APPLICATION OF THE TWO PARAMETER SEU MODEL TO PRACTICE

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Previously we discussed Single Event Upsets (SEU) phenomenon in semiconductor memories being operated in radiation environment [1,2]. The importance of the phenomenon was shown in our experiments with domestic parts [3] at proton energy 1 GeV.

The two parameter model for predicting SEU rate in semiconductor memories irradiated by fast particles was presented in [4].

The future development of our approach is connected with investigation of influence of the some aspects of the phenomenon under consideration [5].

1. Using model parameters obtained in [4] for INTEL 2164A microcircuit ($V = 440$ mm^3, $Ep = 2.4$ MeV) we calculated dependencies of SEU cross section on projectile energy for protons, neutrons and π-mesons with energies up to 1000 MeV. Results are presented on Fig.1. Analyzing the obtained results the coincidence of proton and neutron induced SEU cross sections at nucleon energies $E > 100$ MeV should be mentioned. Besides, pion induced cross section reflects the resonance type of pion-nucleon interaction at energies $E_\pi \sim 150 - 200$ MeV.

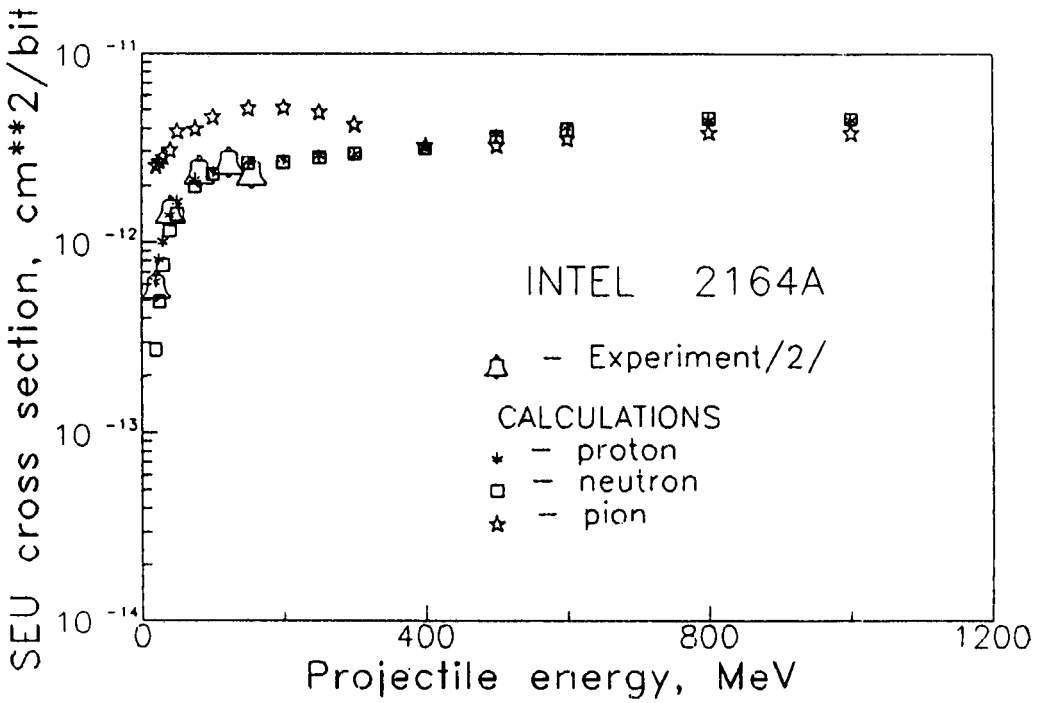

Fig.1. Dependence of SEU cross section for model microcircuit INTEL 2164A on energy of the projectile

2. The influence of π-production in inelastic (p,Si) interaction was investigated. Fig.2 presents the results of SEU rate calculations for INTEL 2164A microcircuit for two cases: 1) taking into account pion production in elementary nucleon-nucleon cross section, 2) under assumption that inelastic nucleon-nucleon interactions are forbidden. It is seen that in the second case the rise of SEU cross section at energies 300-600 MeV is not so steep and the difference grows with the increase of nucleon energy.

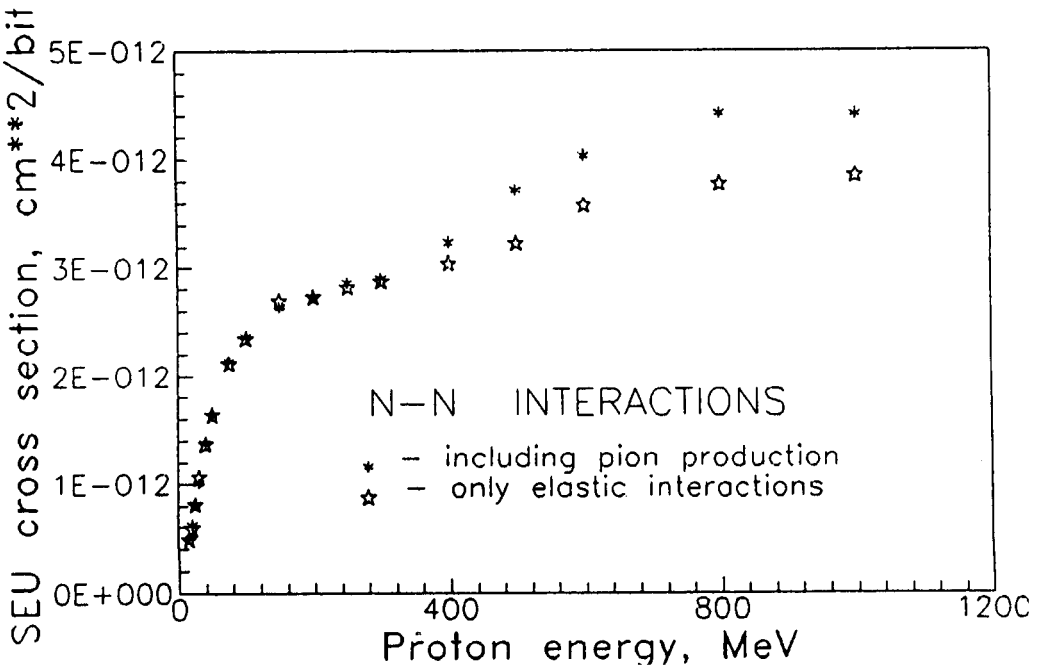

Fig.2. Influence of pion production on SEU cross section.
Calculations were made for model microcircuit INTEL 2164A

3. We investigated the influence of volume shape on obtained results. Calculations were made for: a) different shapes of the same model volume (INTEL 2164A part, $V = 440$ mm^3): cubic cell and rectangular parallelepiped one; b) for normal (along Z axis) and grazing (along X axis) incidence of a proton beam; Obtained dependencies do not differ very much. That indicates on very slight (if any) dependence of SEU cross section on the shape of the memory cell and direction of proton incidence for obtained model parameters.

More details of the discussed problems and some other aspects of two parameter model for predicting SEU rate could be found in [5].

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