Triton implantation simulation using GEANT4

1. Set physics : Scattering and Energy Loss of triton

1.1 Interaction with electron

- Aspects of scattering were not taken into account
- dE/dx
  - from PSTAR parametrization for gold, aSi
  - from ICRU'49 for He3

$$S_{ei}(T) = Z_i^2 \cdot S_{ep}(T_p)$$
$$T_p = T\frac{M_p}{M_i}$$

1.2 Interaction with nucleus

- Classical screened Coulomb scattering : G4ScreenedNuclearRecoil(example : em/extended/Test7)
  - physicsCutOff : 1eV -> determine length of step, scattering angle, energy transfer
  - recoil happens down to 30 eV

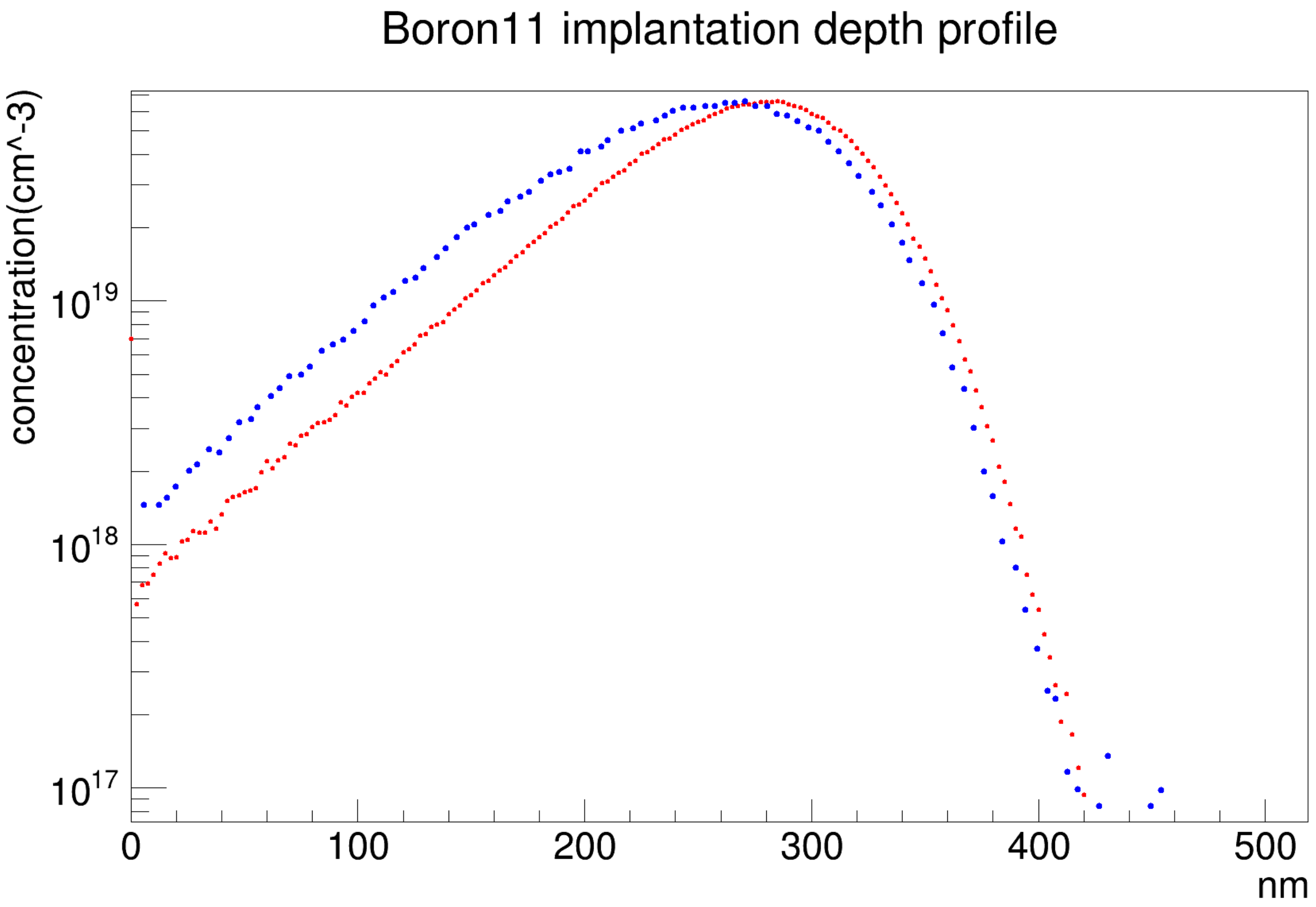
- Binary collision is assumed

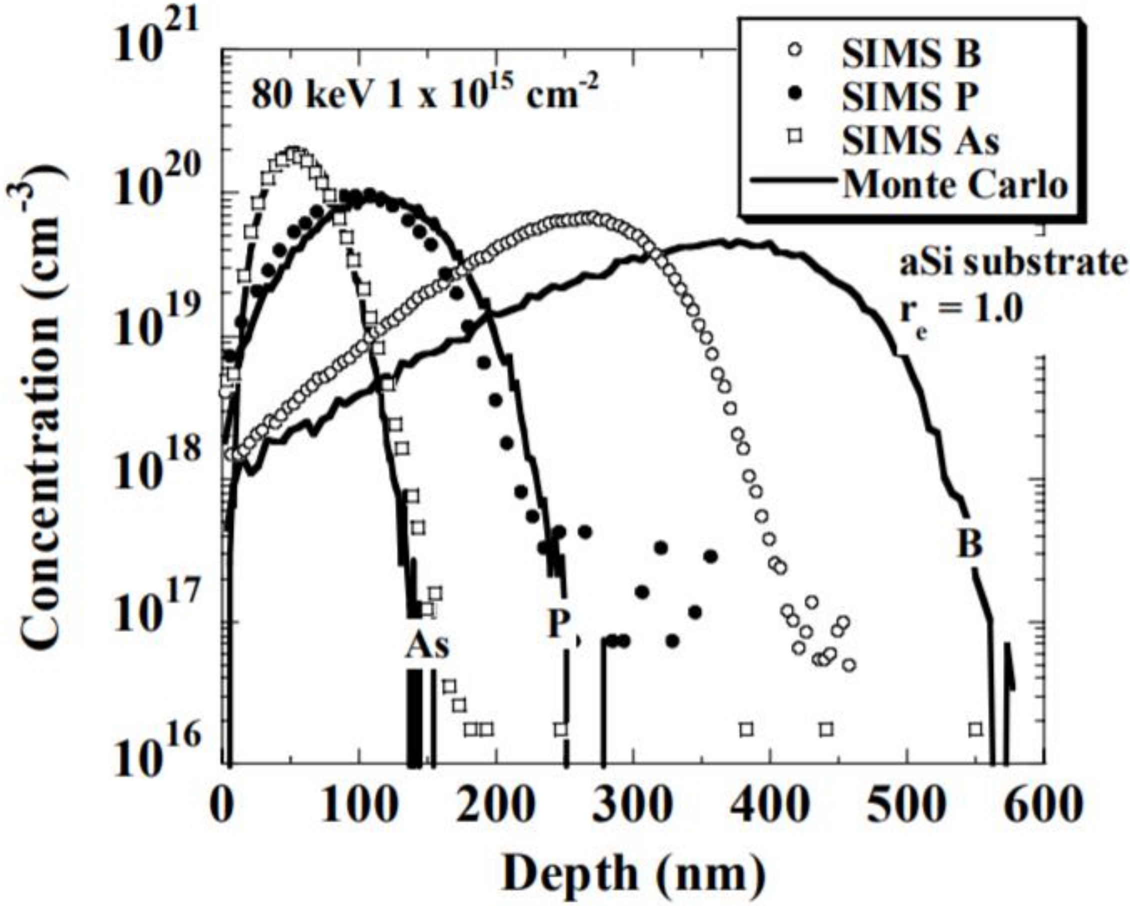
- No lattice structure(channeling effect is neglected now)

“Monte Carlo Simulation of Ion Implantation Profiles Calibrated for Various Ions over Wide Energy Range”, JOURNAL OF SEMICONDUCTOR TECHNOLOGY AND SCIENCE, VOL.9, NO.1, MARCH, 2009

2. Check validity : depth profile

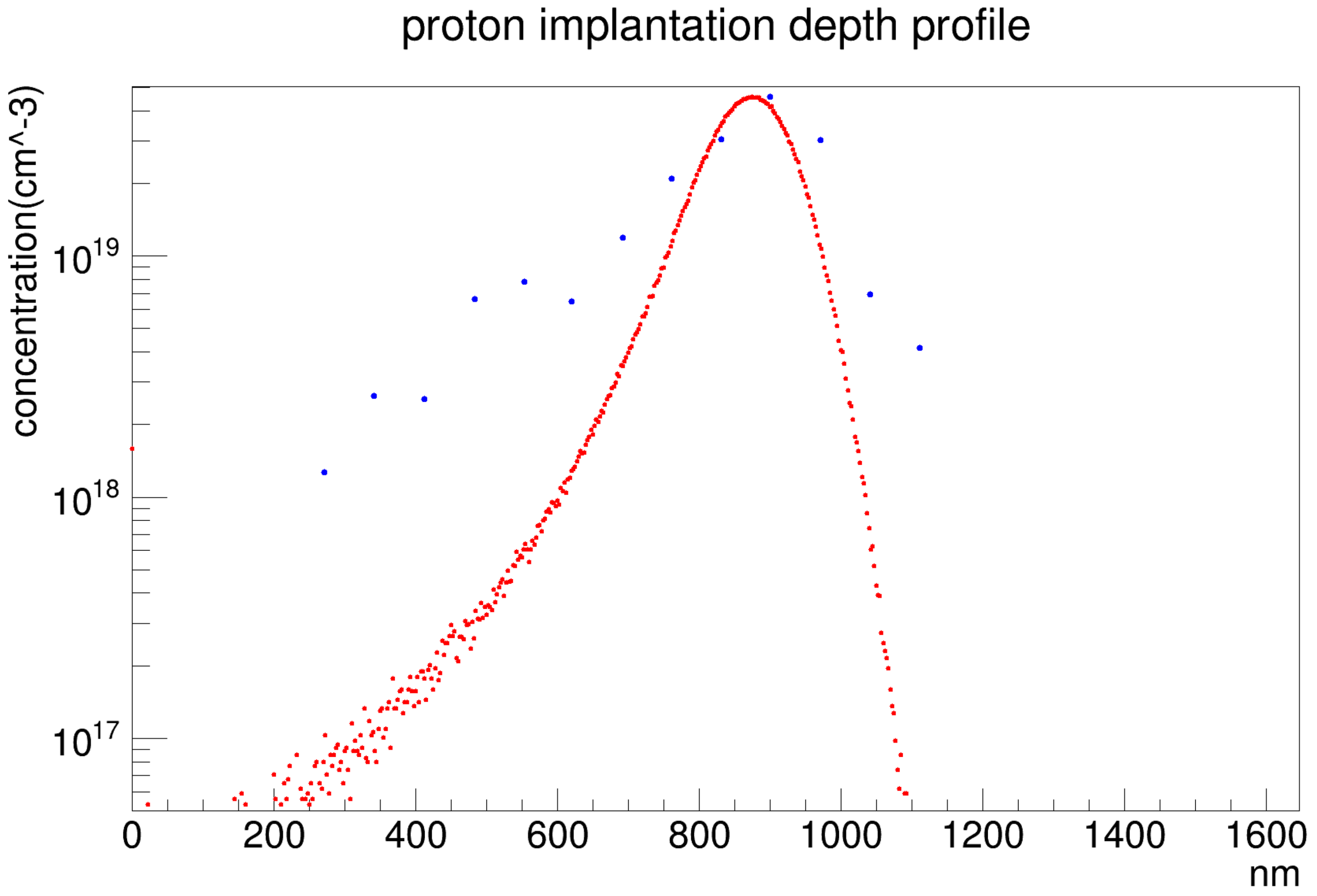
2.1 Boron : electronic stopping scaled by both charge and mass





“Hydrogen implantation and diffusion in silicon and silicon dioxide”, Applied Physics A, D. Fink et al, October 1995, Volume 61, Issue 4, pp 381–388

2.1 Proton implantation : electronic stopping scaled by both charge and mass



Data from NRA(nuclear reaction analysis)

$^{15}N + {}^{1}H \rightarrow {}^{12}C + \alpha + \gamma$ (4.43 MeV)

Tritium source search

Thermal neutron flux at HANARO

: $10^{7-9} neutrons \;/\; cm^2 \;/\; s$ (10^{13} at core)

-> Production rate from 10 gram of Helium-3 $\sim 10^{11}\, tritium$ / s   (for neutron flux of 10^7)

Helium-3 [edit]

Tritium's decay product helium-3 has a very large cross section (5330 barns) for reacting with thermal neutrons, expelling a proton, hence it is rapidly converted back to tritium in nuclear reactors.[12]

$${}^{3}_{2}\mathrm{He} + \mathrm{n} \rightarrow {}^{1}_{1}\mathrm{H} + {}^{3}_{1}\mathrm{T}$$

Mean free path : 7.5cm (for density 0.125g/L(at 1atm))