RT2 : SEE prediction and tools

- **Two issues**
- **Environment model**
- **Effects model**

Heavy ion environments

- **GCR : composition, energy spectra, resulting LET spectrum for elements heavier than Fe group (Z>28-30)**
- **SCR : idem, but even more critical**

- **A working group for collecting evidence though direct or indirect (SEE) in space measurements ?**
- **A tentative revision of the corresponding engineering models ?**

SEE rate calculations

- **Reminder : model hypothesis**
  - In the present model (CREME) the significant quantity is the **ion charge loss** Q_d (assumed to equal collected charge) in a **sensitive volume (RPP)** compared to a **critical charge**. Q_d is derived from ion **energy loss (ΔE).**
  - Some models improvement include funneling, but none (to our knowledge), includes **charge drift**
  - The use of LET was justified, as a **convenient simplification** when this LET could be considered as **constant over the sensitive volume pathlenghts** so we can assume **ΔE = LET x z**
- **In all other situations, LET by itself has poor significance**

SEE rate calculations

- **Danger area 1: long collection length SEEs (10-100 µm or above) : SET, SEL, SEB :**
  - **LET is not constant over ion pathlength**
  - **DE = LET x z is an incorrect assumption**
  - **Correct formulation is integration of LET(z)dz over pathlength**
  - **First improvement : modify CREME module for implementing this intergration**
  - **Currently being implemented in some tools (e.g. OMERE 2007)**
  - **To be used, method has to be agreed in some standard**

SEE rate calculations

- **Danger area 2 : SEEs with a large contribution from charge generated by other mechanisms than prompt charge deposition and funneling effects (typically, drift) :**
  - **Main issue is prediction of MBU rates**
  - **MBUs are a key system issue**
  - **Prediction tools are not <u>at all</u> mature in this field**

SEE rate calculations

- **Danger area 3 : How many sensitive volumes for SEL, SET ?**
  - **SEL : one big volume over the chip ? May change a lot the results**
  - **SET : multiplicity of sensitive volumes, not always the same**
- **Danger area 4 : SEUs on complex devices**
  - **transient SEUs, final application SEE rate prediction**
  - **again, how many SVs and multiplicity of SVs**
  - **more a test than a prediction issue**
- **And other**

Summary

- **Understanding SEE mechanisms is a key for prediction model improvement**
- **Feedback from space observations is a key for model validity assessment**
- **SEE prediction models have to be revisited – many shortcomings arriving at their limits**
- **Priorities should be set on simple but painful questions** ***– (to simplify : on one hand codes such as GEANT-4, on the other end… a very simple RPP, LET x z calculation)***
- **New models have to be easily usable in practice by the engineer (user i/f, portability, calculation times), this was the key of CREME success**
- **We also desperately need an engineering standard**