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<sup>4</sup> particle/cm<sup>2</sup>.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)</li>
  - To optimise switch time air/vacuum/air and access time to chamber



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## 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

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SPACE



## Technical needs regarding test facilities : ions characteristics

## • Range of ions

- To be at least 40 to 50  $\mu m$  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  $\mu m$

#### Available LET value at minimum from 0 to 60 MeV.cm<sup>2</sup>/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







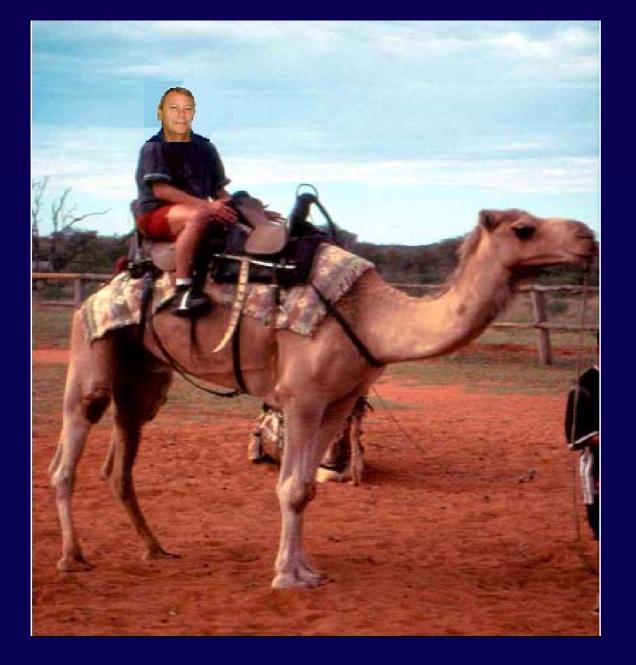


Schedule and geographical aspects : general considerations - 2/2

#### 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...)













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# 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









Outputs of SEE test campaign - 2/2

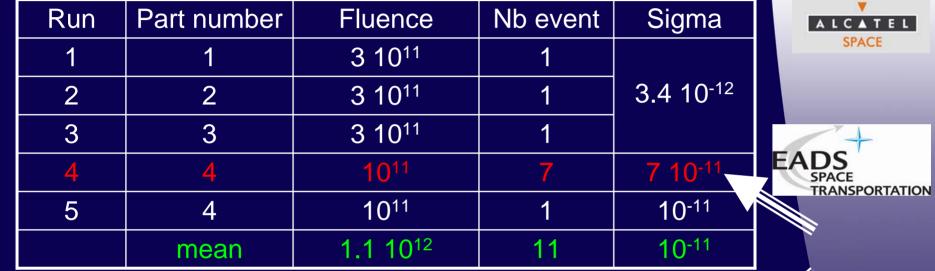
• Example: test results during proton testing at one energy

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

$$\sigma < \left[ \sigma_{\text{mean}} \left( 1 + \frac{2}{\sqrt{\text{Nevent}}} \right) = 1.6 \ 10^{-11} \ \right] < 710^{-11} \text{ cm}^2 \right)$$

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

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## 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.







