Update of the Stripper lifetime utility

In collaboration with Felix Marti & Wolfgang Mittig

See "The Stripper foil lifetime utility" part 1 (v.8.3.6) at:
http://groups.nscl.msu.edu/lise/8_3/foil_lifetime_v8_3_6.pdf

Stripper Lifetime utility *(version 8.3.13)*

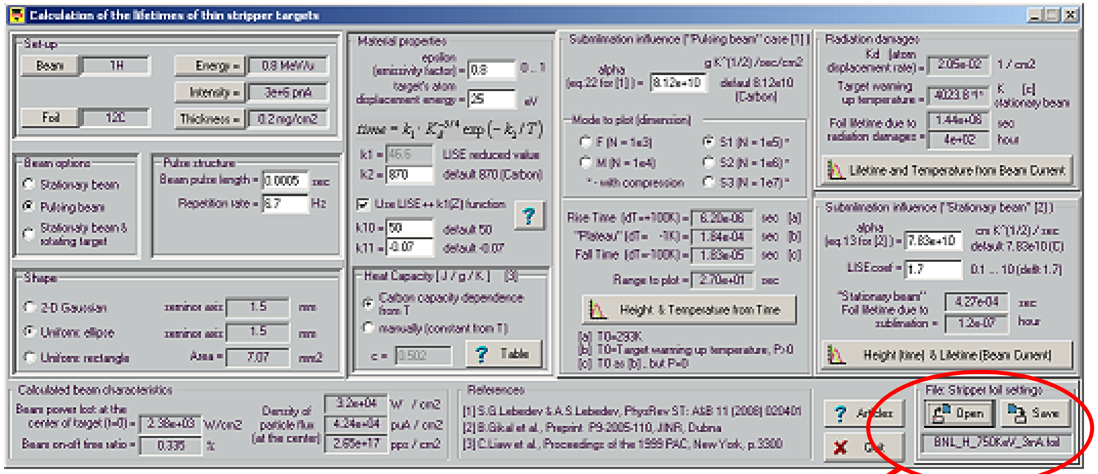
- I/O file for the Striper lifetime dialog
- Baron's parameterization
- LISE++ k1-dependence from Z
- Comparison with experimental data
  - ^{40}Ar @ Dubna : Radiation damage
  - ^{20}Ne @ Dubna : Radiation damage
  - ^{112}Sn @ MSU : Radiation damage
  - ^{238}U @ MSU : Radiation damage
- Analysis of some parameters
  - Interaction area (Current)
  - Foil thickness
  - Beam energy
  - Emissivity factor
  - Heat capacity (pulsing beam)
  - k2 coefficient
  - rotation target frequency

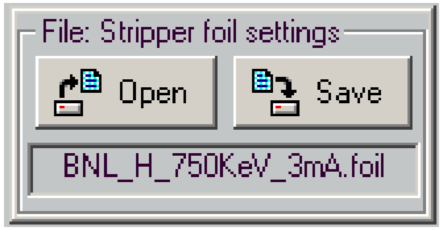
The code operates under MS Windows environment and provides a highly user-friendly interface.
It can be freely downloaded from the following internet addresses:
http://www.nscl.msu/edu/lise

IO file for the Striper lifetime dialog

Default : “ Lise / files ” directory

File extension: “ *.foil “

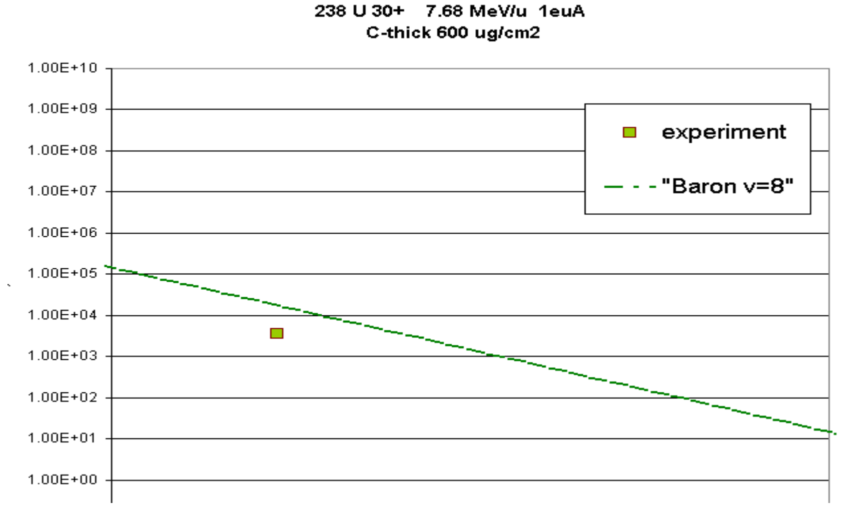


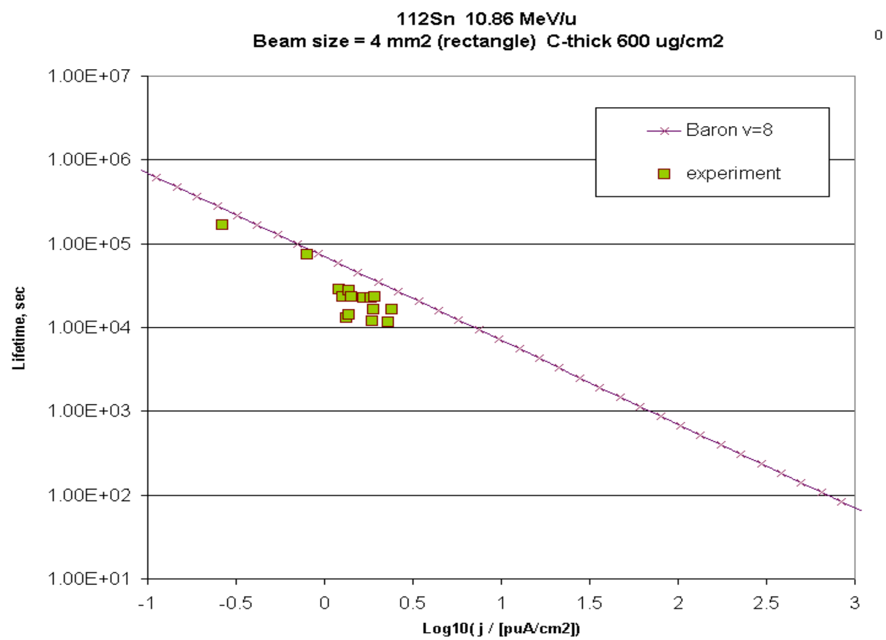


Baron's parameterization

Durée de vie des cibles de stripping (carbone)

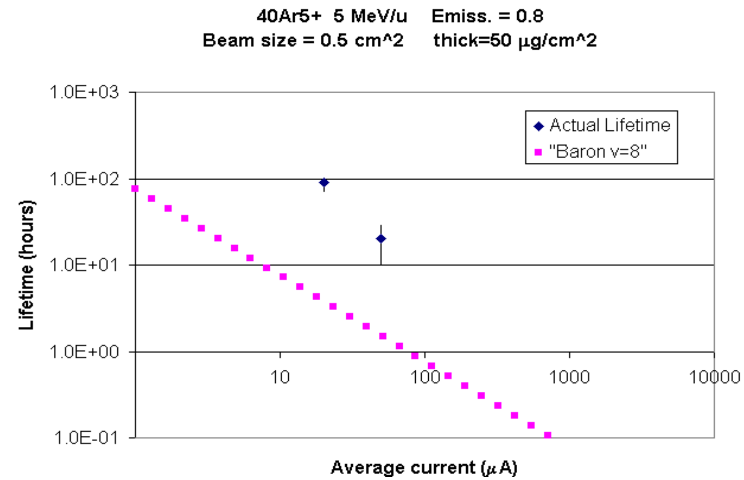
Eric Baron, en réponse à une question de W. Mittig, 17/04/08

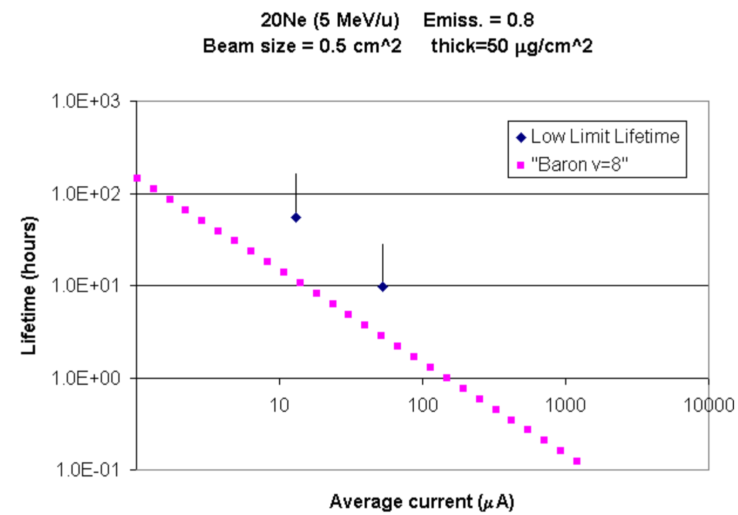




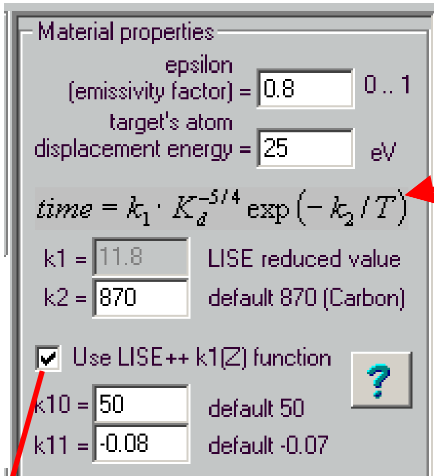
$$T(heures) = 3.6\ 10^{+4}\ \frac{W(MeV/n)}{Z^2\, \nu\, J(p\mu A/cm^2)}$$

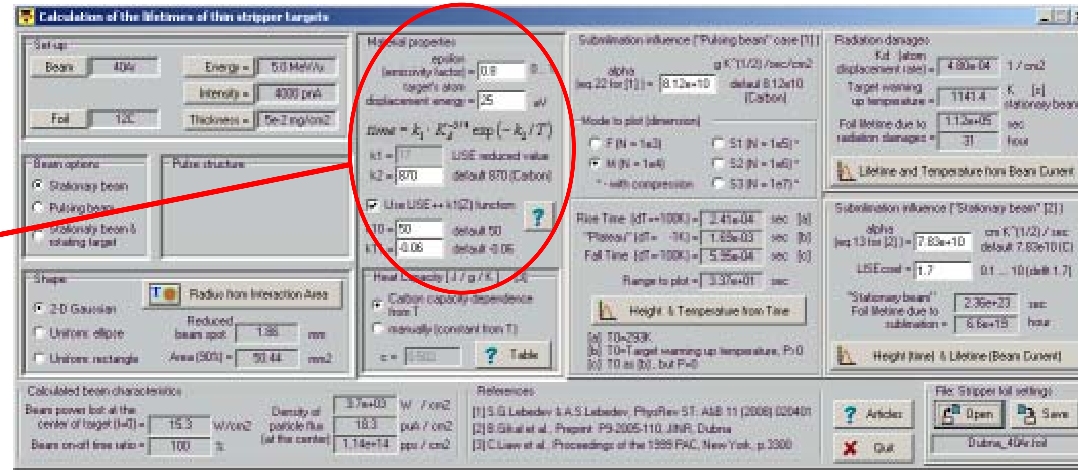
W = l'énergie du projectile de numéro atomique Z, J la densité de courant à l'endroit de l'impact du faisceau sur la cible en μampères-particule, et <u>ν</u> un nombre qui varie entre 5 et 8 (ce n'est donc pas très important, en première approximation) ; c'est le nombre moyen d'atomes de carbone déplacés par un atome de carbone issu d'une collision avec un ion.



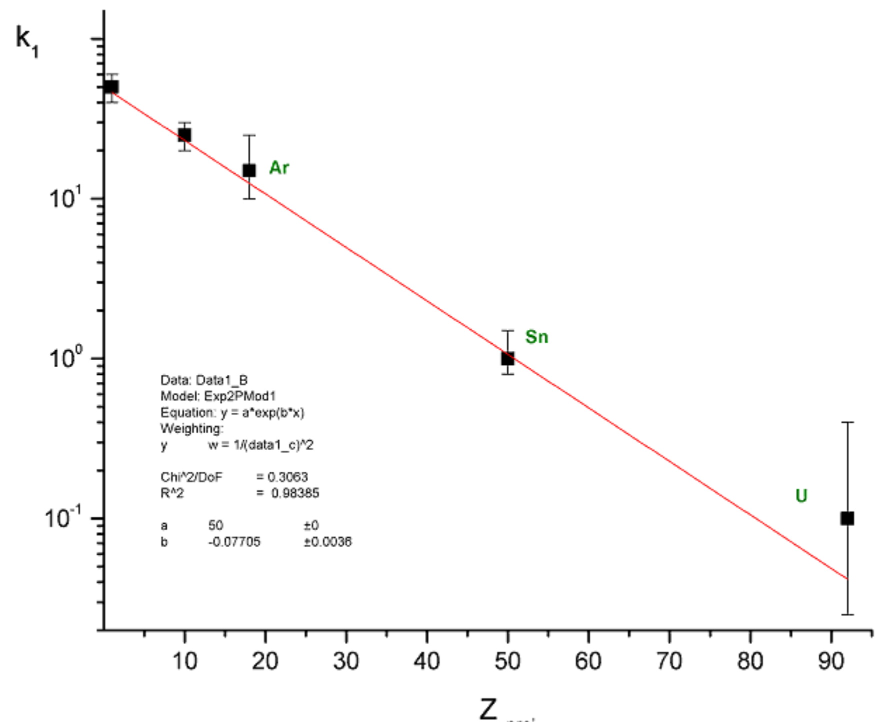


LISE++ k1 (Z) function

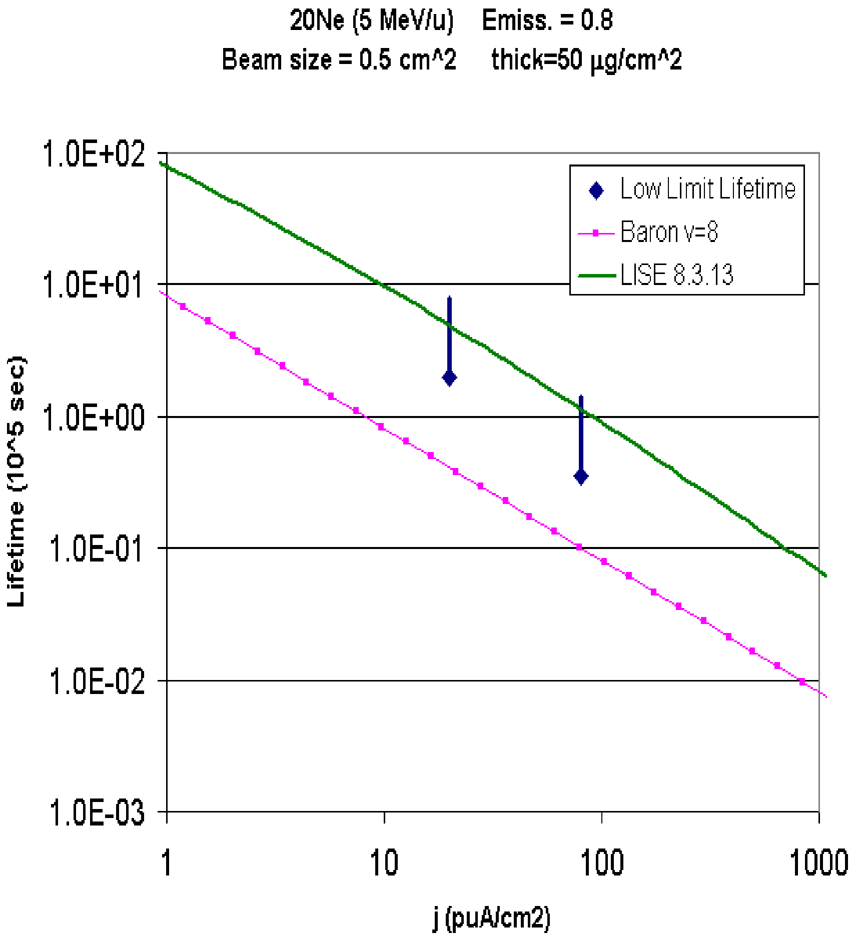


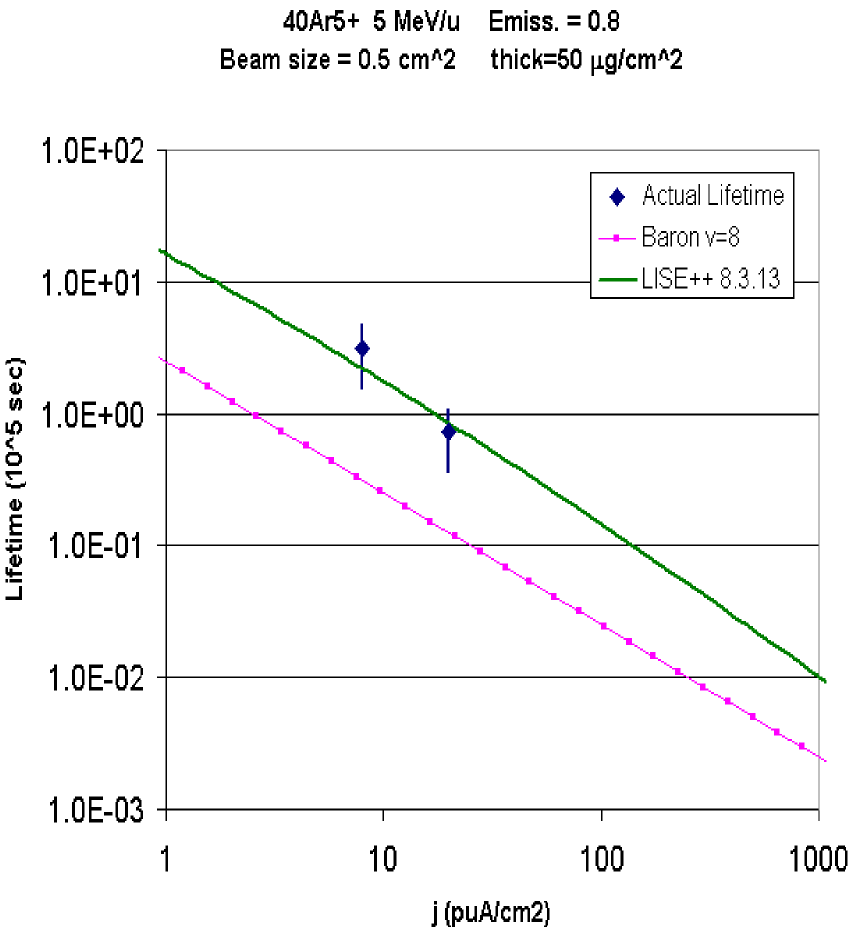


$$k_1 = k_{10} \cdot \exp\left(-k_{11} \cdot Z_{proj}\right)$$



^{20}Ne & ^{40}Ar @ Dubna : Radiation damages

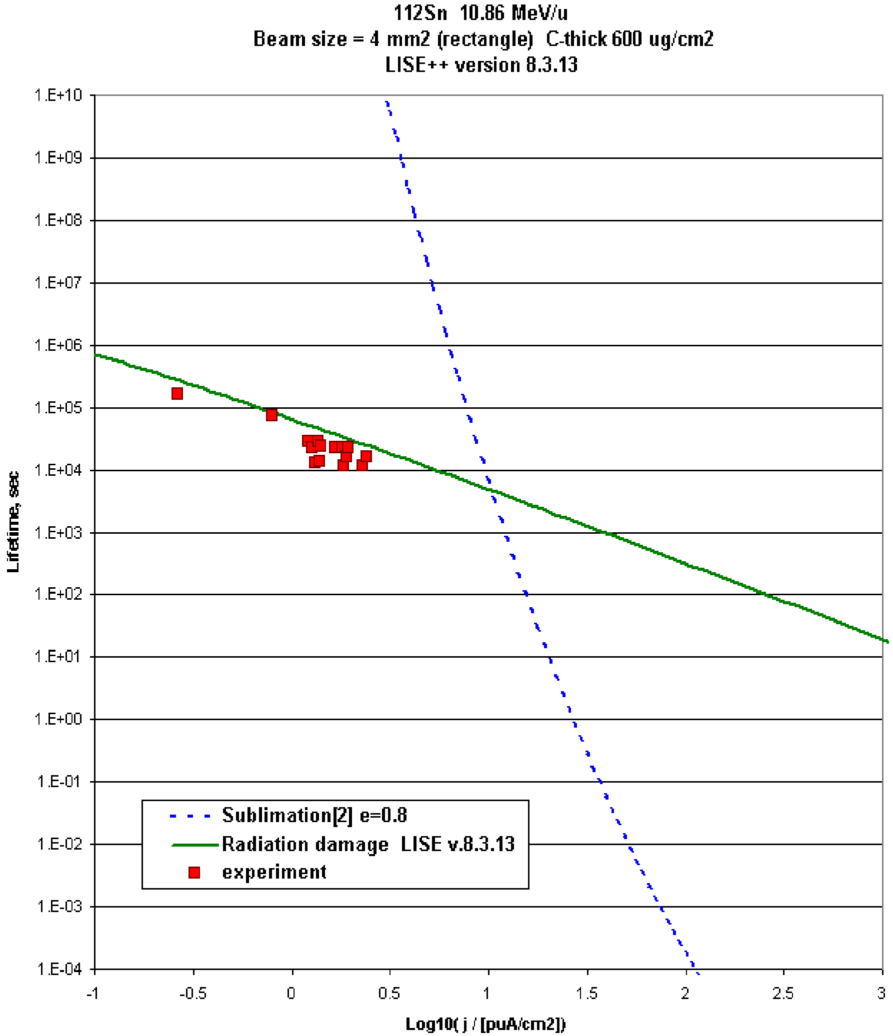


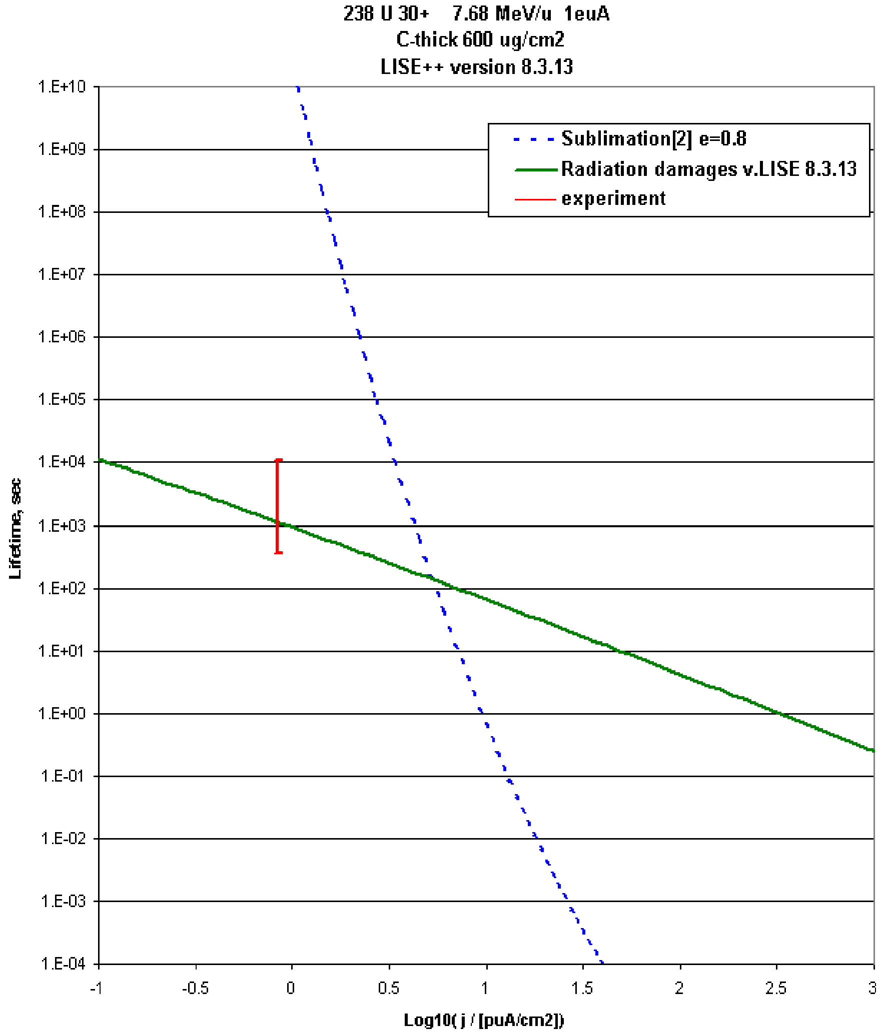


v.8.3.13 http://groups.nscl.msu.edu/lise/8_3/Dubna_20Ne.foil

v.8.3.13 http://groups.nscl.msu.edu/lise/8_3/Dubna_40Ar.foil

$^{112}Sn^{17+}$ & $^{238}U^{30+}$ @ MSU : Radiation damage





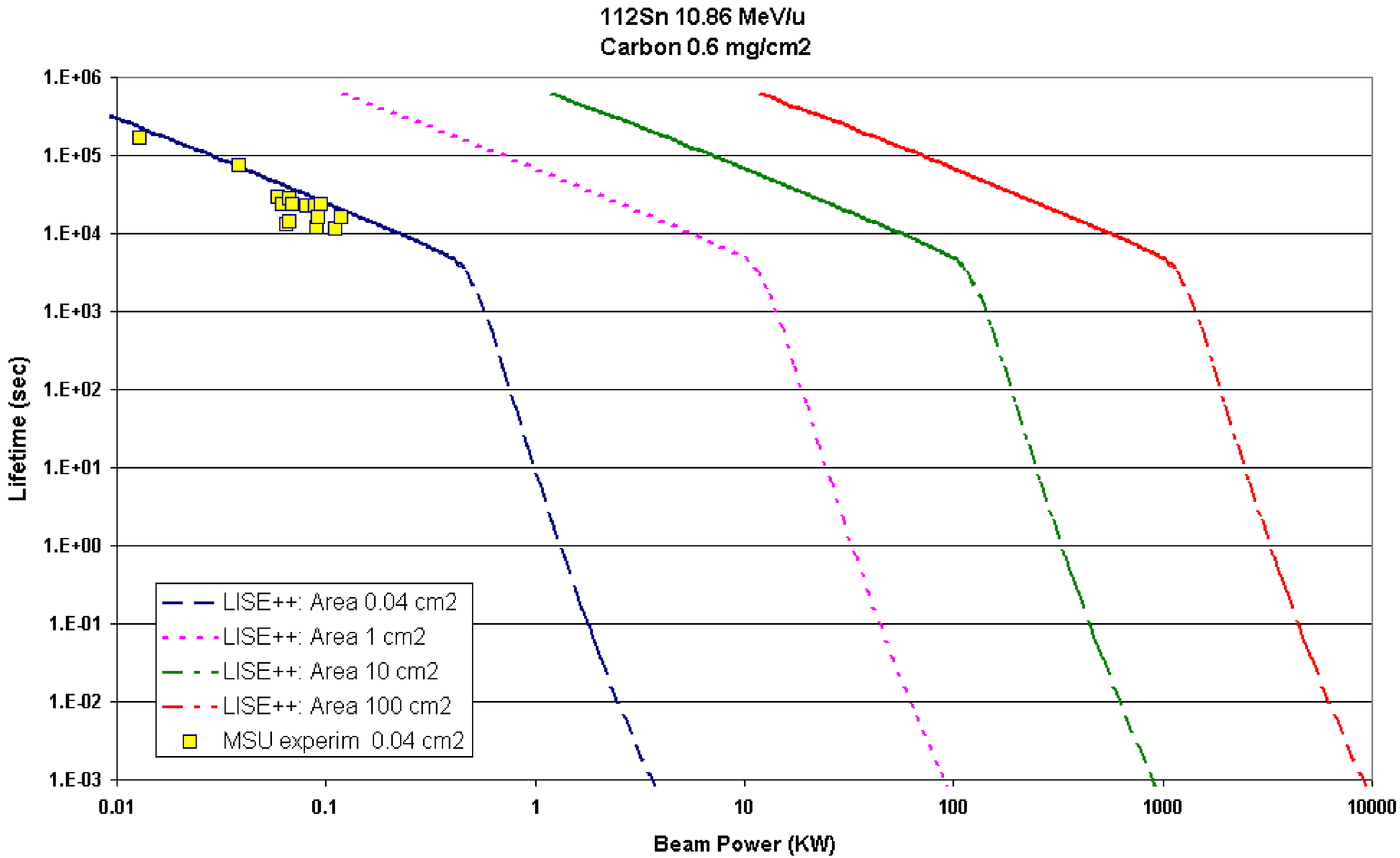
v.8.3.13 http://groups.nscl.msu.edu/lise/8_3/MSU_112Sn.foil

v.8.3.13. http://groups.nscl.msu.edu/lise/8_3/MSU_238U.foil

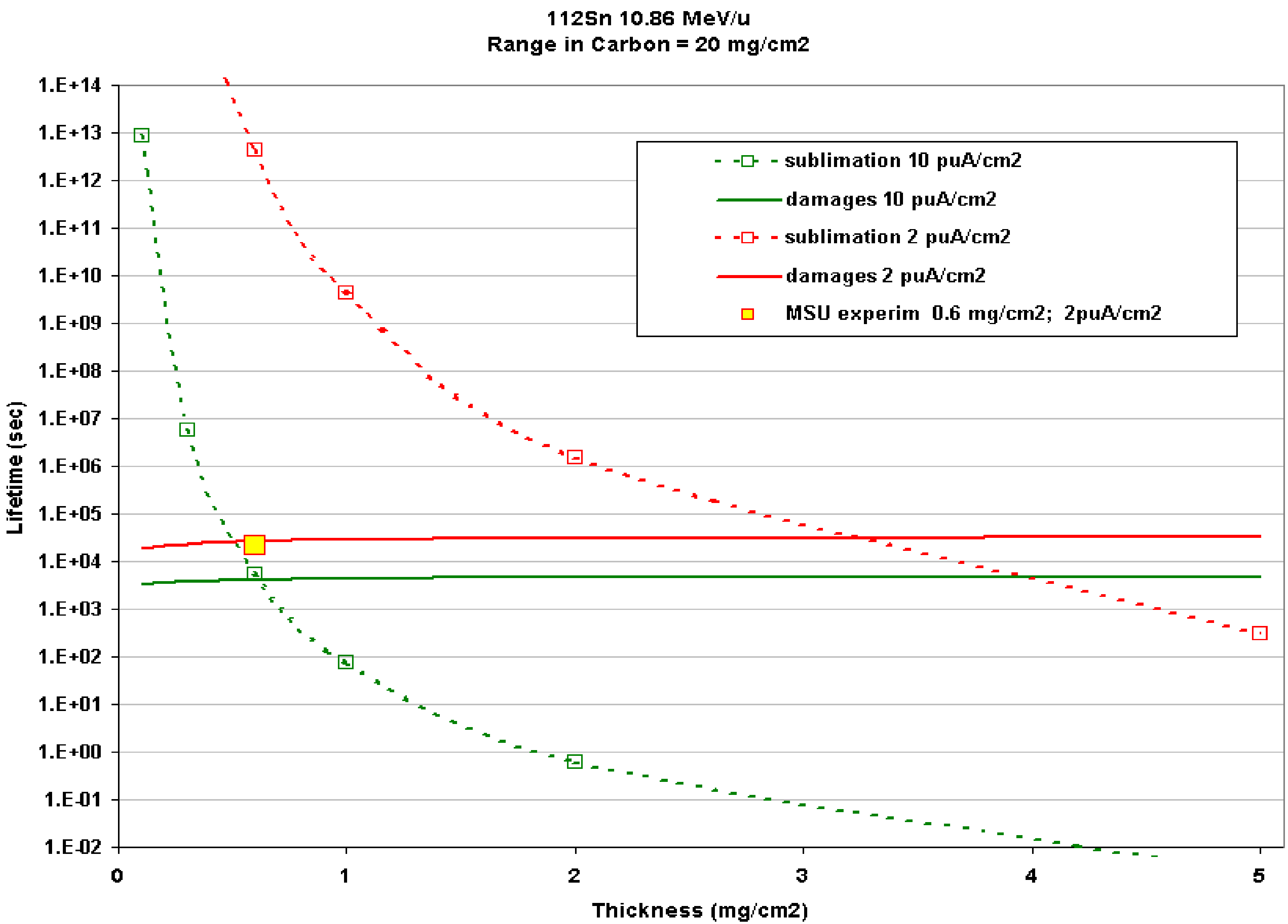
Lifetime = f (j),

where j is the density of particle flux [pμA/cm^2], and equal to $\frac{\textit{Current}}{\textit{Interaction Area}}$

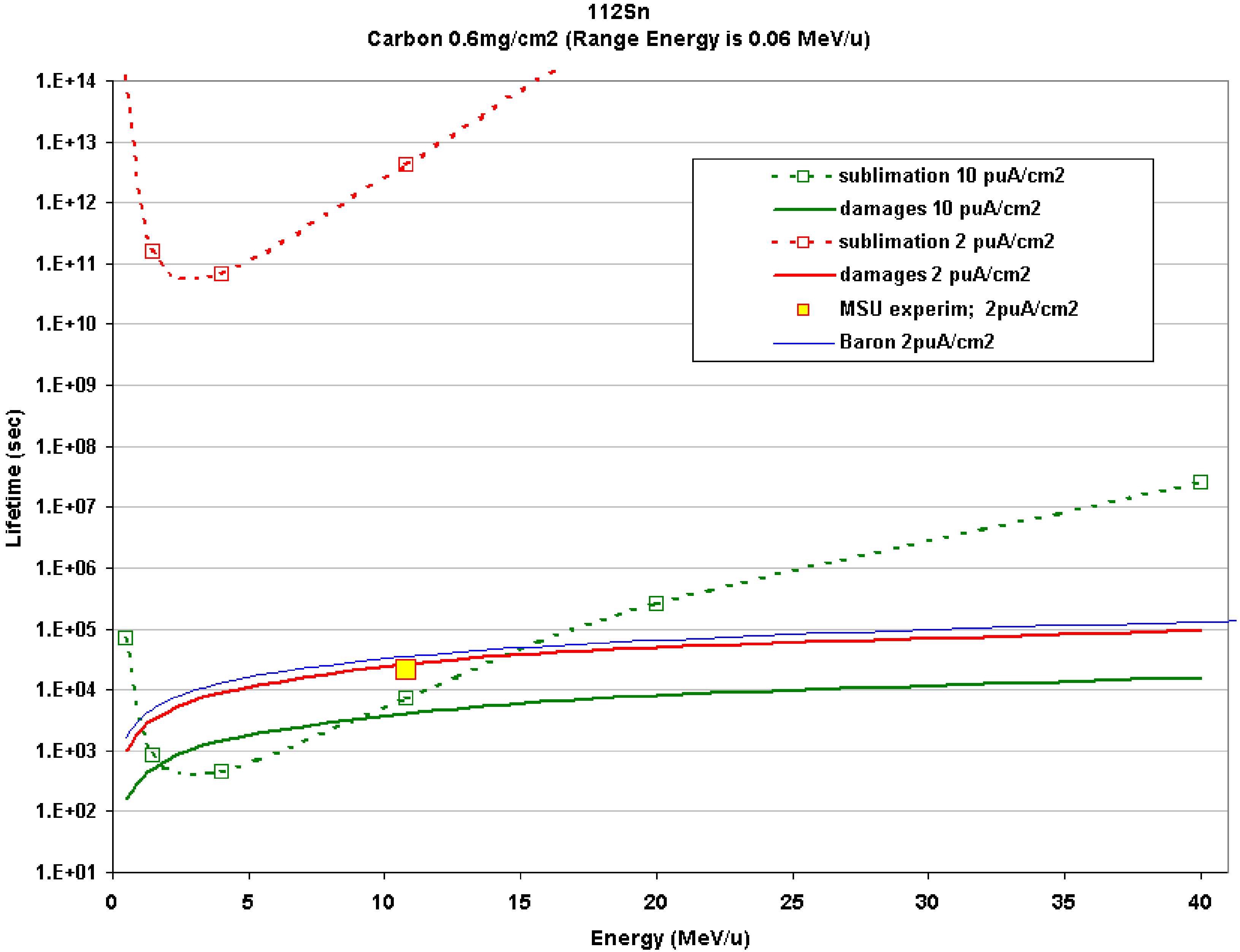
Decrease an interaction area to increase lifetime.



Foil thickness

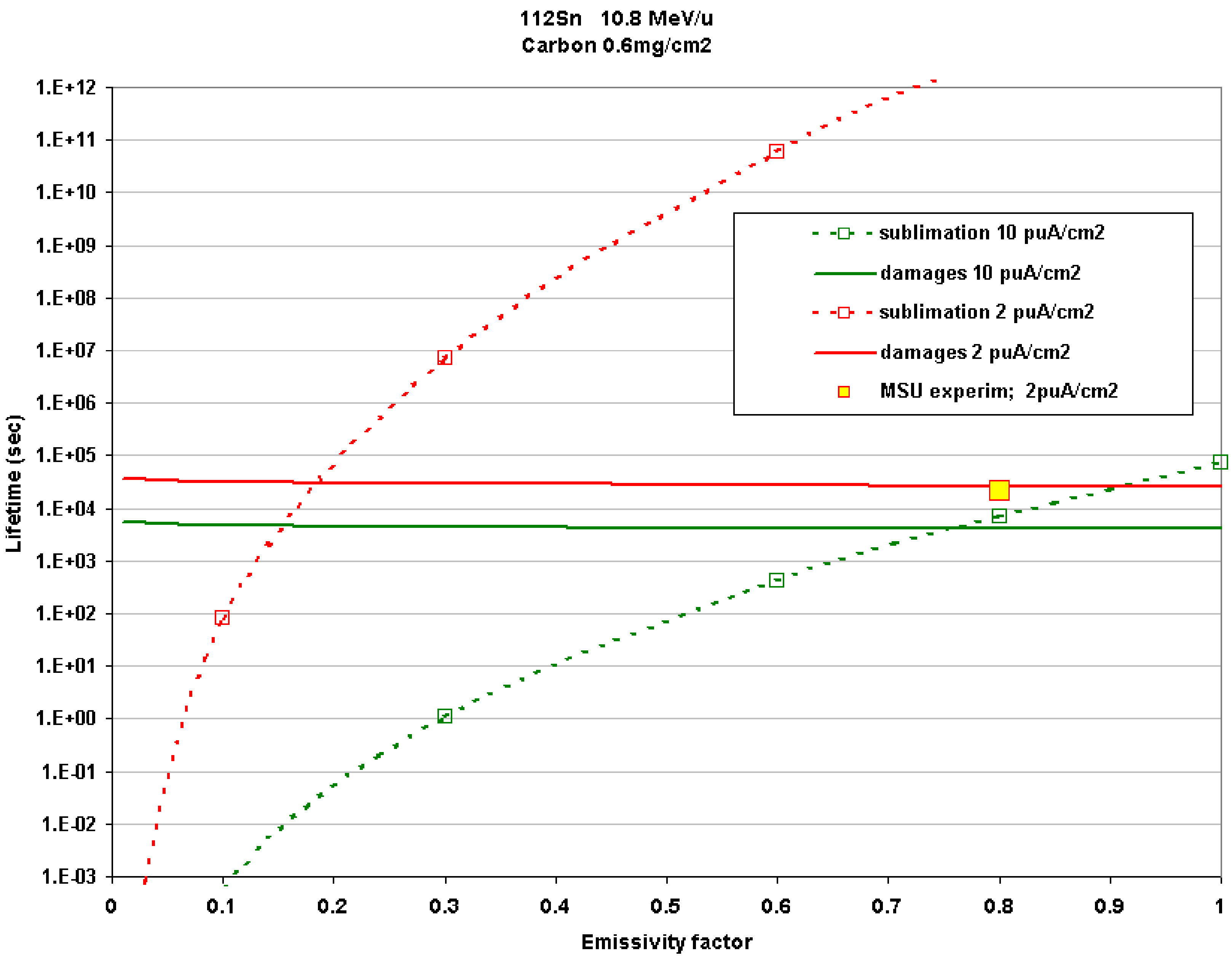


Beam energy

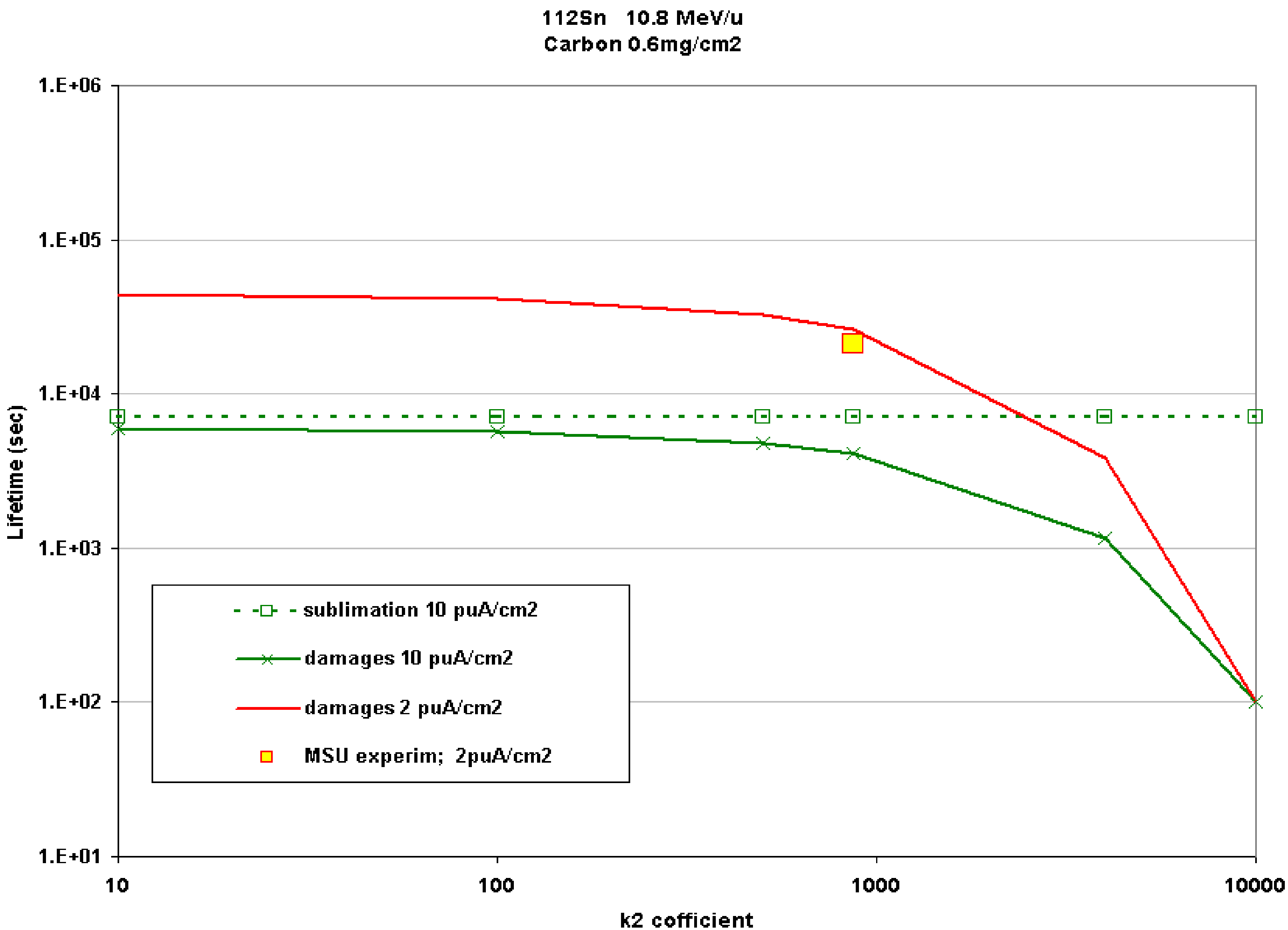


112Sn
Carbon 0.6mg/cm2 (Range Energy is 0.06 MeV/u)
Lifetime (sec)
1.E+14
1.E+13
1.E+12
1.E+11
1.E+10
1.E+09
1.E+08
1.E+07
1.E+06
1.E+05
1.E+04
1.E+03
1.E+02
1.E+01
0
5
10
15
20
25
30
35
40
Energy (MeV/u)
sublimation 10 puA/cm2
damages 10 puA/cm2
sublimation 2 puA/cm2
damages 2 puA/cm2
MSU experim; 2puA/cm2
Baron 2puA/cm2

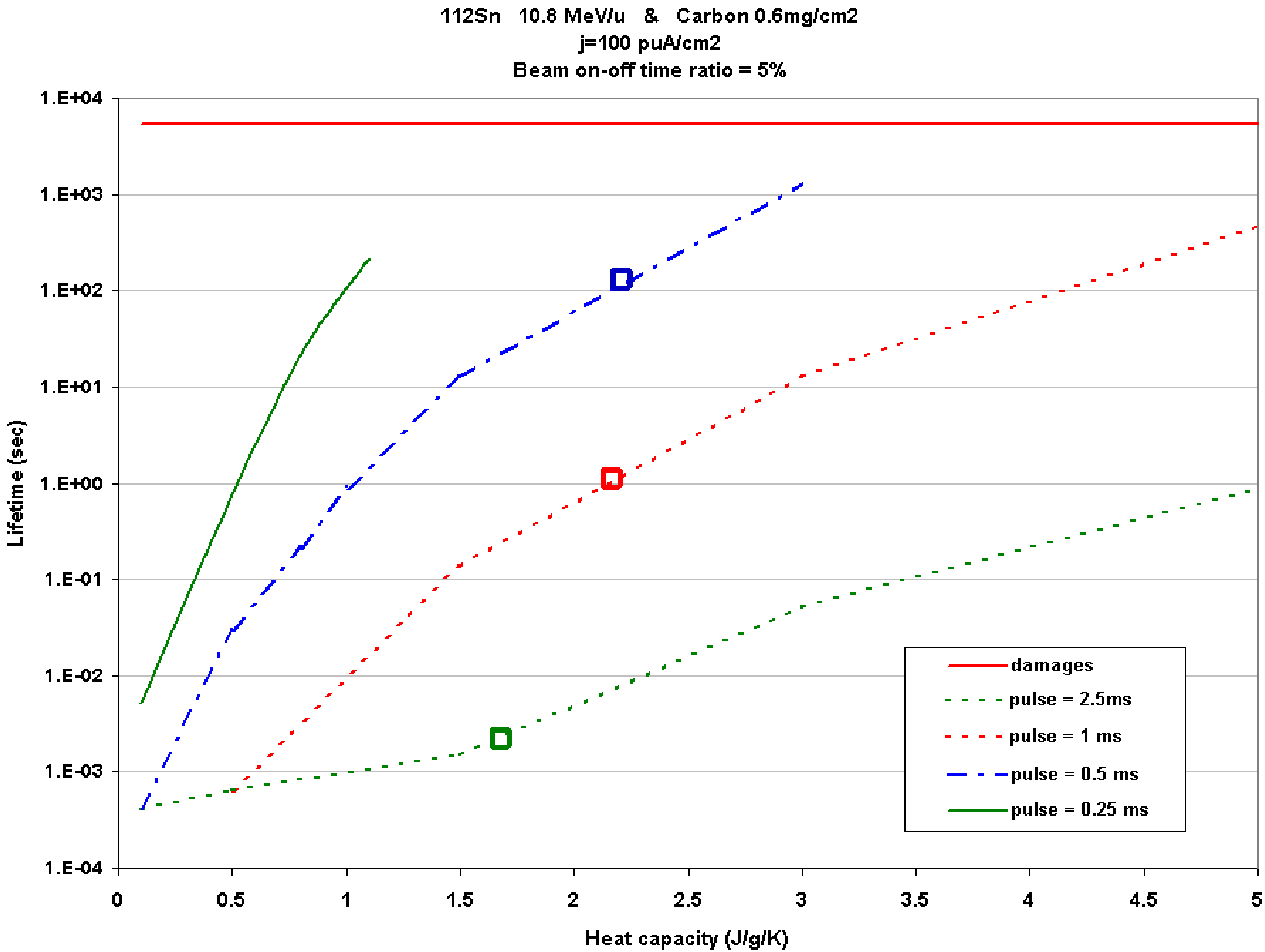
Emissivity factor



k2 coefficient



Heat capacity



- corresponds to the Carbon capacity dependence of [3] C.Liaw et al.

Summary for LISE^{++} version 8.3.13

- The "Stripper foil lifetime" dialog has possibility to load/save dialog settings to/from file
- Lebedev's method of radiation damage calculation overestimates foil lifetimes in the case of heavy projectiles (Sn, U)
- Baron's parameterization underestimates foil lifetimes in the case of light projectiles (Ne, Ar)
- LISE++'s k_1-dependence from the atomic number of projectile for the Lebedev's method of radiation damage helps well to reproduce experimental data for projectiles in wide region (from Neon up to Uranium).
- Analysis of contribution of some parameters in the models has been done