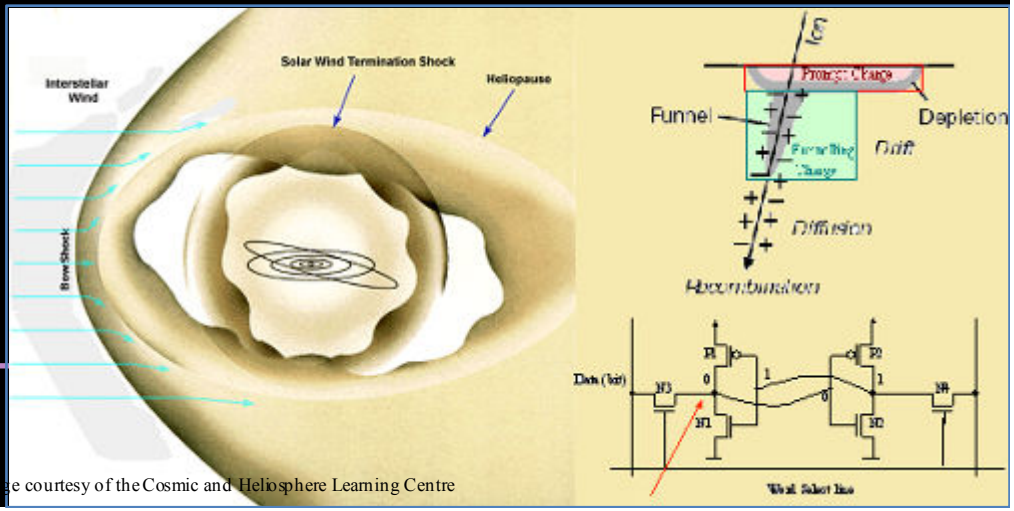
CODES

component degradation simulation tool

A. Keating, S. Joyce, A. Zadeh, M. Pimenta, E.Daly, P.Gonçalves
ESA Project:
18121/04/NL/CH

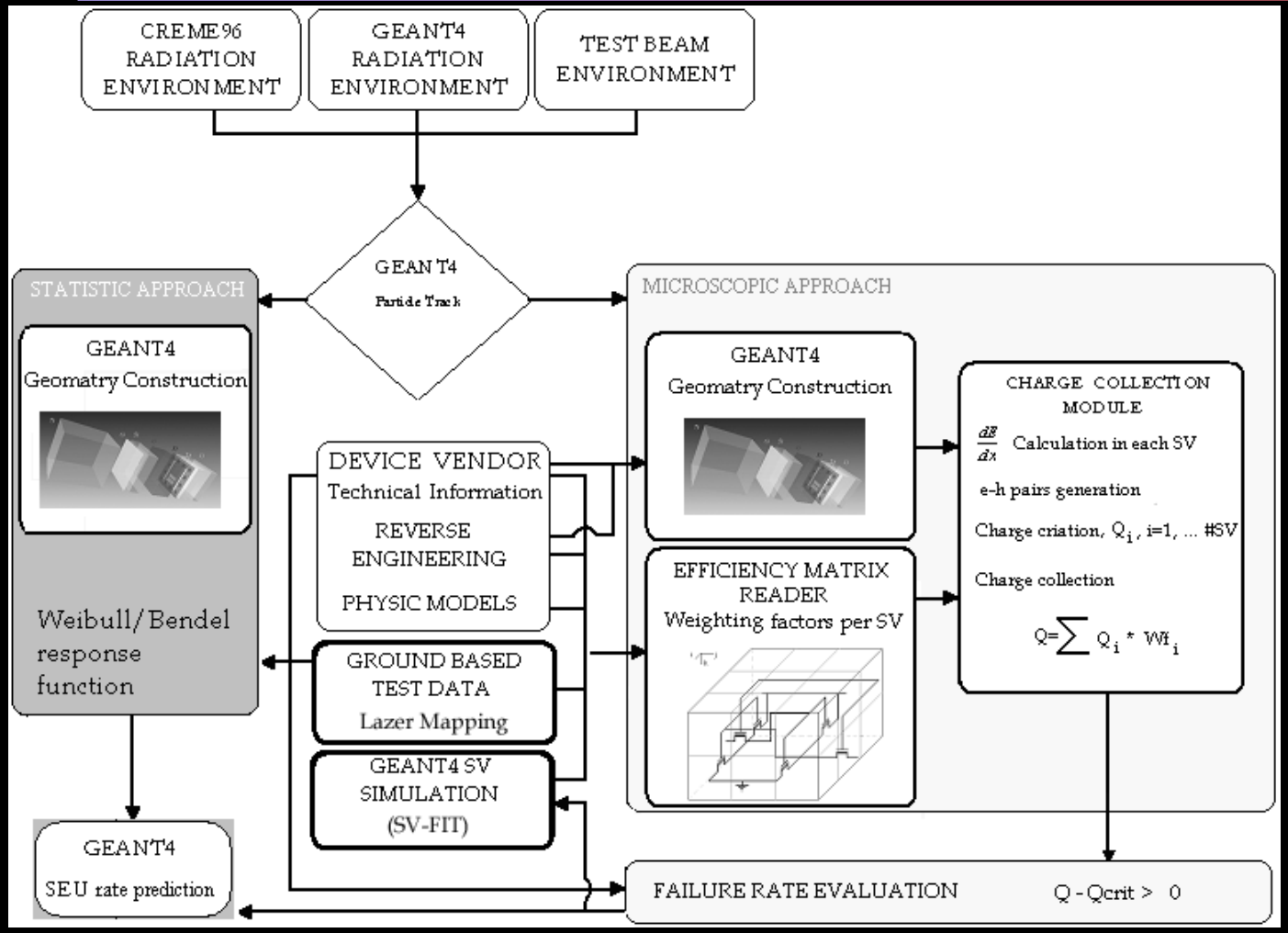


ge courtesy of the Cosmic and Heliosphere Learning Centre

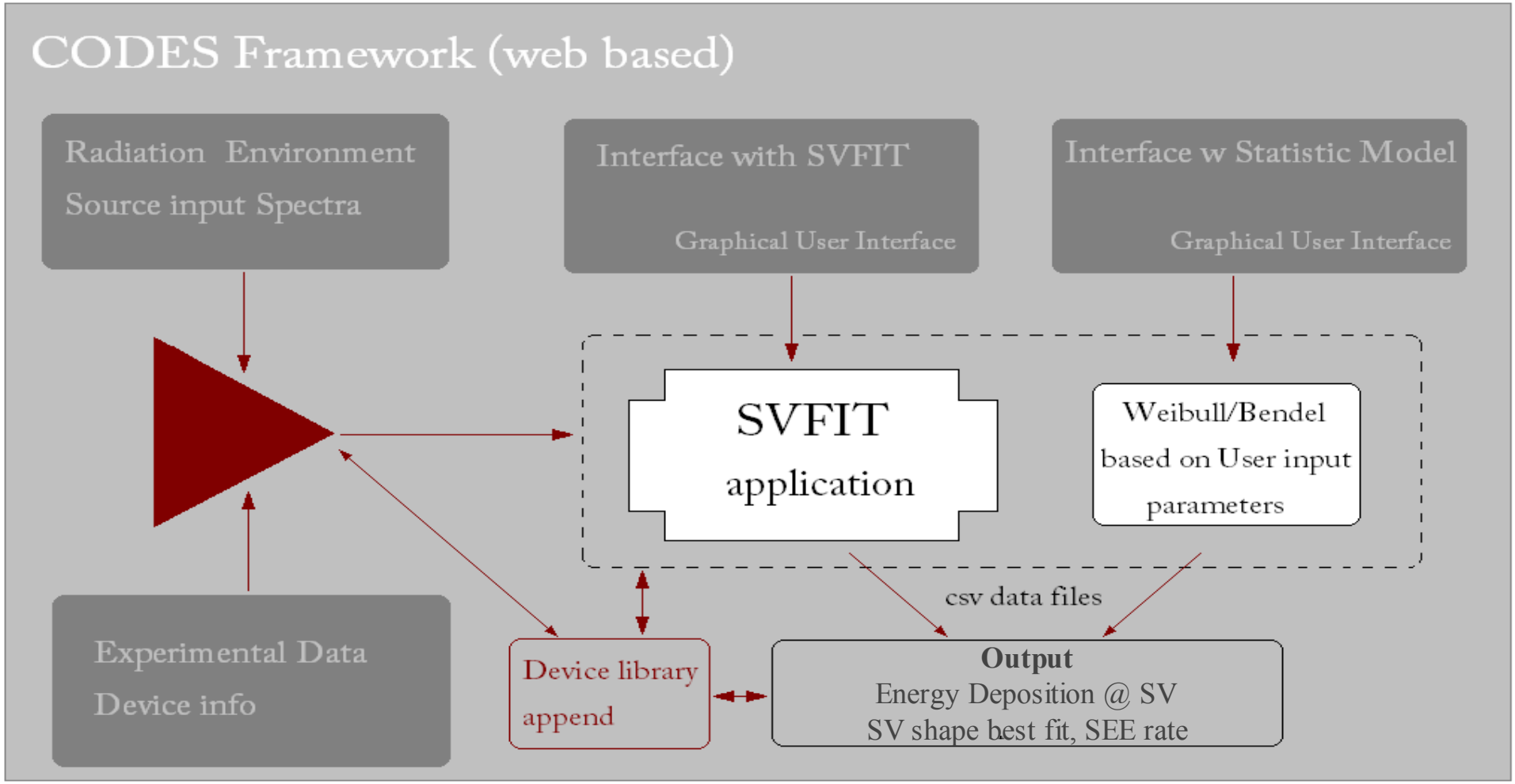
Outline

- Philosophy
- SVFIT
- CODES: the top level tool
- Additional Models developed
- Conclusions

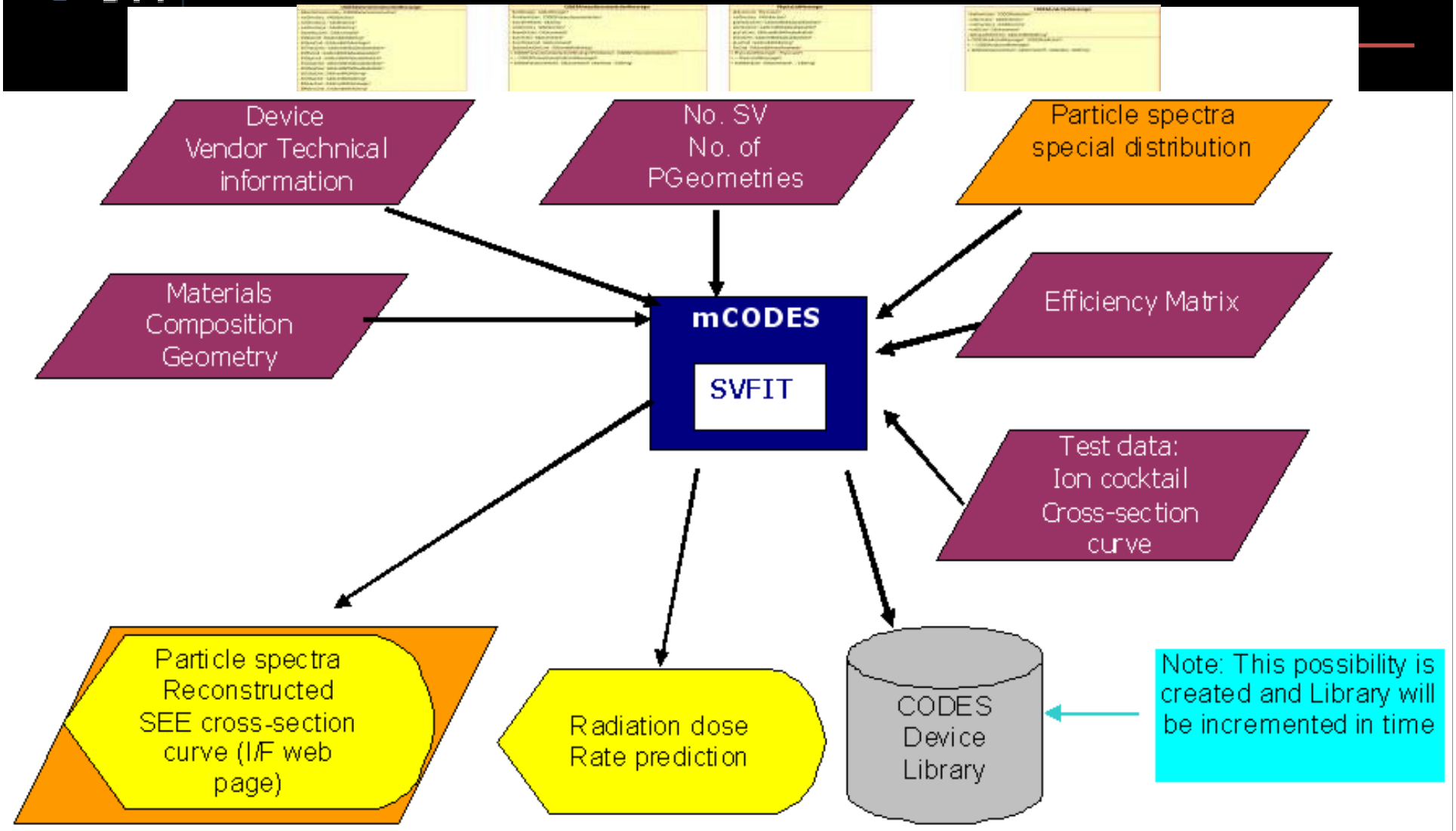
Philosophy


CREME96 RADIATION ENVIRONMENT
GEANT4 RADIATION ENVIRONMENT
TEST BEAM ENVIRONMENT
GEANT4
Particle Track
STATISTIC APPROACH
GEANT4
Geometry Construction
Weibull/Bendel response function
GEANT4
SEU rate prediction
DEVICE VENDOR
Technical Information
REVERSE ENGINEERING
PHYSIC MODELS
GROUND BASED TEST DATA
Lazer Mapping
GEANT4 SV SIMULATION
(SV-FIT)
MICROSCOPIC APPROACH
GEANT4
Geometry Construction
EFFICIENCY MATRIX READER
Weighting factors per SV
CHARGE COLLECTION MODULE
dE/dx Calculation in each SV
e-h pairs generation
Charge criation, Qi, i=1, ... #SV
Charge collection
Q=∑ Qi * Wfi
FAILURE RATE EVALUATION
Q - Qcrit > 0

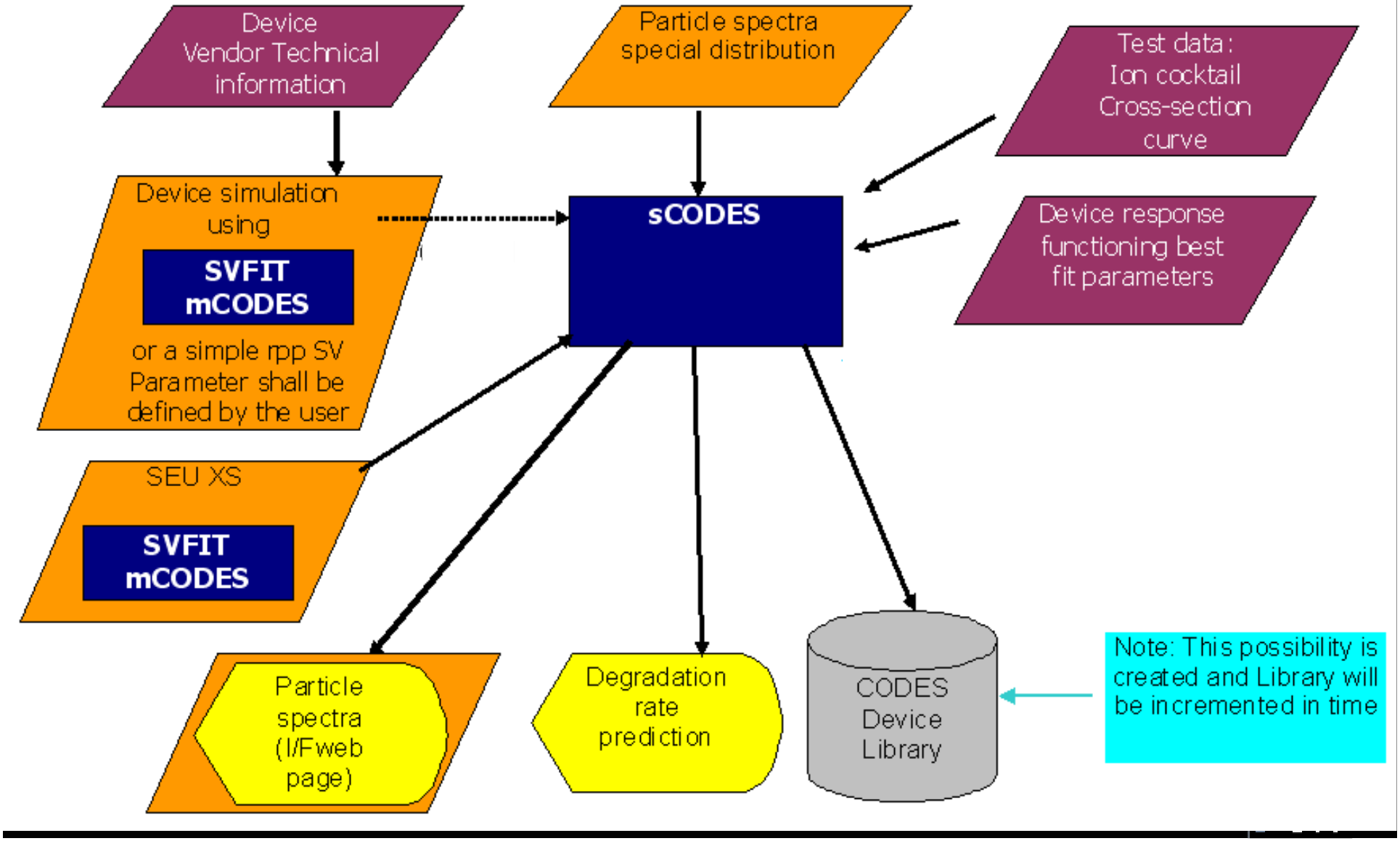
Top Level Framework

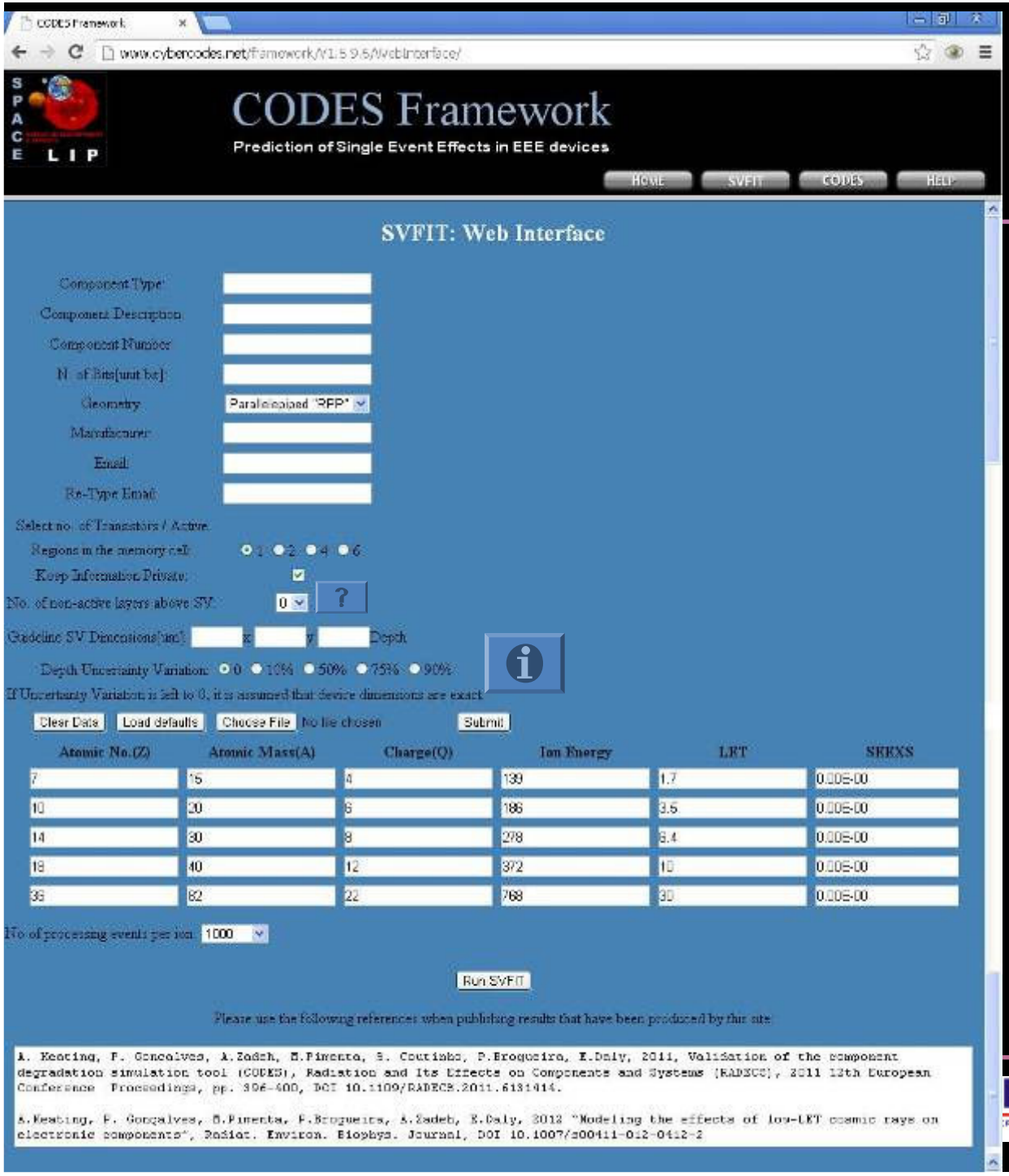


mCODES : SVFIT



sCODES


Device
Vendor Technical
information
Particle spectra
special distribution
Test data:
Ion cocktail
Cross-section
curve
Device simulation
using
SVFIT
mCODES
or a simple rpp SV
Parameter shall be
defined by the user
sCODES
Device response
functioning best
fit parameters
SEU XS
SVFIT
mCODES
Particle
spectra
(I/Fweb
page)
Degradation
rate
prediction
CODES
Device
Library
Note: This possibility is
created and Library will
be incremented in time

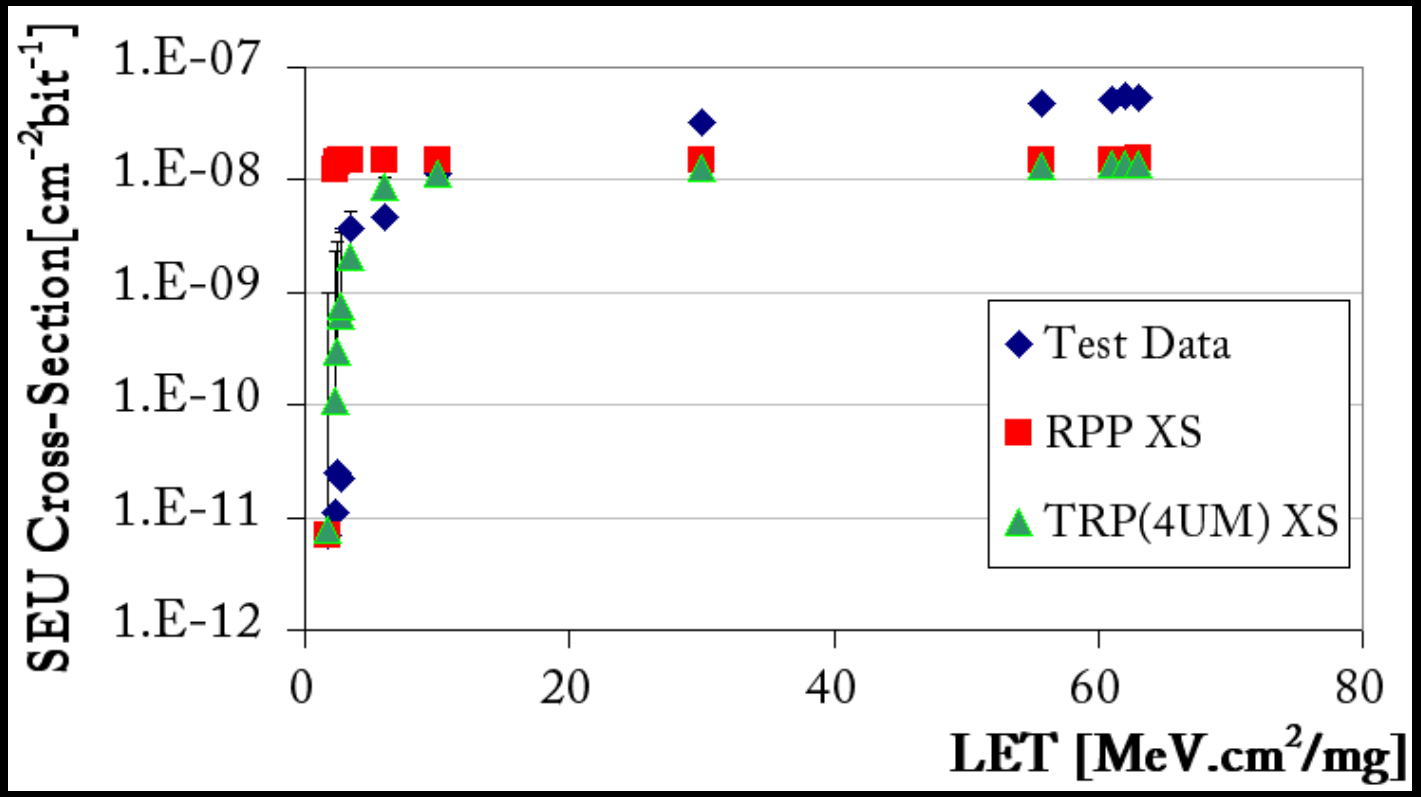


SVFIT: Web interface

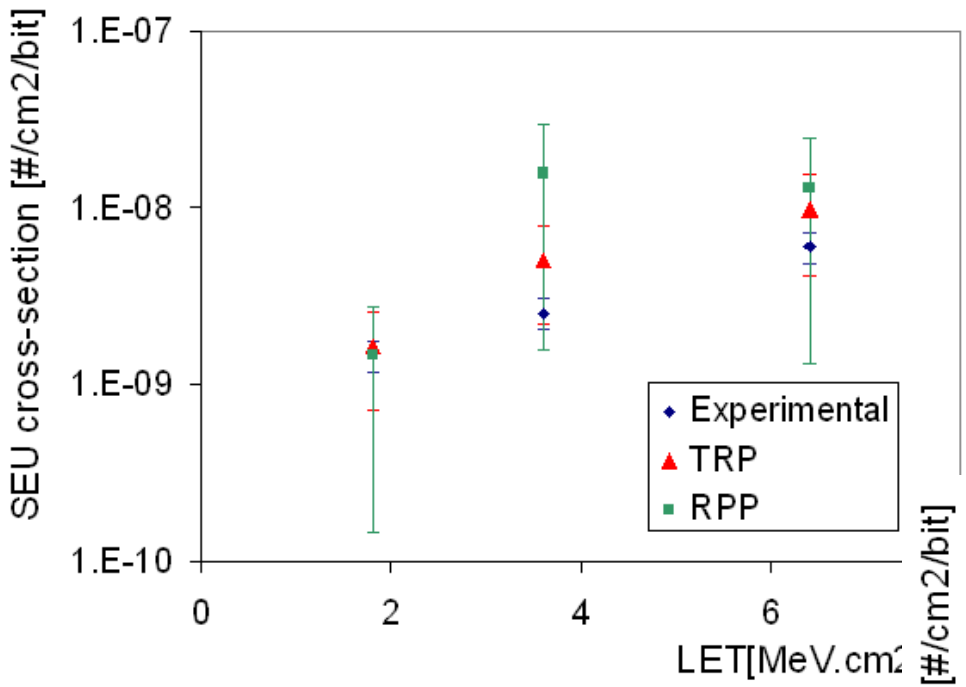
- SVFIT_V. 1.5.7
- Meta Information
- SV geometry
- Email account
- Efficiency matrix: No of SV
- Library
- Non Active layers
- Depth uncertainty -> Interactive Fit
- Guideline SV dimensions
- Experimental Cocktail
- No. Events
- Run SVFIT
- Credits

Detailed SVFIT: Published papers

- RADECS 2011
- 10^6 evts

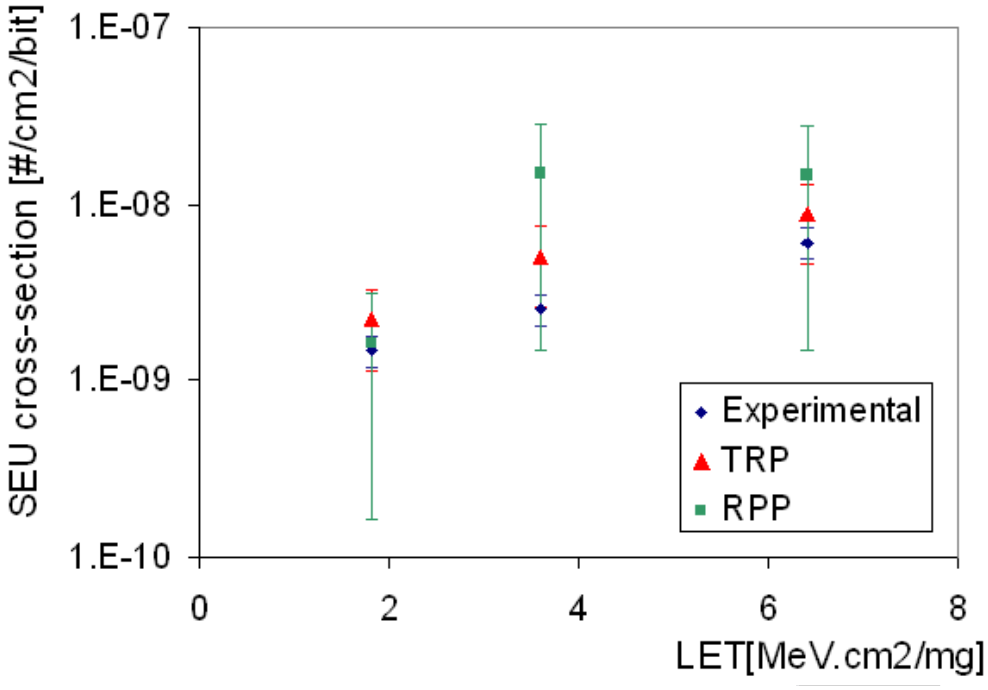


Engineering tool: ISSI1 SEU XS Reconstruction



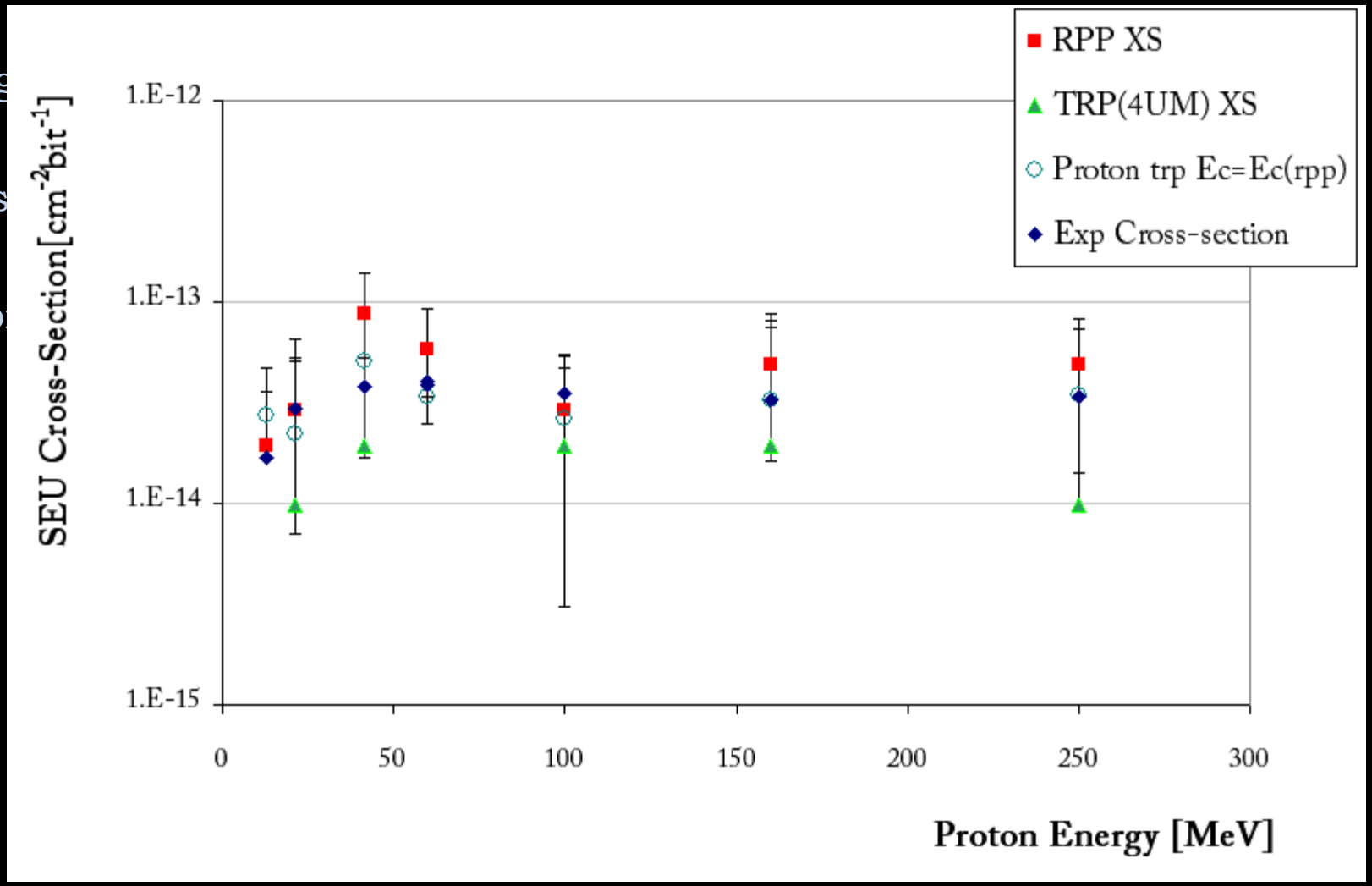
<- 10^3 evts

10^6evts ->



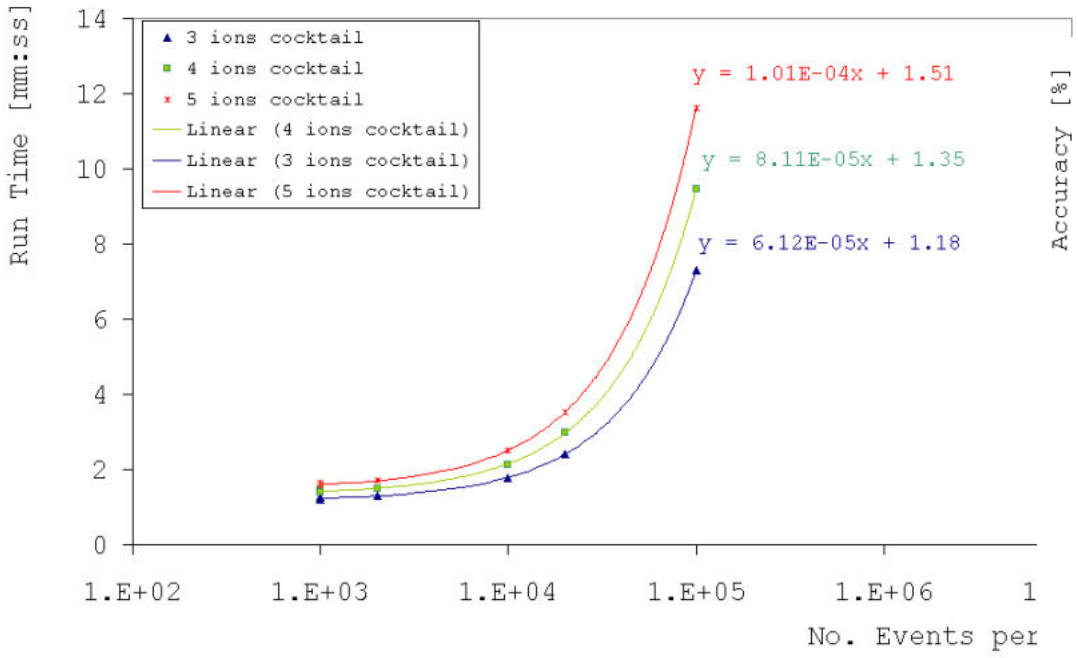
From Ion data to proton prediction

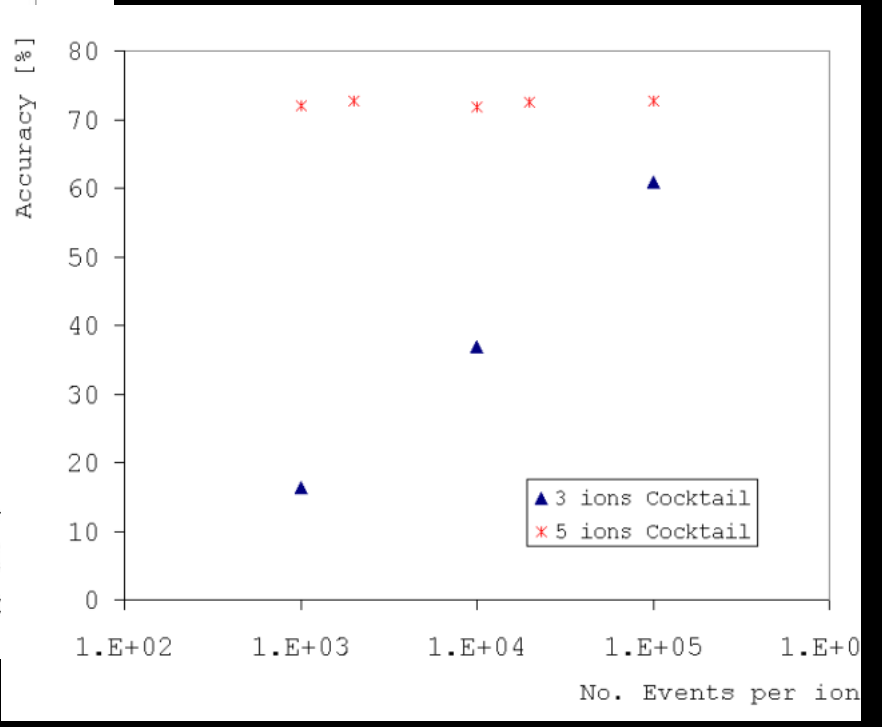
- Using
- The s
- Proto

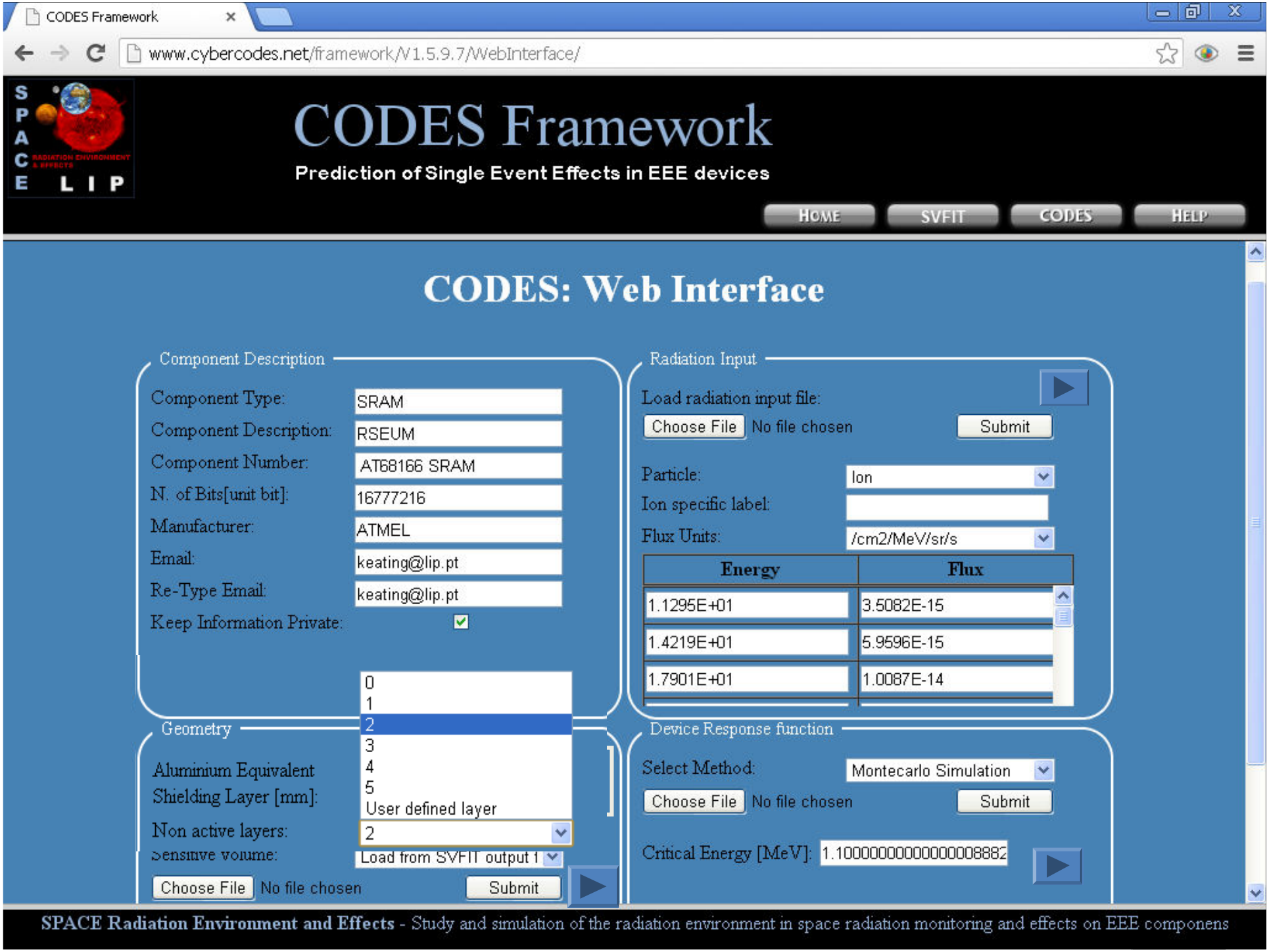


SVFIT working for different devices

- Tests have been made for the Reference SEU Monitor and SEL monitor devices



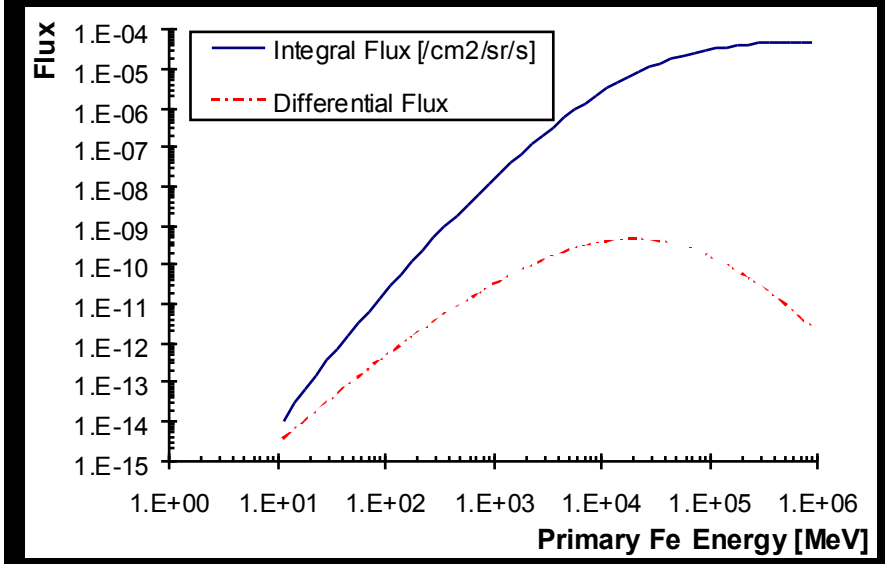



CODES Framework
www.cybercodes.net/framework/V1.5.9.7/WebInterface/
SPACE RADIATION ENVIRONMENT & EFFECTS LIP
CODES Framework
Prediction of Single Event Effects in EEE devices
HOME
SVFIT
CODES
HELP
CODES: Web Interface
Component Description
Component Type: SRAM
Component Description: RSEUM
Component Number: AT68166 SRAM
N. of Bits[unit bit]: 16777216
Manufacturer: ATMEL
Email: keating@lip.pt
Re-Type Email: keating@lip.pt
Keep Information Private:
Radiation Input
Load radiation input file:
Choose File No file chosen
Submit
Particle: Ion
Ion specific label:
Flux Units: /cm2/MeV/sr/s
Energy
Flux
1.1295E+01
3.5082E-15
1.4219E+01
5.9596E-15
1.7901E+01
1.0087E-14
0
1
2
3
4
5
User defined layer
Geometry
Aluminium Equivalent Shielding Layer [mm]:
Non active layers: 2
Sensitive volume: Load from SVFIT output 1
Choose File No file chosen
Submit
Device Response function
Select Method: Montecarlo Simulation
Choose File No file chosen
Submit
Critical Energy [MeV]: 1.1000000000000008882
SPACE Radiation Environment and Effects - Study and simulation of the radiation environment in space radiation monitoring and effects on EEE componens

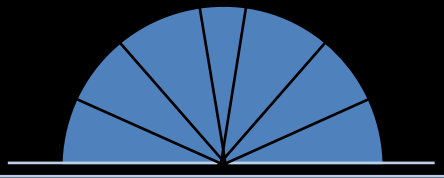
Normalization

According to the ICR

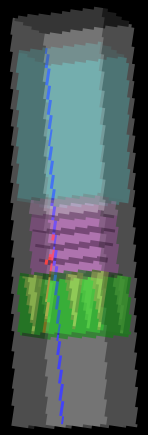
- Normalization is based on dMEREM/MARSREM normalization methods



Primary Integral Flux Normalization



Angular normalization



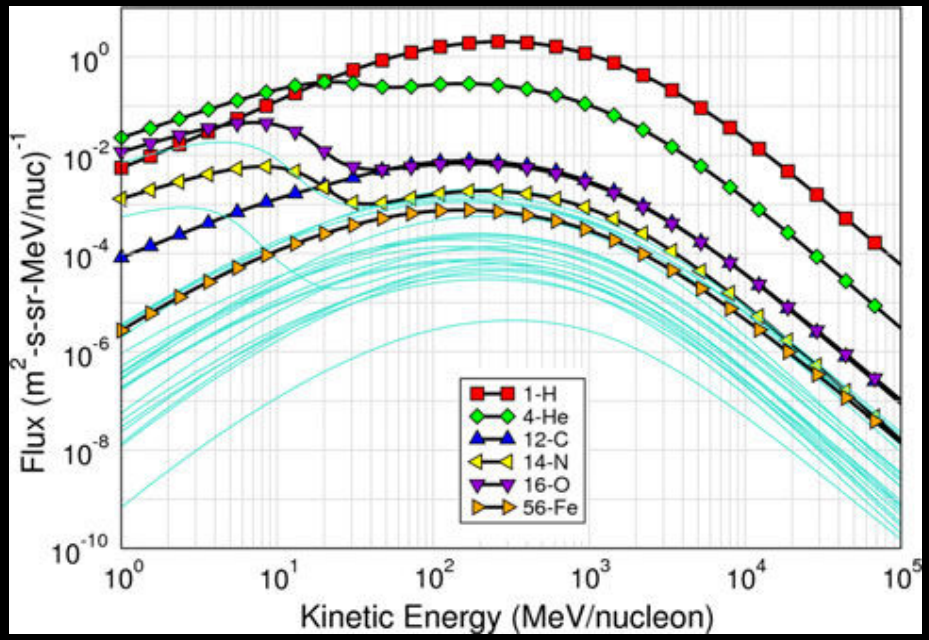
Geometrical acceptance

Theta Max

Total Flux Norm. = PrimFlxuNorm * GeomAccept * SolidAnglNorm

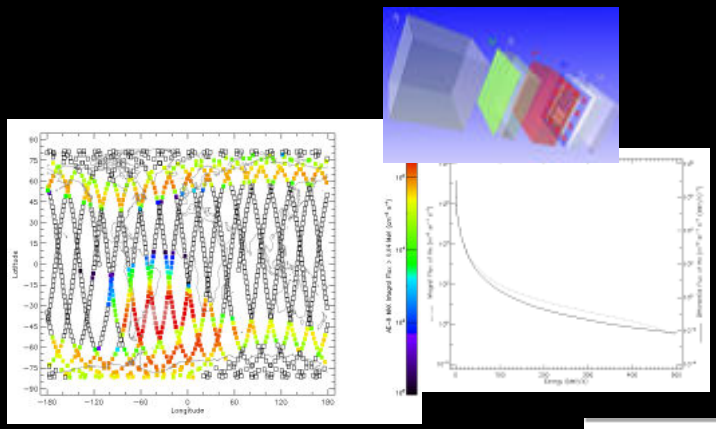
Full spectrum simulation

- CODES pre-processor takes inputs for several ions' energy spectra
- Computes individual contributions for SEE rates
- Outputs the total rate prediction



CODES top level framework

- The framework is working properly under :
  - Windows Internet Explorer
  - Google Chrome
  - Firefox



Particles		SEU [#/device/s]
Protons		
Neutrons		
Ions	Oxygen	
	Carbon	
	Helium	

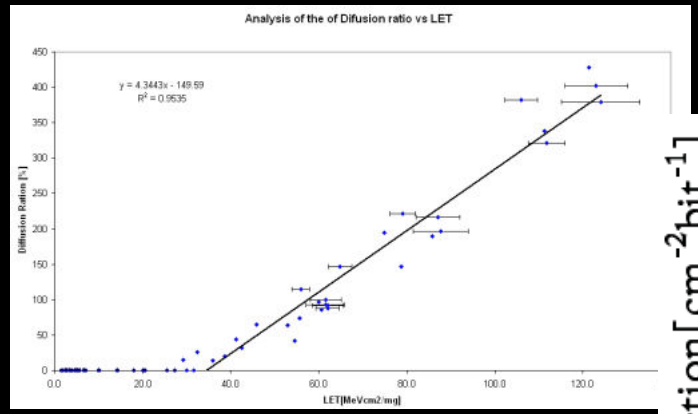
- Both Microscopic and Statistical Modules

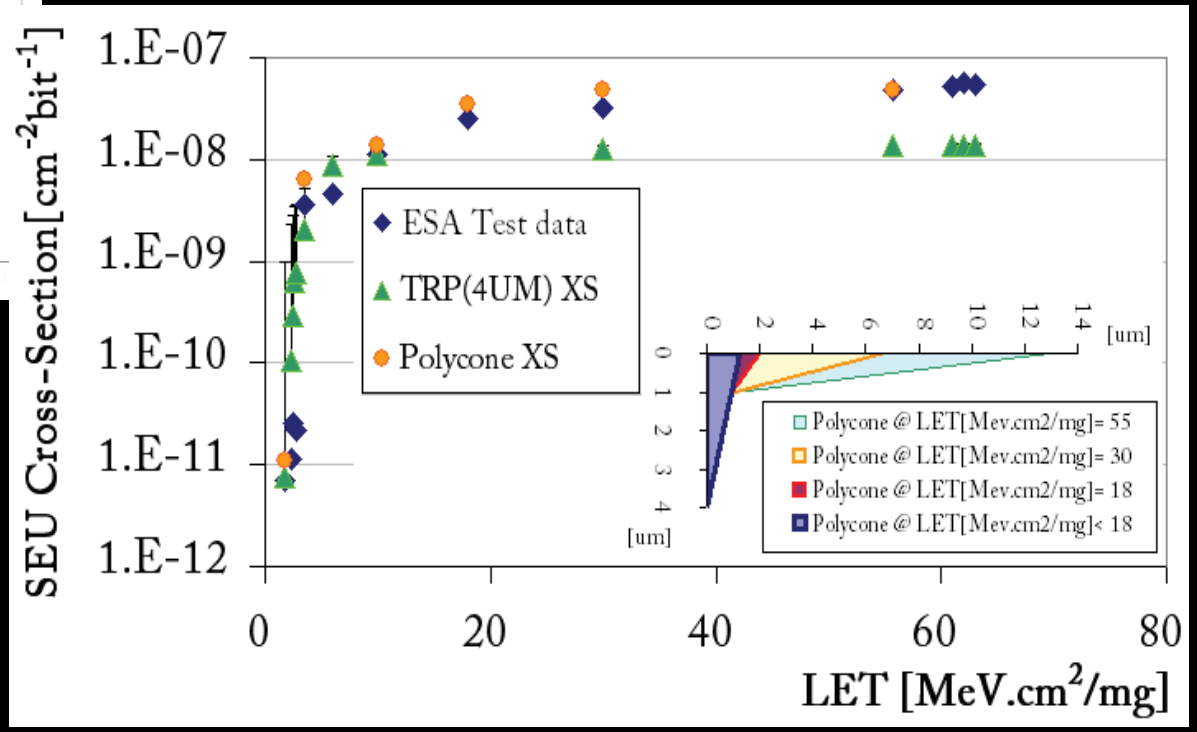
Additional models developed: that might be implemented

With SVFIT

MBU diffusion model: Results

- Results published at RADECS 2011

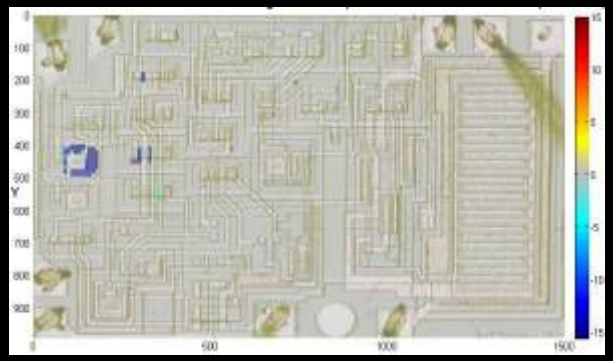


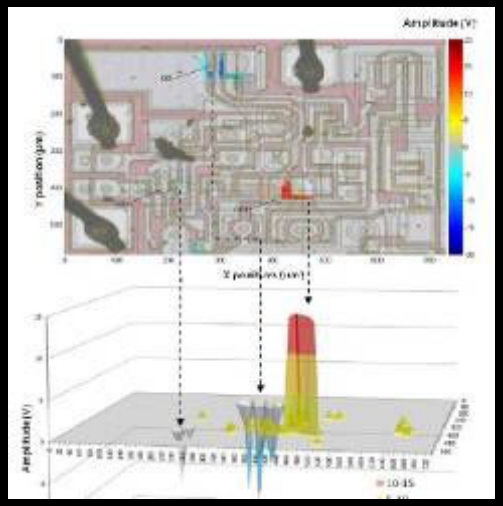


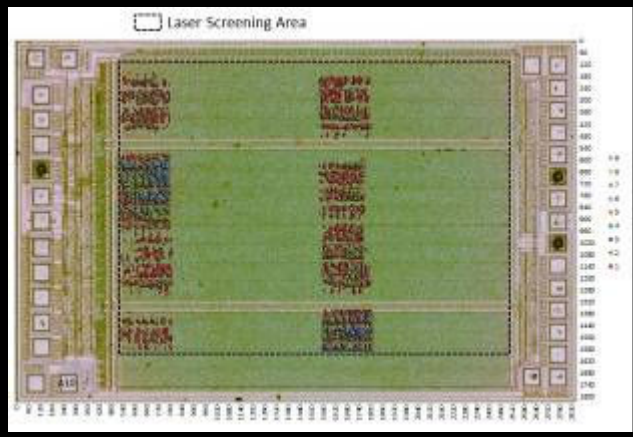
- Doi: 10.1109/RADECS.2011.6131414

Efficiency matrix from Laser maps

- The model of defining an efficiency matrix was developed for SVFIT
- Objective : robust module for extraction from **laser maps** the charge **collection efficiency**
- SVFIT and CODES : benefit from the inclusion under the user-friendly interface







Images from of Isabel Lopez

Conclusion

- SVFIT, mCODES and sCODES were developed and integrated into a top level user friendly tool, with a web-interface
- Tests show the robustness of the tool: results consistency and good SV fit accuracy

- Results show that:
  - Very good device response function reconstruction with 3-5 ion cocktails
  - Accuracy is not dependent on statistics when using 5 ion cocktails
  - Run time using iterative fit capability with 5 ions and 6 possible geometries is of the order of 30 minutes, for SV thickness fit
  - Run time using SVFIT for 3 to 5 ions using two geometries for SV shape fit ranges btw 2-10 minutes depending on the statistics
  - mCODES results tend to be less dependent of user definitions than standard statistical methods and sCODES

Further Work

- Distribution of the tool under discussion
- Inclusion of ready-to-use developed models
- Incrementation of the Device Library
- Further models were investigated: TRL needs to be increased