RADECS Thematic Workshop on European Accelerators

Test Experiences and Needs

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Outline

- Technical needs regarding test facilities
  - Set up
  - Ion characteristics
  - Validation of test conditions
- Schedule and geographical consideration
  - Availability
  - Access
- Outputs of test campaign
  - Test results analysis
- Conclusions

Technical needs regarding test facilities : test setup – 1/3

- Size of the vacuum chamber big enough to easily install the setup
- Availability of numerous reliable vacuum pipes/connectors that may be used in parallel
  - BNC, DB25, HE40, SMA
  - Possibility to have specific pipes implemented on request
- Availability of 3 axes positioning system for test board
  - Possibility to increase the usable size of the test board up to A4 paper sheet

Technical needs regarding test facilities : test setup – 2/3

- Available flux from about 100 to 5 10^4 particle/cm^2.s
  - Stability of the flux monitored whatever the value is
  - Possibility to modify the flux during a run
- Beam size ideally to be extended up to a diameter of about 5 cm
- To optimise experimental duration
  - Possibility of a quick ion change (< 15 minutes)
  - To optimise switch time air/vacuum/air and access time to chamber

Technical needs regarding test facilities : test setup - 3/3

- Temperature aspects
  - Need of a cooling system allowing heat dissipation when testing power devices
  - Possibility to perform testing at different temperatures
- Implementation of optical assistance setup
  - Camera targeting the device under test / ion beam
  - Laser beam for precise localisation of heavy ion beam
- Possibility for experimental measurement setup to be located near the chamber (ideally 1 to 2 meters)
- Need for a shutter with a reaction time < 10 ms

Technical needs regarding test facilities : ions characteristics

- Range of ions
  - To be at least 40 to 50 μm whatever the LET is
  - Ideally to have access to range representative of space ion population (to be discussed during Round Table 2)
    - Range likely to be extended above 100 μm
- Available LET value at minimum from 0 to 60 $MeV.cm^2/mg$
  - Ideally to have access to LET range representative of space ion population (to be discussed during Round Table 2)
  - Amount of available LET value to be increased
    - LET values distributed across the overall LET range,
    - 7 different LET attainable sounds like a good number

Technical needs regarding test facilities : validation of the test conditions – 1/2

- Before the test
  - On line availability of technical characteristics of the test facility
    - Flux and LET range, beam size, beam homogeneity, ion species (with associated uncertainty whenever applicable)…
    - Calculation methodology regarding LET values
    - Radioprotection requirements
  - Use of SEE test monitor (see "Design and Test of a Reference SEU Monitor" presentation)

Technical needs regarding test facilities : validation of the test conditions – 2/2

- After the test
  - Availability of information regarding each run
    - Flux and fluence measurement with associated precision
    - Ion specie used together with its energy, range, LET
    - Run duration, deposited dose
    - Activation status

Schedule and geographical aspects : general considerations - 1/2

- To homogenise / centralise accelerator availability across Europe
  - To have on line real time access (internet/other) about available slots on the different European accelerators
  - Once on line/e-mail reservation is performed by user, quick validation of chosen slot needed (typ. 72 hours) from test facility
  - Reservation process based on first in – first out principle
  - Availability of test slots uniformly spread over the year

Schedule and geographical aspects : general considerations – 2/2

- Accelerator location
  - Since experimental work is very often performed at night, need for cosy & warm office for test team, associated with efficient coffee machine…
  - Need for standard small materials (soldering tool,…)
  - Need for hotel arrangement very close from test facility
  - Location easily accessible (plane, train, camel, pirogue…)

Outputs of SEE test campaign – 1/2

- Having a SEE test result is good… but not sufficient
- To update specification/requirements for SEE test report validation
  - To define the mandatory information to be placed in a SEE test report according to state of the art
  - To provide with guide lines regarding test consistency determination (See next slide)
  - To precise applicability domain of the SEE test results
- To state about the usage of SEE rate prediction tools (example : SIMPA, PROFIT)
  - Possibly associated with recommendations for use

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Outputs of SEE test campaign – 2/2

- Example: test results during proton testing at one energy

Run	Part number	Fluence	Nb event	Sigma
1	1	$3\ 10^{11}$	1	$3.4\ 10^{-12}$
2	2	$3\ 10^{11}$	1	
3	3	$3\ 10^{11}$	1	
4	4	10^{11}	7	$7\ 10^{-11}$
5	4	10^{11}	1	10^{-11}
	mean	$1.1\ 10^{12}$	11	10^{-11}

Classical analysis deals only with mean results and leads to wrong result:

$$\sigma < \left[\ \sigma_{mean}\left(1+\frac{2}{\sqrt{Nevent}}\right) = 1.6\ 10^{-11}\ \right] < 7\ 10^{-11} cm^2$$

Need of statistical tools to verify the consistency between runs, to help to the decision (exclude run, retest…) and to define reliable cross section

Conclusions

- SEE testing should mimic at best flight conditions in coherence with industrial needs in terms of
  - Technical outputs
  - Cost
  - Schedule

- By doing such, we optimise risk analysis regarding SEE assessment.