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ONERA

RT2 – LET calculation, ions penetration

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Main problems to discuss

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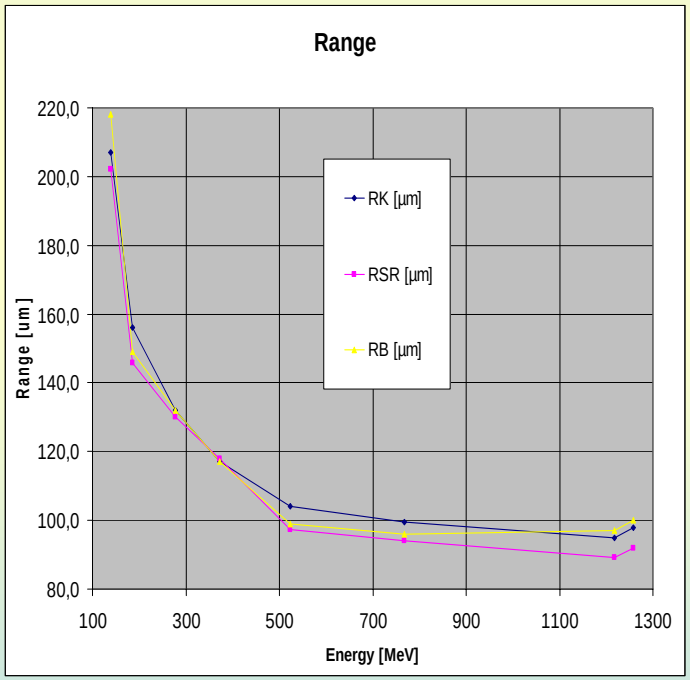
- Various LET calculation methods.
- Range effects:
  - LET modifications due to DUT overlayers.
  - LET calculation at sensitive volume level (deep located sensitive volumes or back-side irradiation).
- Other problems when performing HI tests

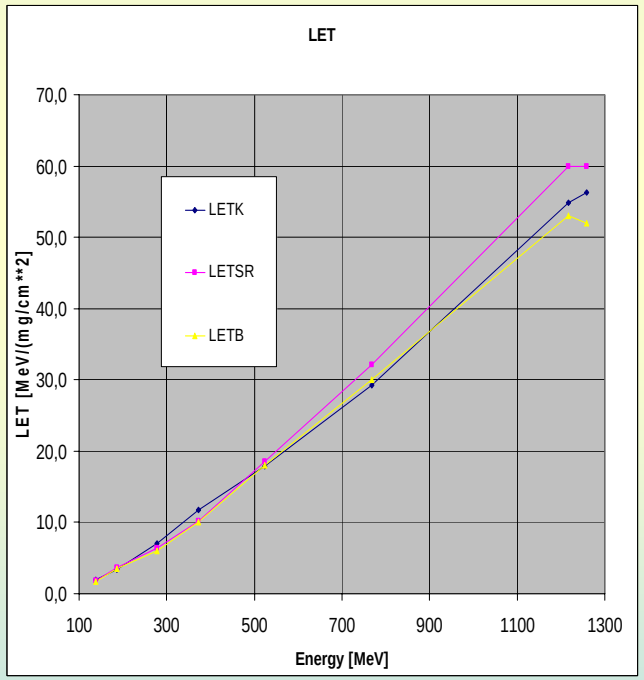
Various LET/range calculation tools

- SRIM, TRIM, Kantele, Hubert & al.,…

=>some non negligible differences!!!

e.g.: Kantele (K)
vs SRIM (S) &
BNL LET calculator (B)

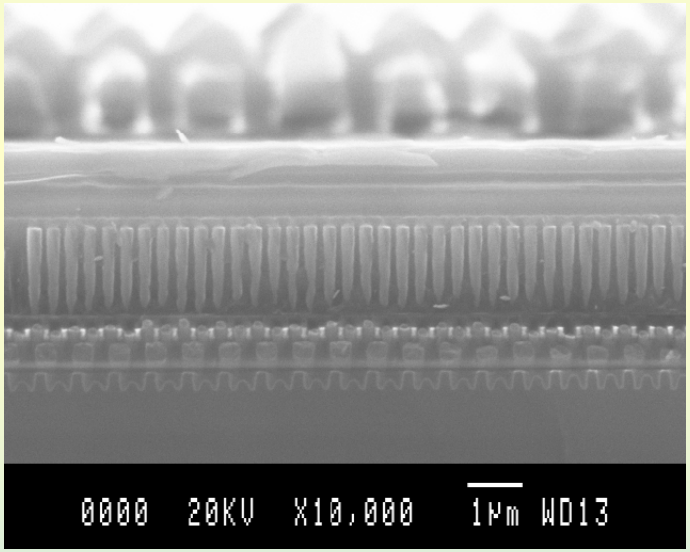




Is it possible to harmonize the LET/ range calculation methods?

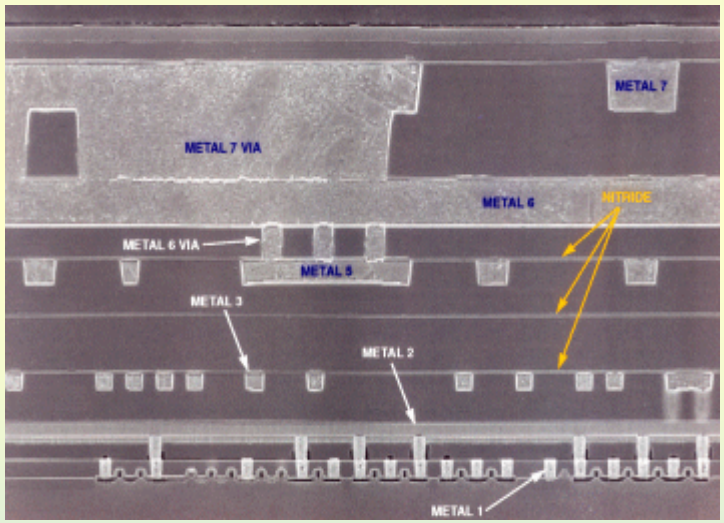
LET calculation at sensitive volume level

– Front side irradiation: Overlayer materials are not taken into account when calculating LET and range.



<< 256Mb SDRAM (vertical storage capacitor).

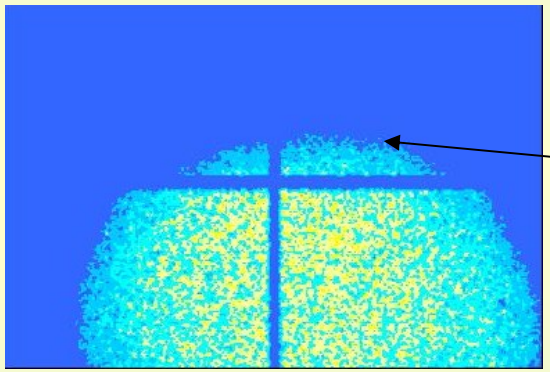
Planar Copper >>
7 Metal layers
Damascene technology

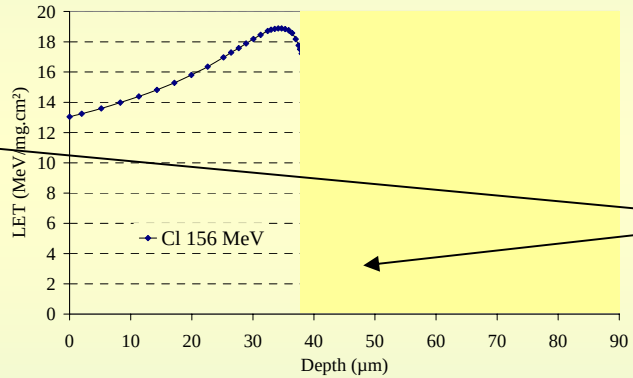


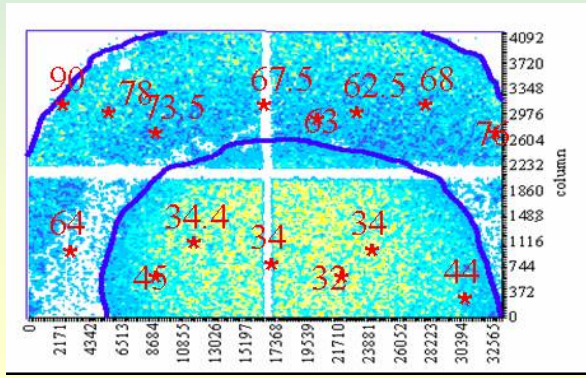
– Backside irradiation: After thinning, the die thickness may vary all over the DUT surface (a few µm only with up-to-date techniques). This shall be taken into account when choosing the ion.

LET calculation at sensitive volume level

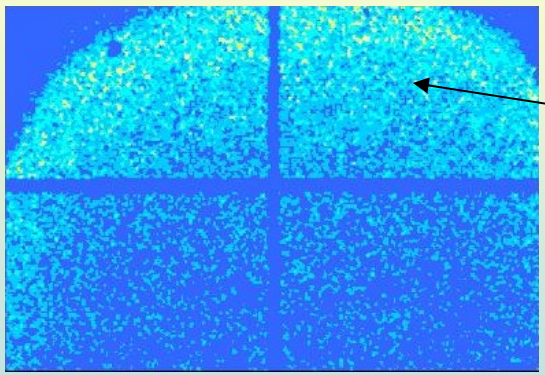
Backside irradiation of 256Mbit SDRAM (2001)
=> Worst case: important thickness variation and limited beam range.

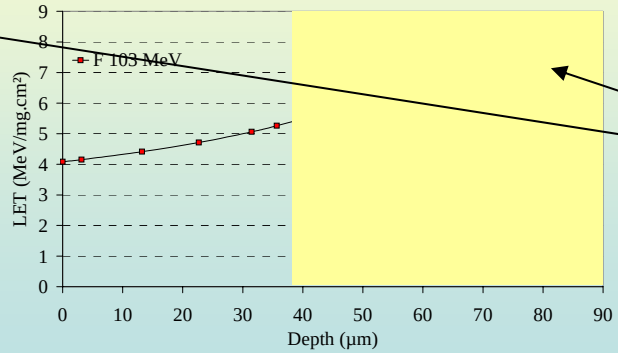






Range limitation





Enhanced LET effect

Other problems

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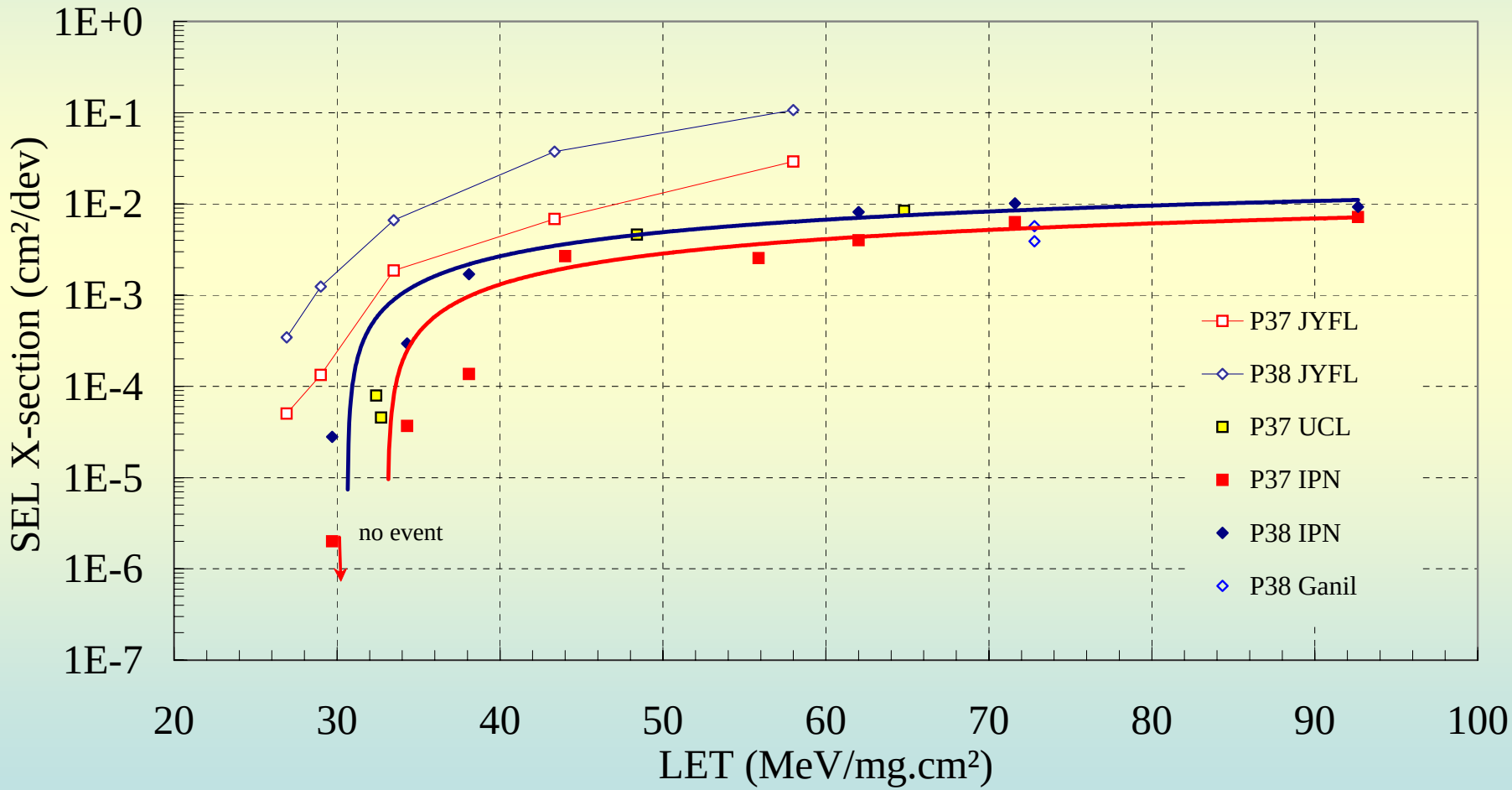
– Particle monitoring X-check between accelerators
  - ➢ Reproductibility between accelerators (Differences can be observed even when testing the same DUT with the same test system and similar LET and range).
  - ➢ Reproductibility between test campaigns at the same facility.

⇒Is the problem due to LET/range, dosimetry (counting, homogeneity, beam purity)?

Ex: 1M SRAM / SEL

IPN(>30µm)-UCL(>100µm)-JYFL(>100µm)-Ganil(>>100µm)



Beams LET/range comparison