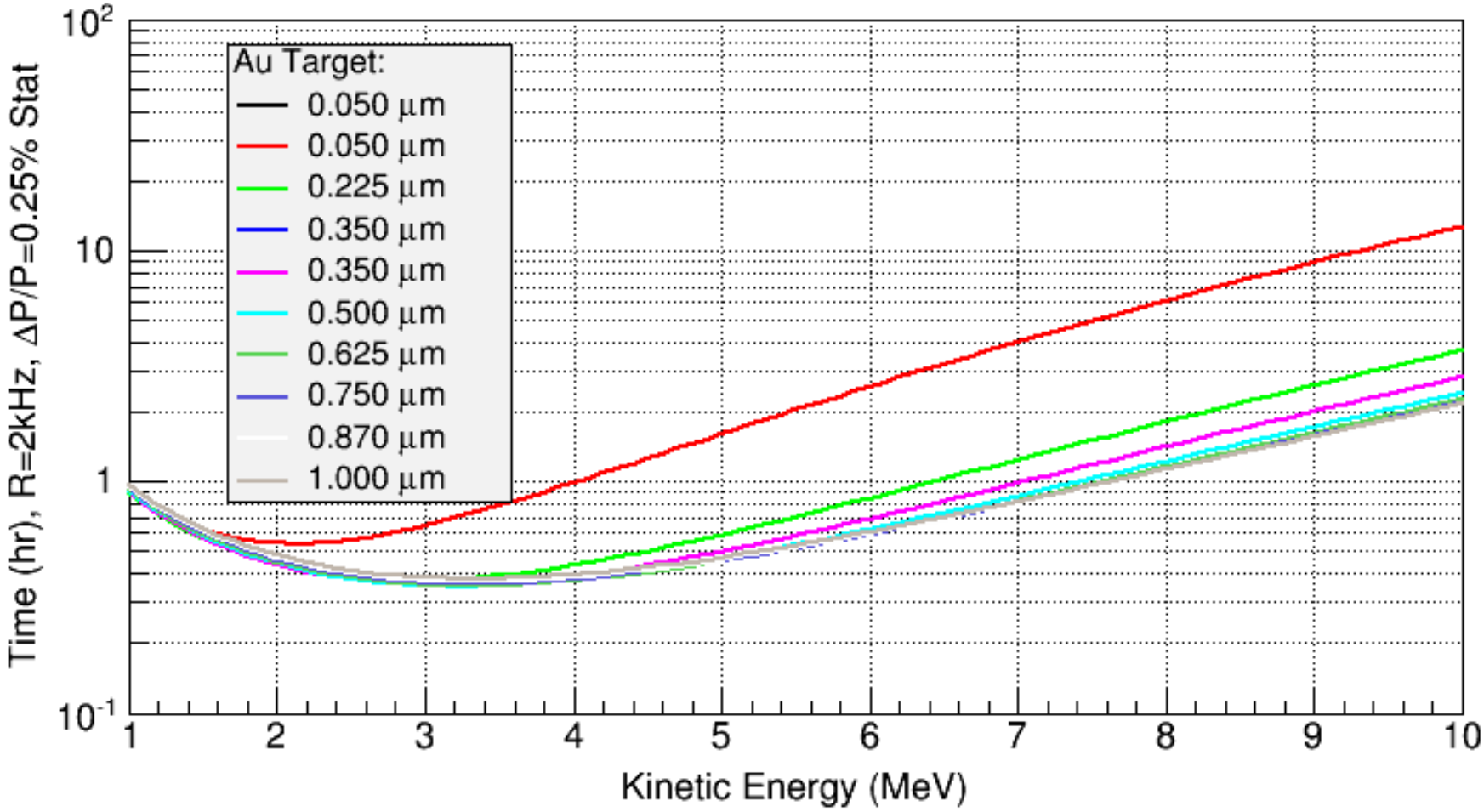
DAQ Speed and Run2 Estimates

April 3, 2015


Au Target:
0.050 µm
0.050 µm
0.225 µm
0.350 µm
0.350 µm
0.500 µm
0.625 µm
0.750 µm
0.870 µm
1.000 µm
Time (hr), R=2kHz, ΔP/P=0.25% Stat
Kinetic Energy (MeV)
10^2
10
1
10^-1
1
2
3
4
5
6
7
8
9
10

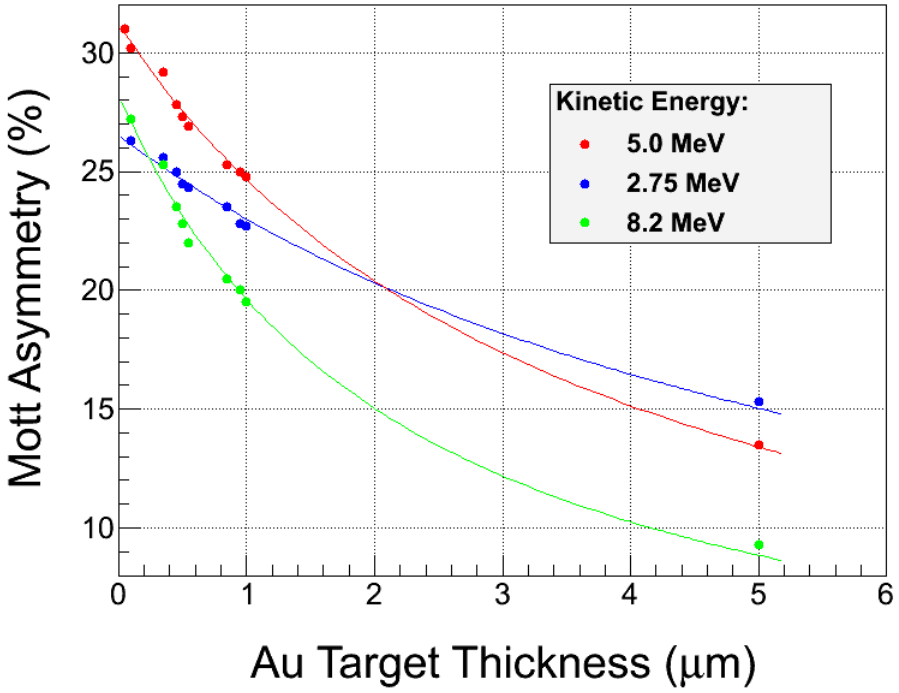
Estimates Assumptions

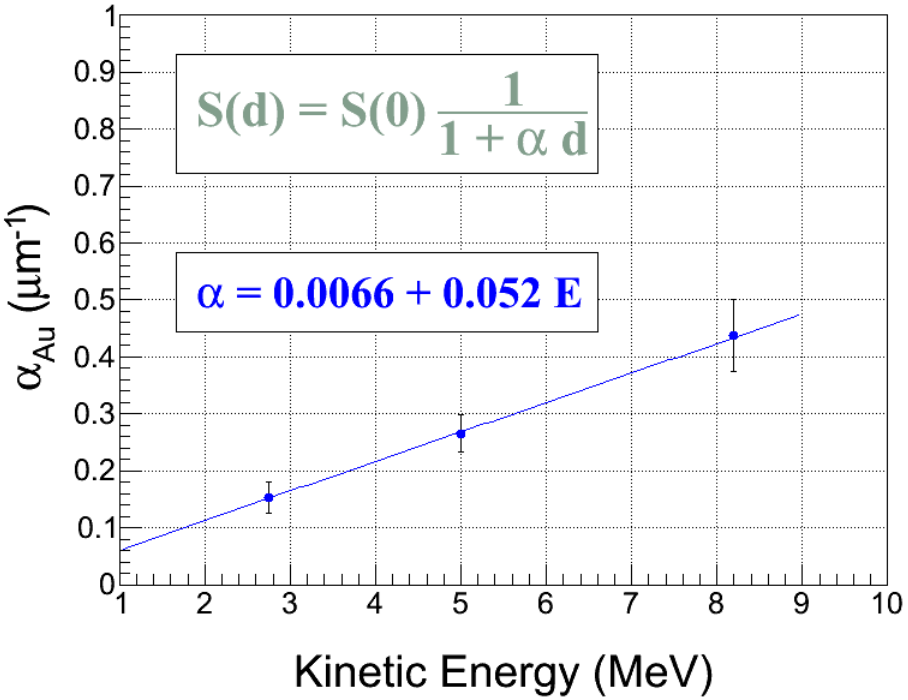
- DAQ Rate limit = 2 kHz, Deadtime = 15%. Note that any systematic errors due to deadtime cancel to all orders in cross-ratio method – Measured in Run1

- Current Limit of 5 μA

- Dump rate = 100 Hz/μA per detector:
  - Measured during Run1 5 MeV data at
  - Discriminator Threshold was 25 mV (or energy of about 1.25 MeV)
  - Dump Dipole Magnet was at +5A

Target Thickness Extrapolation





3 MeV

T(um) = 0.05	I (uA) = 2.89021	Elas(Hz) = 843.917	Dmp(Hz) = 1156.08	Tot(Hz) = 2000	Tim (h) = 0.642548	N_elas(M#) = 1.95213
T(um) = 0.05	I (uA) = 2.89021	Elas(Hz) = 843.917	Dmp(Hz) = 1156.08	Tot(Hz) = 2000	Tim (h) = 0.642548	N_elas(M#) = 1.95213
T(um) = 0.225	I (uA) = 1.16689	Elas(Hz) = 1533.25	Dmp(Hz) = 466.754	Tot(Hz) = 2000	Tim (h) = 0.373913	N_elas(M#) = 2.06388
T(um) = 0.35	I (uA) = 0.818349	Elas(Hz) = 1672.66	Dmp(Hz) = 327.34	Tot(Hz) = 2000	Tim (h) = 0.356321	N_elas(M#) = 2.14561
T(um) = 0.35	I (uA) = 0.818349	Elas(Hz) = 1672.66	Dmp(Hz) = 327.34	Tot(Hz) = 2000	Tim (h) = 0.356321	N_elas(M#) = 2.14561
T(um) = 0.5	I (uA) = 0.602424	Elas(Hz) = 1759.03	Dmp(Hz) = 240.97	Tot(Hz) = 2000	Tim (h) = 0.354643	N_elas(M#) = 2.24578
T(um) = 0.625	I (uA) = 0.493839	Elas(Hz) = 1802.46	Dmp(Hz) = 197.536	Tot(Hz) = 2000	Tim (h) = 0.359231	N_elas(M#) = 2.331
T(um) = 0.75	I (uA) = 0.418421	Elas(Hz) = 1832.63	Dmp(Hz) = 167.368	Tot(Hz) = 2000	Tim (h) = 0.366475	N_elas(M#) = 2.41781
T(um) = 0.87	I (uA) = 0.364919	Elas(Hz) = 1854.03	Dmp(Hz) = 145.968	Tot(Hz) = 2000	Tim (h) = 0.374954	N_elas(M#) = 2.50264
T(um) = 1	I (uA) = 0.320521	Elas(Hz) = 1871.79	Dmp(Hz) = 128.208	Tot(Hz) = 2000	Tim (h) = 0.385279	N_elas(M#) = 2.59619

5 MeV

T(um) = 0.05	I (uA) = 4.27389	Elas(Hz) = 290.443	Dmp(Hz) = 1709.56	Tot(Hz) = 2000	Tim (h) = 1.59739	N_elas(M#) = 1.67022
T(um) = 0.05	I (uA) = 4.27389	Elas(Hz) = 290.443	Dmp(Hz) = 1709.56	Tot(Hz) = 2000	Tim (h) = 1.59739	N_elas(M#) = 1.67022
T(um) = 0.225	I (uA) = 2.83363	Elas(Hz) = 866.548	Dmp(Hz) = 1133.45	Tot(Hz) = 2000	Tim (h) = 0.585837	N_elas(M#) = 1.82756
T(um) = 0.35	I (uA) = 2.28388	Elas(Hz) = 1086.45	Dmp(Hz) = 913.552	Tot(Hz) = 2000	Tim (h) = 0.497104	N_elas(M#) = 1.94428
T(um) = 0.35	I (uA) = 2.28388	Elas(Hz) = 1086.45	Dmp(Hz) = 913.552	Tot(Hz) = 2000	Tim (h) = 0.497104	N_elas(M#) = 1.94428
T(um) = 0.5	I (uA) = 1.85258	Elas(Hz) = 1258.97	Dmp(Hz) = 741.032	Tot(Hz) = 2000	Tim (h) = 0.460941	N_elas(M#) = 2.08911
T(um) = 0.625	I (uA) = 1.60068	Elas(Hz) = 1359.73	Dmp(Hz) = 640.272	Tot(Hz) = 2000	Tim (h) = 0.452252	N_elas(M#) = 2.21378
T(um) = 0.75	I (uA) = 1.40908	Elas(Hz) = 1436.37	Dmp(Hz) = 563.633	Tot(Hz) = 2000	Tim (h) = 0.45293	N_elas(M#) = 2.34206
T(um) = 0.87	I (uA) = 1.26385	Elas(Hz) = 1494.46	Dmp(Hz) = 505.542	Tot(Hz) = 2000	Tim (h) = 0.458846	N_elas(M#) = 2.46861
T(um) = 1	I (uA) = 1.13691	Elas(Hz) = 1545.23	Dmp(Hz) = 454.765	Tot(Hz) = 2000	Tim (h) = 0.469088	N_elas(M#) = 2.60946

8 MeV

T(um) = 0.05	I (uA) = 4.75761	Elas(Hz) = 96.955	Dmp(Hz) = 1903.05	Tot(Hz) = 2000	Tim (h) = 6.03289	N_elas(M#) = 2.10571
T(um) = 0.05	I (uA) = 4.75761	Elas(Hz) = 96.955	Dmp(Hz) = 1903.05	Tot(Hz) = 2000	Tim (h) = 6.03289	N_elas(M#) = 2.10571
T(um) = 0.225	I (uA) = 4.06748	Elas(Hz) = 373.009	Dmp(Hz) = 1626.99	Tot(Hz) = 2000	Tim (h) = 1.80348	N_elas(M#) = 2.42176
T(um) = 0.35	I (uA) = 3.6856	Elas(Hz) = 525.76	Dmp(Hz) = 1474.24	Tot(Hz) = 2000	Tim (h) = 1.40592	N_elas(M#) = 2.66104
T(um) = 0.35	I (uA) = 3.6856	Elas(Hz) = 525.76	Dmp(Hz) = 1474.24	Tot(Hz) = 2000	Tim (h) = 1.40592	N_elas(M#) = 2.66104
T(um) = 0.5	I (uA) = 3.31241	Elas(Hz) = 675.034	Dmp(Hz) = 1324.97	Tot(Hz) = 2000	Tim (h) = 1.2193	N_elas(M#) = 2.96305
T(um) = 0.625	I (uA) = 3.05466	Elas(Hz) = 778.134	Dmp(Hz) = 1221.87	Tot(Hz) = 2000	Tim (h) = 1.15202	N_elas(M#) = 3.22713
T(um) = 0.75	I (uA) = 2.83413	Elas(Hz) = 866.348	Dmp(Hz) = 1133.65	Tot(Hz) = 2000	Tim (h) = 1.123	N_elas(M#) = 3.50247
T(um) = 0.87	I (uA) = 2.65044	Elas(Hz) = 939.826	Dmp(Hz) = 1060.17	Tot(Hz) = 2000	Tim (h) = 1.11646	N_elas(M#) = 3.77741
T(um) = 1	I (uA) = 2.47654	Elas(Hz) = 1009.38	Dmp(Hz) = 990.616	Tot(Hz) = 2000	Tim (h) = 1.12472	N_elas(M#) = 4.08697

Dump Event Suppression

- Increase Discriminator Threshold – Tested in Run1
- Study Dump dipole (+5A, 0A, +5A) – Tested in Run1 (for thinner foils, 0A or -5A may yield lower dump rate)
- Laser timing veto – Tested on February 9, 2015

Note: Dump rate depends on electron energy (~1/E)

Run2 Strategy

- At 3 MeV:
  - Dump events will be higher due to energy
  - Increase Discriminator Threshold
  - ➢ Thick foils will benefit from faster DAQ but very little reduction in overall time required for Run2. Here DAQ speed will help with systematic studies, e.g., many short runs with very high statistics for stability study.

- At 8 MeV:
  - Dump events will be lower due to energy
  - Elastic rate is too low to benefit from faster DAQ
  - Suppress dump events will reduce deadtime
  - ➢ Will run at about 5 μA (31 MHz) for all foils (current limited)

What is a reasonable current limit? Run1 was 5 μA

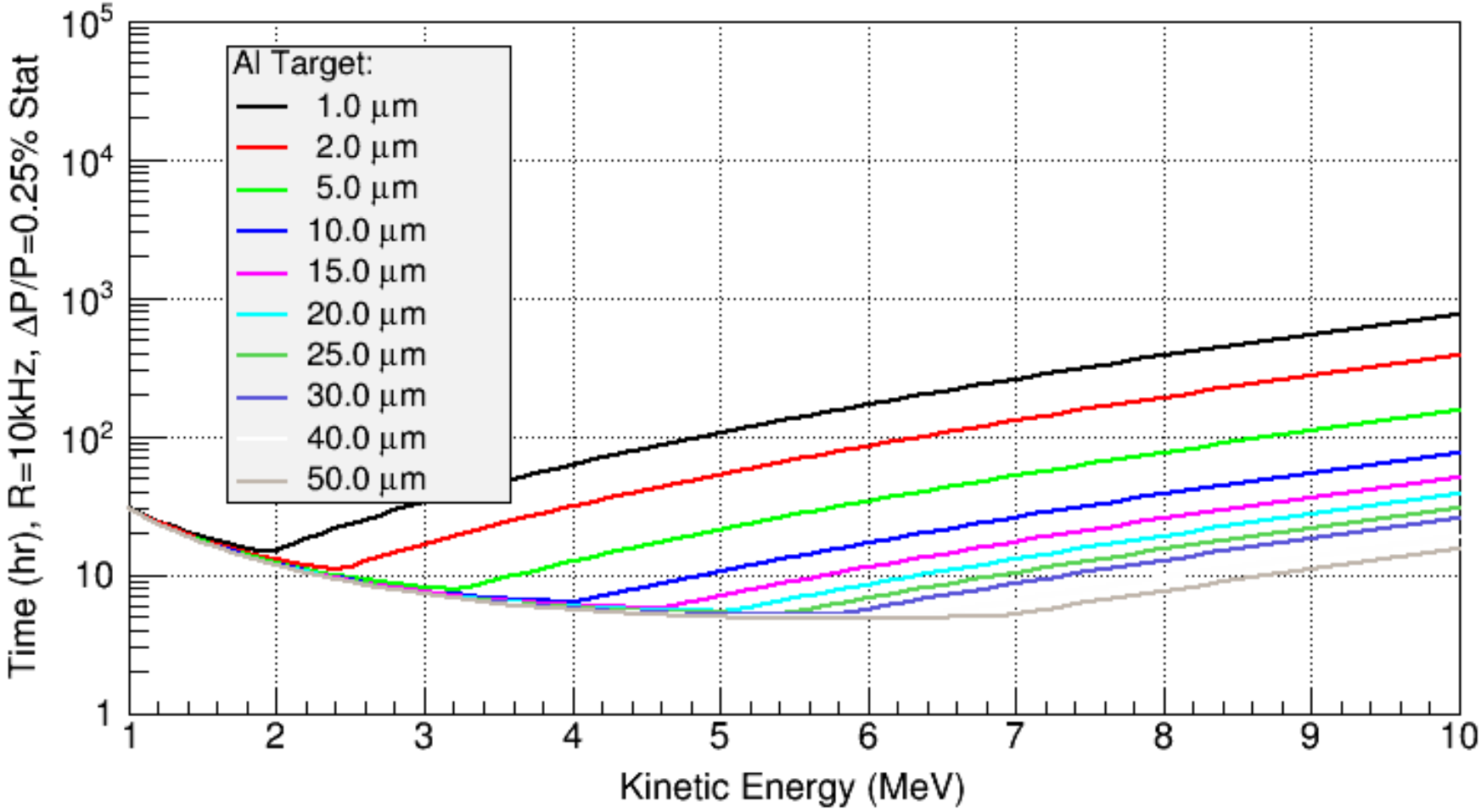
SUMMARY OF FADC DEVELOPMENT FOR FASTER PERFORMANCE

REMAINING CHALLENGES & PLANS

Al Estimates

Al Estimates Assumptions

- DAQ Rate limit = 10 kHz
- Current Limit = 40 μA
- Dump rate = 10 Hz/μA per detector
- Target Thickness Extrapolation: $\alpha = 0$


Al Target:
1.0 μm
2.0 μm
5.0 μm
10.0 μm
15.0 μm
20.0 μm
25.0 μm
30.0 μm
40.0 μm
50.0 μm
Time (hr), R=10kHz, ΔP/P=0.25% Stat
Kinetic Energy (MeV)
10^5
10^4
10^3
10^2
10
1
1
2
3
4
5
6
7
8
9
10

KE = 3 MeV

T(um) = 1	I (uA) = 40	Tim (h) = 33.0332
T(um) = 2	I (uA) = 40	Tim (h) = 16.5166
T(um) = 5	I (uA) = 32.5581	Tim (h) = 8.11673
T(um) = 10	I (uA) = 17.4129	Tim (h) = 7.5882
T(um) = 15	I (uA) = 11.8845	Tim (h) = 7.41202
T(um) = 20	I (uA) = 9.02061	Tim (h) = 7.32393
T(um) = 25	I (uA) = 7.26895	Tim (h) = 7.27108
T(um) = 30	I (uA) = 6.08695	Tim (h) = 7.23584
T(um) = 40	I (uA) = 4.59317	Tim (h) = 7.1918
T(um) = 50	I (uA) = 3.68809	Tim (h) = 7.16537

KE = 5 MeV

T(um) = 1	I (uA) = 40	Tim (h) = 105.241
T(um) = 2	I (uA) = 40	Tim (h) = 52.6204
T(um) = 5	I (uA) = 40	Tim (h) = 21.0482
T(um) = 10	I (uA) = 40	Tim (h) = 10.5241
T(um) = 15	I (uA) = 40	Tim (h) = 7.01605
T(um) = 20	I (uA) = 38.6771	Tim (h) = 5.44202
T(um) = 25	I (uA) = 31.9297	Tim (h) = 5.27363
T(um) = 30	I (uA) = 27.1868	Tim (h) = 5.16138
T(um) = 40	I (uA) = 20.9599	Tim (h) = 5.02105
T(um) = 50	I (uA) = 17.0539	Tim (h) = 4.93686

KE = 8 MeV

T(um) = 1	I (uA) = 40	Tim (h) = 378.985
T(um) = 2	I (uA) = 40	Tim (h) = 189.492
T(um) = 5	I (uA) = 40	Tim (h) = 75.7969
T(um) = 10	I (uA) = 40	Tim (h) = 37.8985
T(um) = 15	I (uA) = 40	Tim (h) = 25.2656
T(um) = 20	I (uA) = 40	Tim (h) = 18.9492
T(um) = 25	I (uA) = 40	Tim (h) = 15.1594
T(um) = 30	I (uA) = 40	Tim (h) = 12.6328
T(um) = 40	I (uA) = 40	Tim (h) = 9.47461
T(um) = 50	I (uA) = 40	Tim (h) = 7.57969