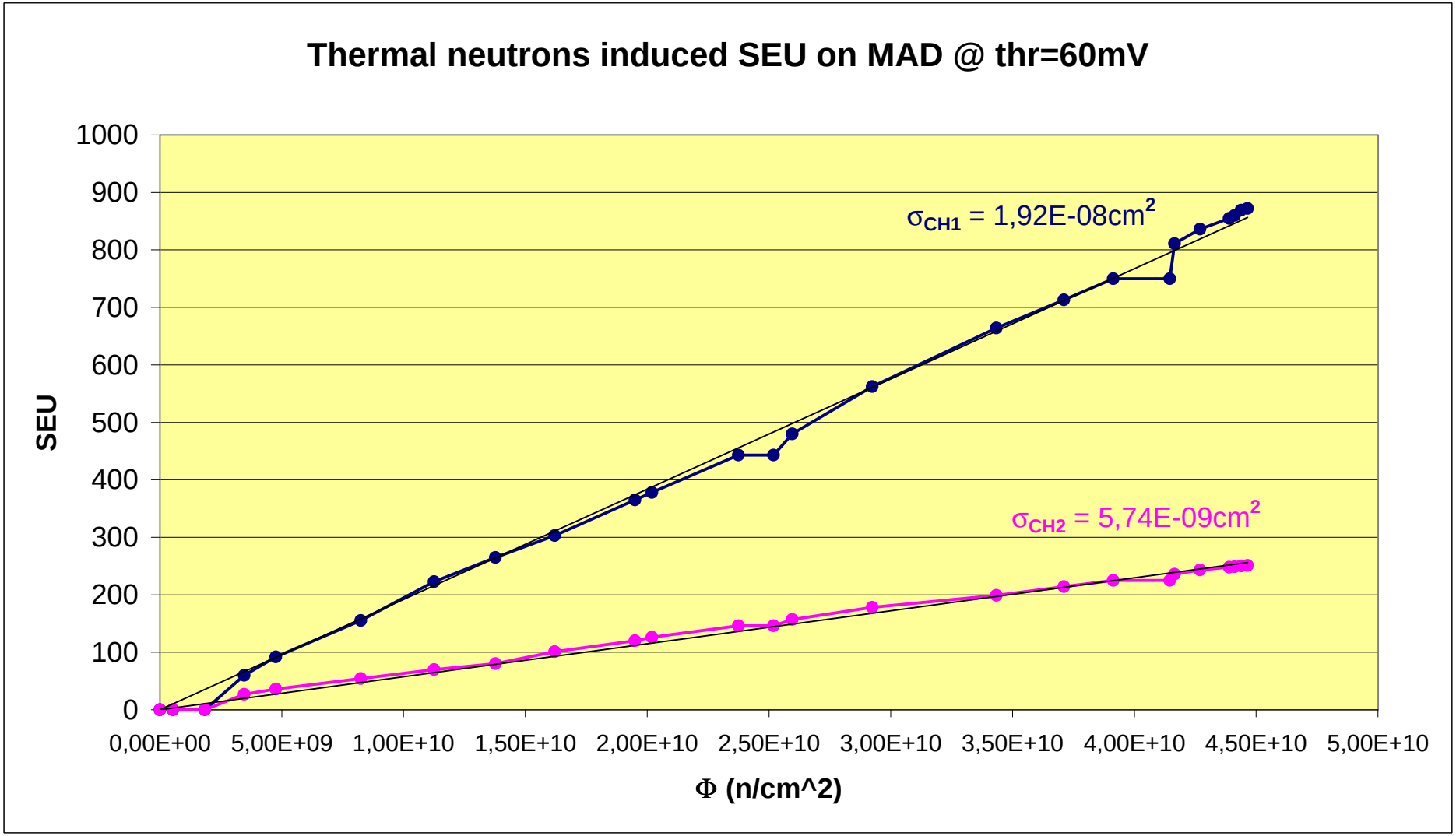
Neutron flux is calculated using the nominal yield of 2.3x10^6n/cm^2/μC

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

Neutron flux without DUT is Φ=2.3x10^6 n/cm^2/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		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
		Illegal Instruction -> Reboot	14.31	0.58	14100	4,89E-03	1,13E+10	223	70	4,89E-03	1,13E+10	223	70
		System crash	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		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
		Execution Error -> Reboot	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 2.3x10^6n/cm^2/μC

Irradiation test with fast neutrons at LNL on 16/06/99

Estimated mean neutron flux is Φ=4x10^6 n/cm^2/μC

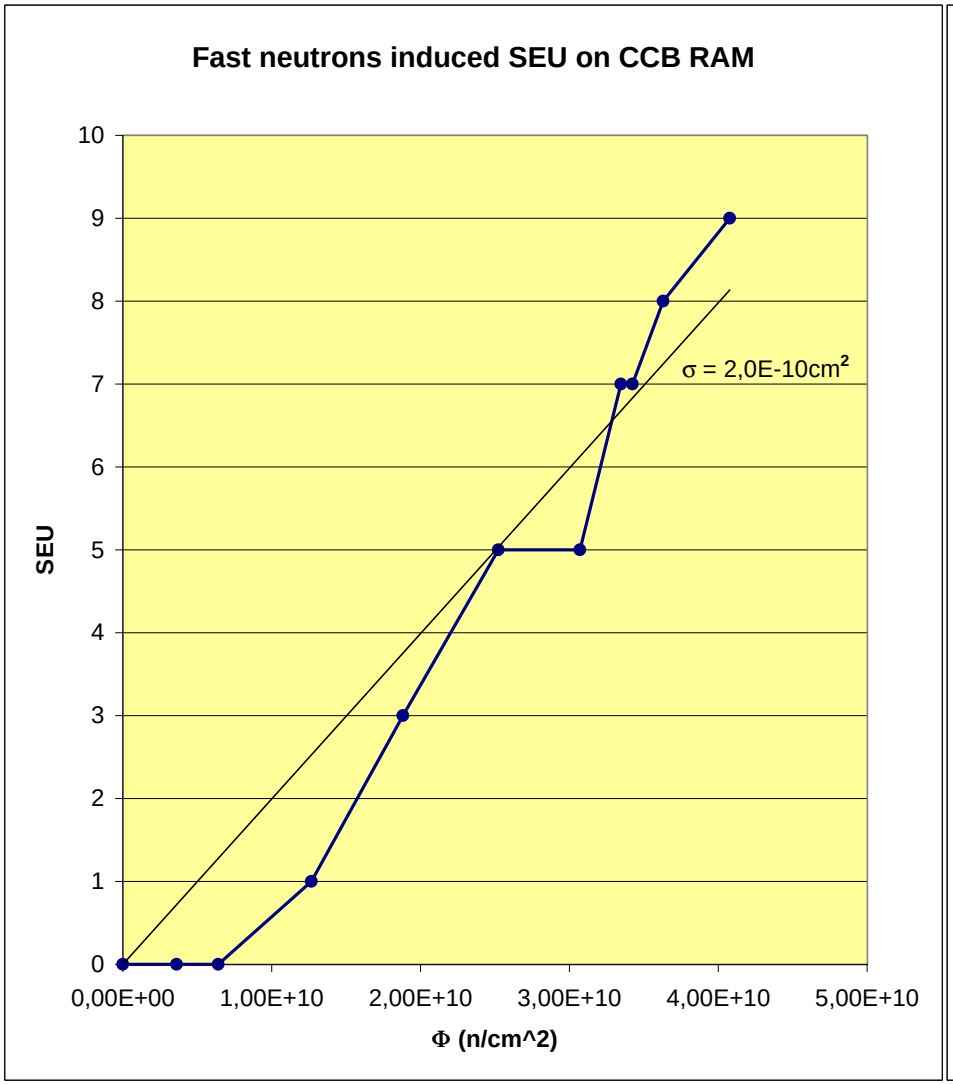
DAY	BEAM	NOTES	TIME	Δt (hh.mm)	t (s)	CHARGE (C)	Φ (n/cm^2)	SEU
16/06/99	400nA		10.23	0.00	0	0,00E+00	0,00E+00	0
			10.54	0.31	1860	9,01E-04	3,60E+09	0
			11.23	0.29	3600	1,60E-03	6,42E+09	0
			12.23	1.00	7200	3,17E-03	1,27E+10	1
			13.23	1.00	10800	4,71E-03	1,88E+10	3
		Chip TO su targhetta	14.32	1.09	14940	6,30E-03	2,52E+10	5
			15.27	0.55	18240	7,68E-03	3,07E+10	5
			16.02	0.35	20340	8,37E-03	3,35E+10	7
			16.21	0.19	21480	8,56E-03	3,42E+10	7
		tolto chip TO da targhetta	16.46	0.25	22980	9,07E-03	3,63E+10	8
			17.30	0.44	25620	1,02E-02	4,08E+10	9

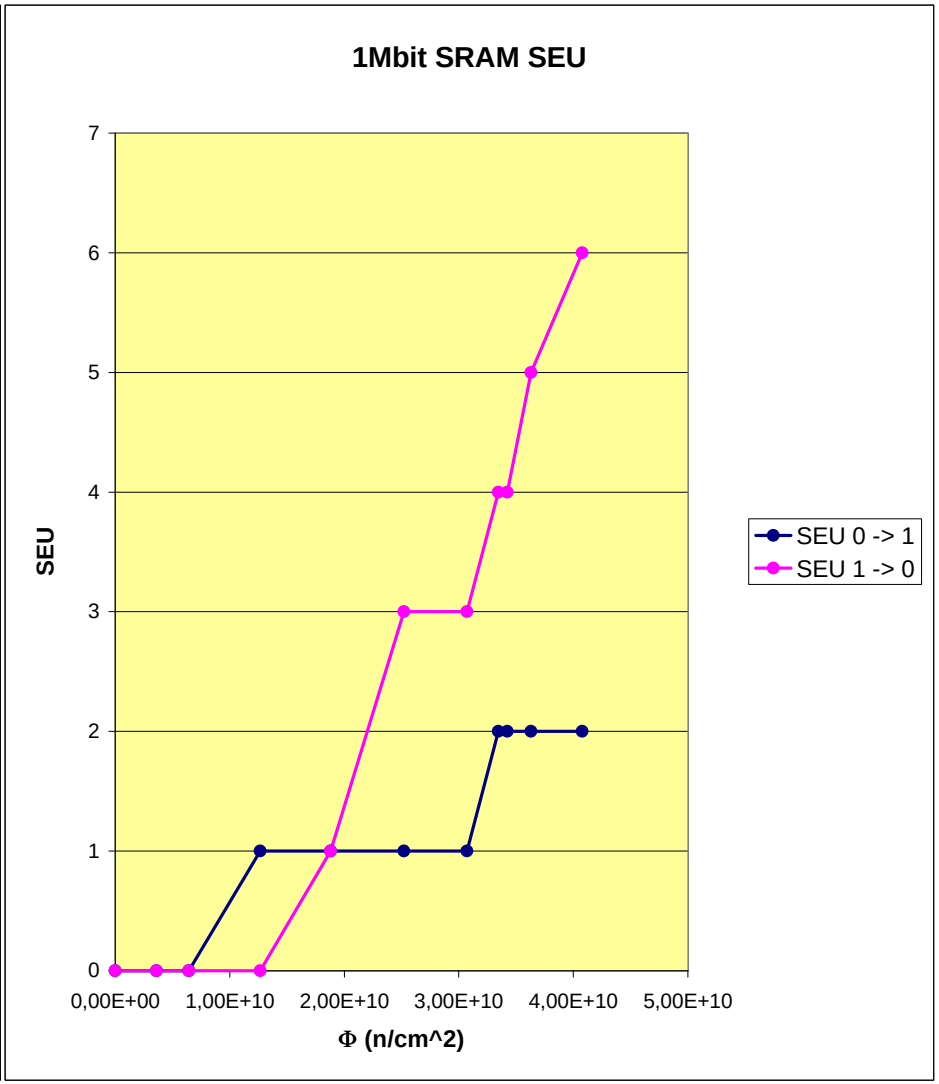
SRAM SEUs distinguishing 0-to-1 from 1-to-0 upsets.

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
16/06/99	400nA		10.23	0.00	0	0,00E+00	0,00E+00	0	0
			10.54	0.31	1860	9,01E-04	3,60E+09	0	0
			11.23	0.29	3600	1,60E-03	6,42E+09	0	0
			12.23	1.00	7200	3,17E-03	1,27E+10	1	0
			13.23	1.00	10800	4,71E-03	1,88E+10	1	1
		Chip TO su targhetta	14.32	1.09	14940	6,30E-03	2,52E+10	1	3
			15.27	0.55	18240	7,68E-03	3,07E+10	1	3
			16.02	0.35	20340	8,37E-03	3,35E+10	2	4
			16.21	0.19	21480	8,56E-03	3,42E+10	2	4
		tolto chip TO da targhetta	16.46	0.25	22980	9,07E-03	3,63E+10	2	5
			17.30	0.44	25620	1,02E-02	4,08E+10	2	6

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*





σ *SRAM SEU cross section*

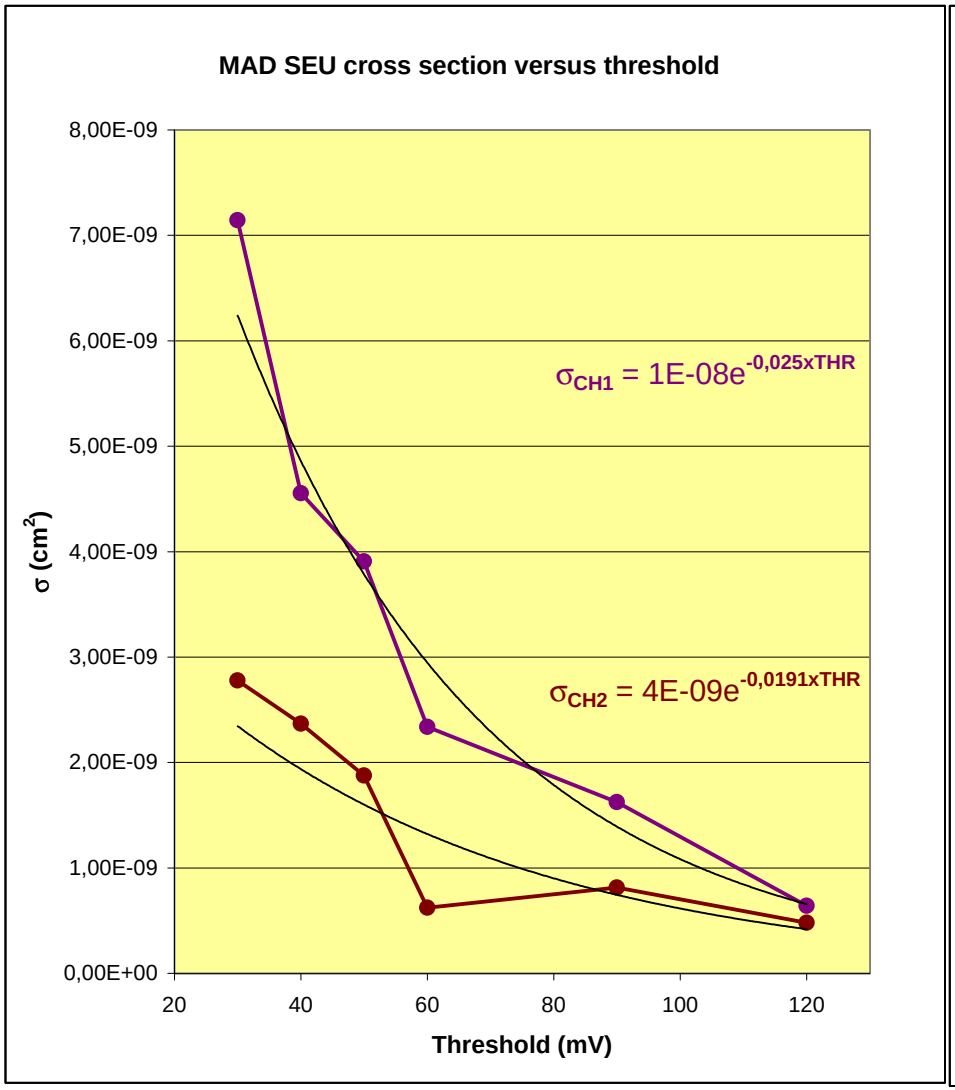
Neutron flux is calculated using the nominal yield of 4x10^6n/cm^2/μC

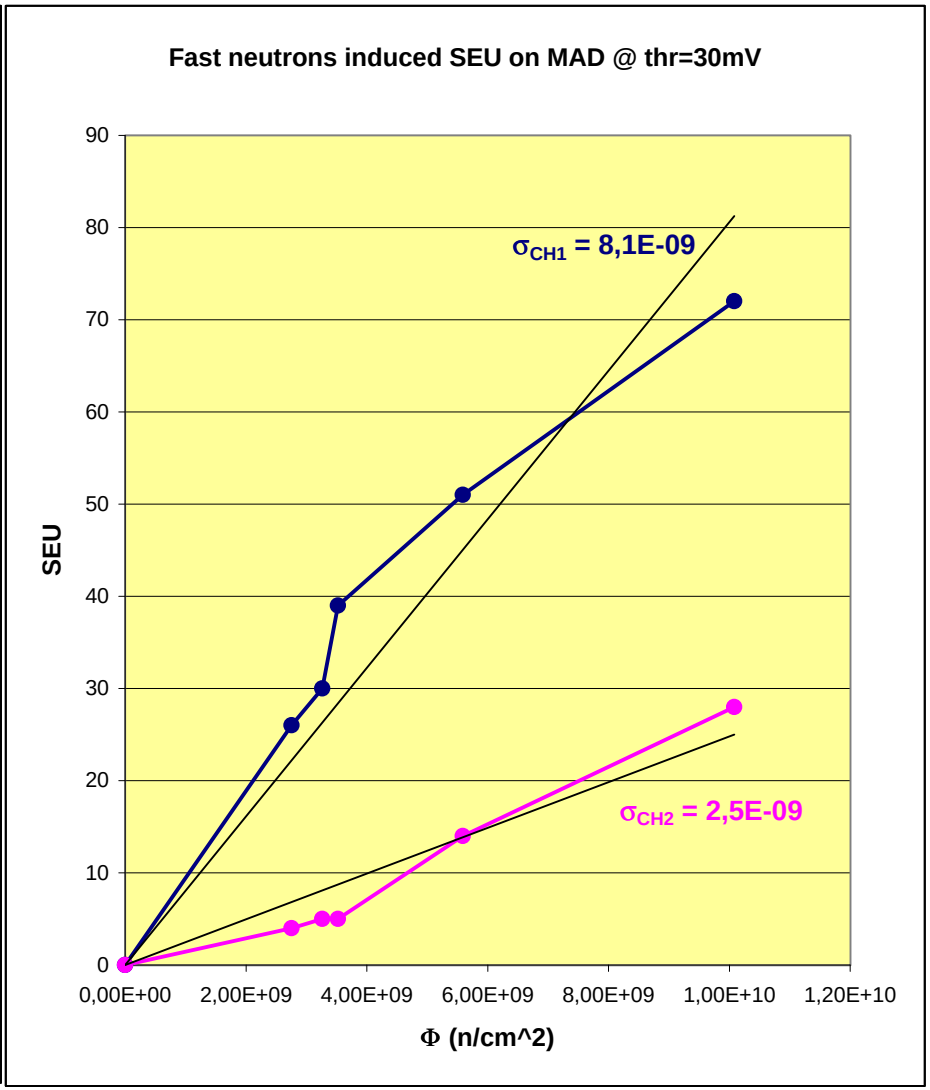
Irradiation test with fast neutrons at LNL on 16/06/99
Estimated mean neutron flux is Φ=4x10^6 n/cm^2/μC

DAY	BEAM	Threshold (mV)	CHARGE (C)	Φ (n/cm^2)	MAD Ch1	MAD Ch2	σ Ch1 (cm^2)	σ Ch2 (cm^2)
16/06/99	400nA	30	2,52E-03	1,01E+10	72	28	7,14E-09	2,78E-09
		40	1,37E-03	5,49E+09	25	13	4,56E-09	2,37E-09
		50	1,60E-03	6,40E+09	25	12	3,91E-09	1,88E-09
		60	1,60E-03	6,42E+09	15	4	2,34E-09	6,23E-10
		90	1,54E-03	6,16E+09	10	5	1,62E-09	8,12E-10
		120	1,56E-03	6,25E+09	4	3	6,40E-10	4,80E-10

DAY	BEAM	NOTES	TIME	Δt (hh.mm)	t (s)	CHARGE (C)	Φ (n/cm^2)	MAD Ch1	MAD Ch2
16/06/99	400nA	Threshold 30mV	15.27	0.00	0	0,00E+00	0,00E+00	0	0
			16.02	0.35	2100	6,89E-04	2,76E+09	26	4
			16.17	0.15	3000	8,16E-04	3,26E+09	30	5
		tolto chip TO da targhetta	16.21	0.04	3240	8,81E-04	3,52E+09	39	5
			16.46	0.25	4740	1,40E-03	5,59E+09	51	14
			17.30	0.44	7380	2,52E-03	1,01E+10	72	28

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





Neutron flux is calculated using the nominal yield of 4x10^6n/cm^2/mC