

# The CMEE library for numerical modeling of electron effects

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\*The work of Dr. Stoltz for this project is funded by the DoE OFES through the SBIR program

# The CMEE library is a collection of numerical routines for modeling electron effects

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- CMEE = Computational Modules of Electron Effects
- The goal is to provide routines for modeling
  - secondary electron yield
  - ion-induced electron yield
  - ion and neutral gas desorption
  - ion/neutral gas ionization and stripping
- The approach is
  - use tested routines from community where possible
  - use tables of data and interpolation routines
  - make them available on any platform or language

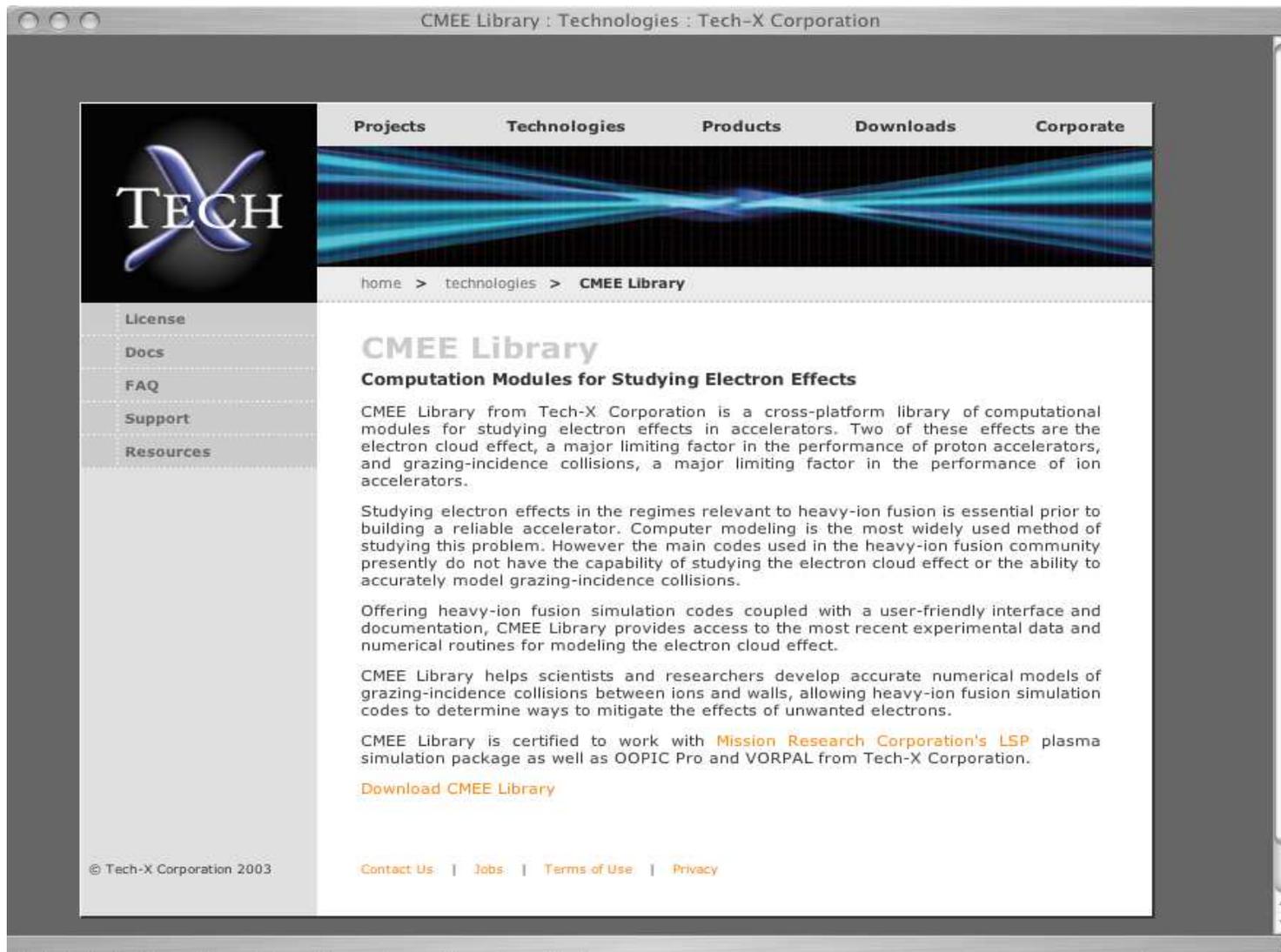
# CMEE presently contains secondary electron yield modules from Furman's group

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- CMEE has now
  - SEY models for Cu and SS from POSINST
- 3-6 months from now
  - SEY models for Al and TiN from POSINST
  - electron impact ionization models from OOPIC
  - ion-induced electron yields for p, He -> Au
- 6-12 months from now
  - ion-induced electron yields for SS
  - ion/neutral desorption
  - ion impact ionization/stripping

# Users download CMEE and build library locally

A screenshot of a web browser displaying the "CMEE Library" page. The browser's title bar reads "CMEE Library : Technologies : Tech-X Corporation". The page has a dark header with the Tech-X logo on the left and navigation links for "Projects", "Technologies", "Products", "Downloads", and "Corporate" on the right. Below the header is a decorative blue and black graphic. A breadcrumb trail shows "home > technologies > CMEE Library". On the left side, there is a vertical menu with links for "License", "Docs", "FAQ", "Support", and "Resources". The main content area features the heading "CMEE Library" and the sub-heading "Computation Modules for Studying Electron Effects". The text describes the library as a cross-platform tool for studying electron effects in accelerators, mentioning the electron cloud effect and grazing-incidence collisions. It also notes that the library is certified to work with Mission Research Corporation's LSP plasma simulation package and OOPIC Pro and VORPAL from Tech-X Corporation. A "Download CMEE Library" link is provided at the bottom of the main text. The footer includes "© Tech-X Corporation 2003" and links for "Contact Us", "Jobs", "Terms of Use", and "Privacy".

free for non-commercial and government-funded research...

# Building library is automated with GNU tools



You type 'configure'

```
Terminal — tcsh — 80x24
[localhost ~/CME-0.93b] pstoltz% ./configure
checking for a BSD-compatible install... /usr/bin/install -c
checking for awk... awk
checking whether make sets $(MAKE)... yes
checking whether to enable maintainer-specific portions of Makefiles... no
checking for style of include used by make... GNU
checking for ranlib... ranlib
checking for g77... g77
checking whether we are using the GNU Fortran 77 compiler... yes
checking whether g77 accepts -g... yes
Default F77 is g77
checking for g77... /sw/bin/g77
configure: creating ./config.status
config.status: creating Makefile
config.status: creating src/Makefile
config.status: creating src/SECELEC/Makefile
config.status: executing depfiles commands
[localhost ~/CME-0.93b] pstoltz%
```

Makefiles created for you!

# Building library is automated with GNU tools



```
Terminal — tcsh — 80x24
[localhost ~/CME-0.93b/src] pstoltz% make
Making all in SECELEC
rm -f libsecelectronsF.a
ar cru libsecelectronsF.a CMEEMathwrapper.o txranu.o gamma.o erf.o cdfbet.o cdfg
am.o mt19937.o spmpar.o exparg.o dinvr.o dzror.o cumbet.o gaminv.o cumgam.o brat
io.o gratio.o rcomp.o alnrel.o gamln.o ipmpar.o gamln1.o gam1.o rexp.o erfc1.o r
log.o bup.o bgrat.o bfrac.o basym.o apser.o fpser.o bpsr.o grat1.o rlog1.o algd
iv.o brcmp1.o brcomp.o bcorr.o betaln.o esum.o psi.o gsumln.o dlngam.o set_param
s.o init_pascal_triangle.o nsec.o secelectrons.o
ranlib libsecelectronsF.a
g77 -g -O2 -o f_test f_test.o ./SECELEC/libsecelectronsF.a
[localhost ~/CME-0.93b/src] pstoltz%
```

User now links their code to this library

# SEY routines come with Fortran and C bindings



```
Terminal — vim — 80x24
[localhost ~/CME-0.93b/src] pstoltz% more f_test.f
PROGRAM f_test
implicit none
integer maxsec
parameter (maxsec=50)
real*8 Ek0, costheta
integer mat_num, ns
real*8 bn(0:maxsec), bt(0:maxsec), bz(0:maxsec)
integer myi

costheta=1.
mat_num=1

do 9 myi=0, 99
do 9 Ek0=100., 300.
call nsec(Ek0, costheta, mat_num, ns, bn, bt, bz)

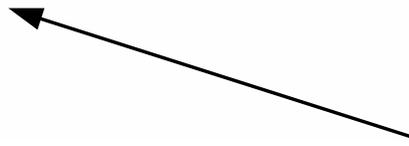
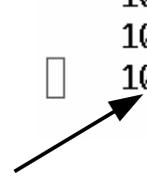
[localhost ~/CME-0.93b/src] pstoltz% f_test
100.0 1
101.0 3
102.0 0
103.0 1
104.0 2
```

POSINST routine call (Fortran)

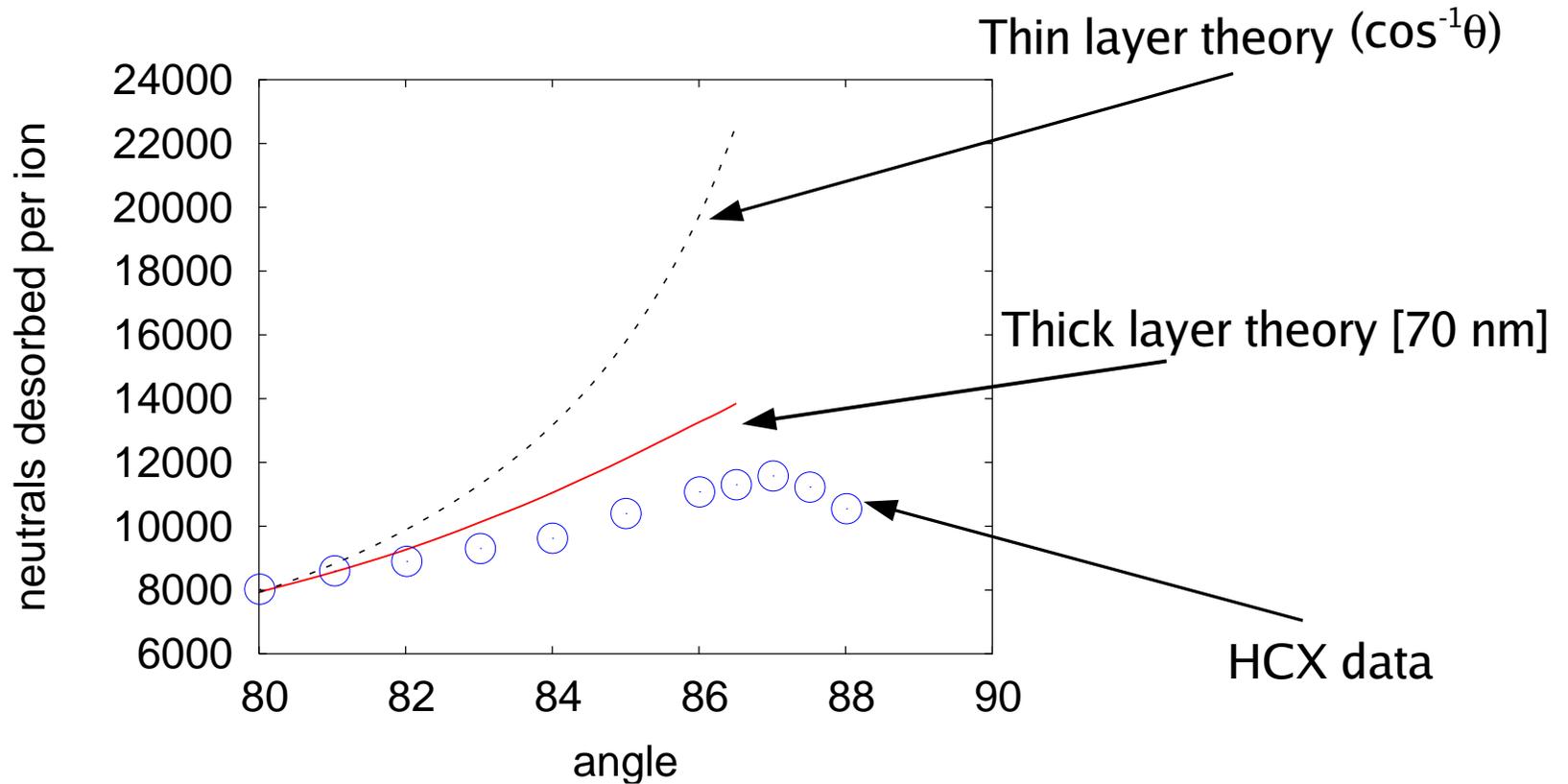


Energy (ev)

# of secondaries



# We're not *just* writing software! We try to help with the physics along the way.



HCX desorption data

# I'd like feedback where to go next...



- Models of SEY for NEG materials? (“Wunderkind”: TiZrV)
- Models of heavy ion stripping with cross sections  $\sim E^{-1/2}$  ?
  - tabulated results of Olson and interpolation routines?
- Simple models of desorption/ionization?
  - first version could just be constants (e.g.  $\eta_{\text{des}} \approx 10^4$ )
  - more detailed improvements later
- What else?