

An idea for relic neutrino detection with MMC technique

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Introduction to relic neutrino

- The relic neutrino
 - The cosmic neutrino background
 - Analogous to the cosmic background radiation
 - Neutrino decoupling about 1 second after the Big Bang,
 - 10^{10} K
 - Very low average energy
 - $E_\nu \approx 0.00055$ eV (corresponding to $T = 1.95$ K)
 - (during the calculation, $E_\nu \approx 0.0005$ eV)

Introduction to relic neutrino

- Why so important?
 - A crucial role in nucleosynthesis, structure formation and the evolution of the universe as a whole.

Relic neutrino detection with beta decaying isotopes

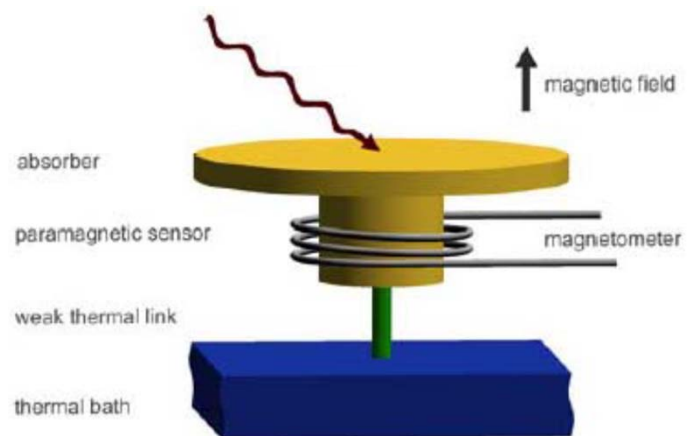
- Antineutrino absorption
 - Exothermic
 - Weak interaction
 - $\bar{\nu}_e + e^- + p^+ \rightarrow n$
 - $\bar{\nu}_e + (A, Z, Z_e) \rightarrow (A, Z - 1, Z_e - 1)^*$
- Ordinary electron capture
 - $p^+ + e^- \rightarrow n + \nu_e$

Relic neutrino detection with beta decaying isotopes

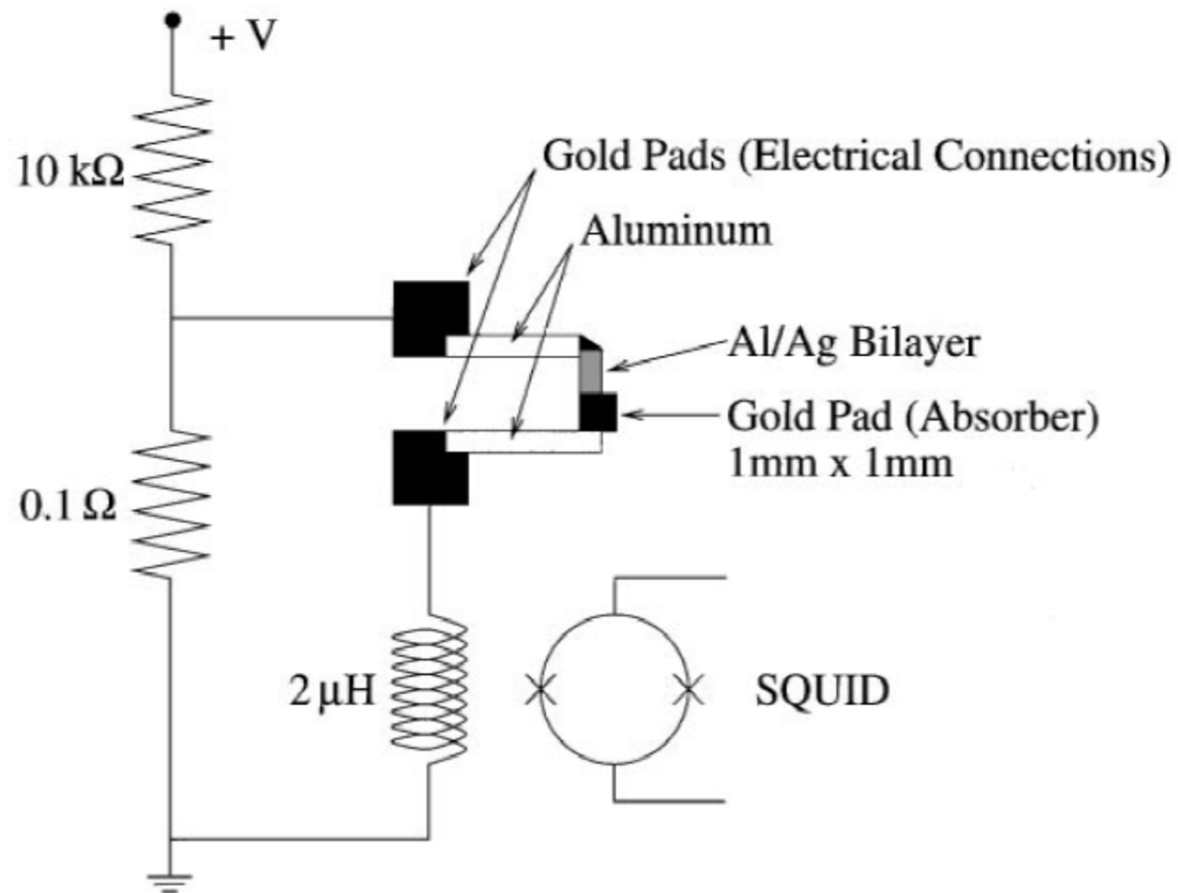
- EC capturing nuclei are able to capture relic $\bar{\nu}_e$
- Challenge!: usually, (anti)neutrino capture rate $\ll$ EC capturing nuclei

Proposed experiments for relic neutrino detection

Energy resolution of MMC

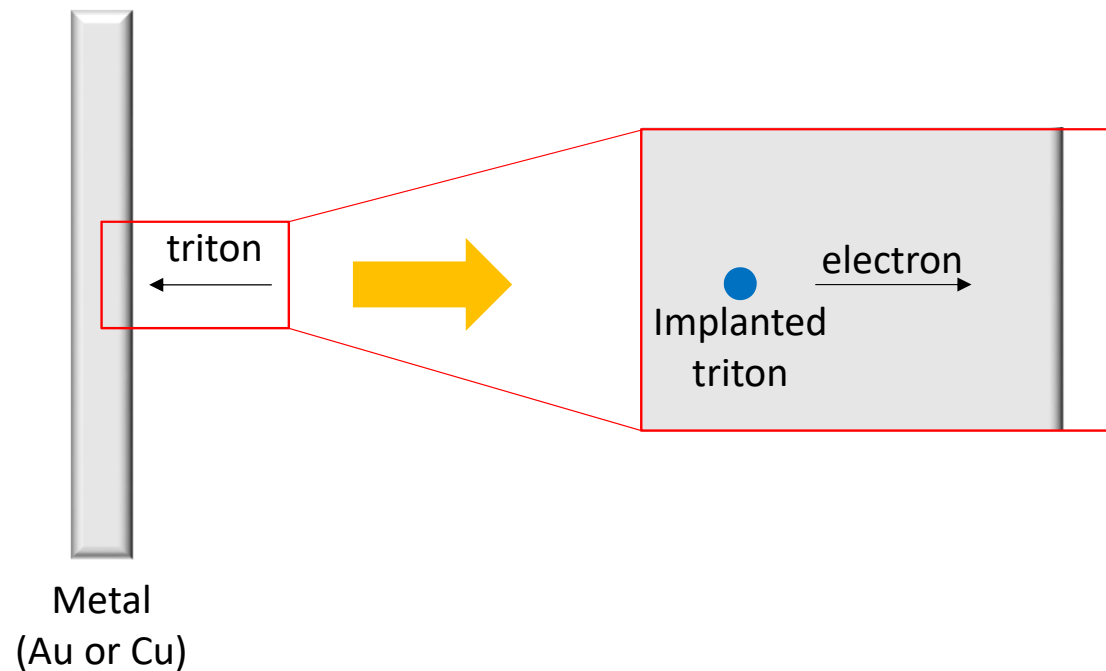


Energy resolution of MMC



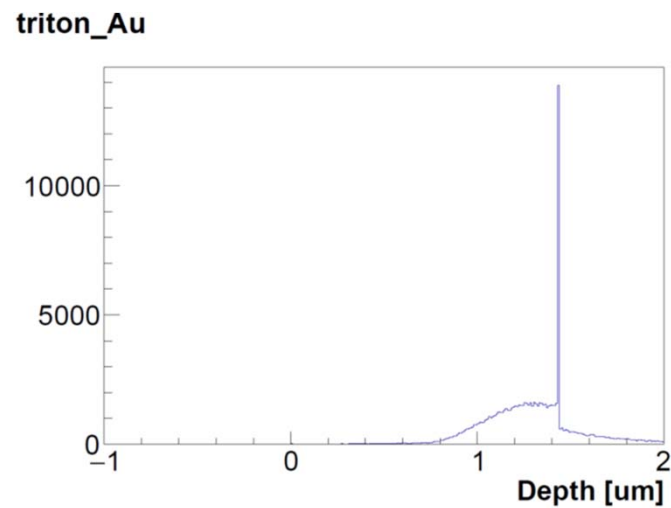
Tritium implantation into metal

- Implantation – ${}^3\text{He}(n,p){}^3\text{H}$ nuclear reaction
 - Neutron capture
 - ${}^3\text{He} + n \rightarrow {}^3\text{H} + p$
 - Q-value: 765 keV
 - Emitted tritium: 191 keV

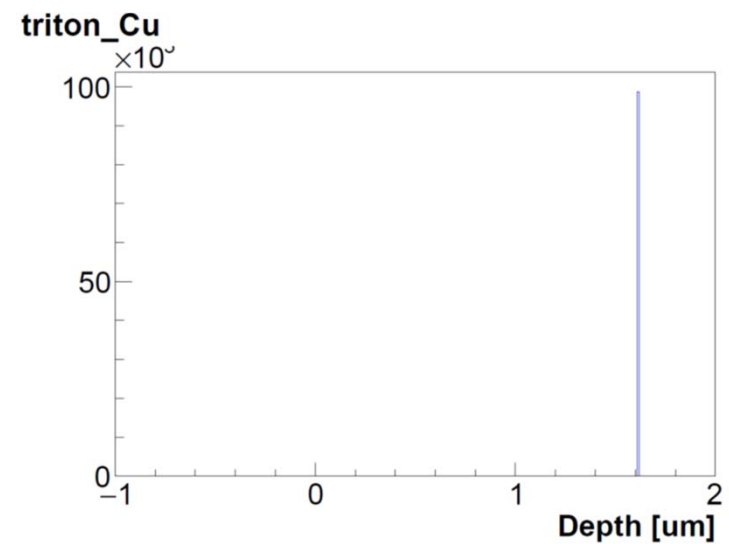


Tritium implantation into metal

- GEANT4 Simulation



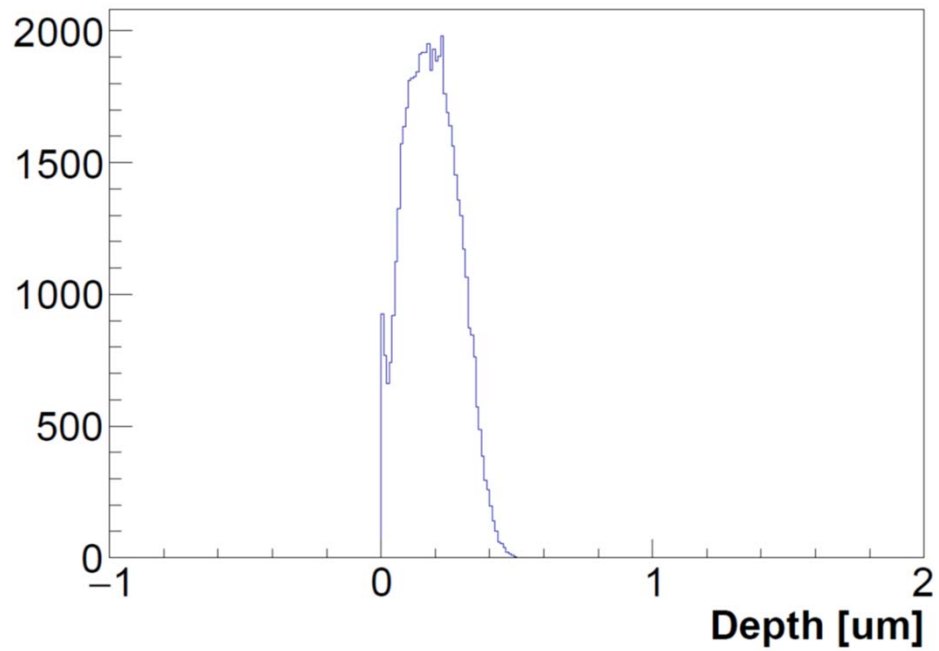
- Expected depth:
1.287 μm



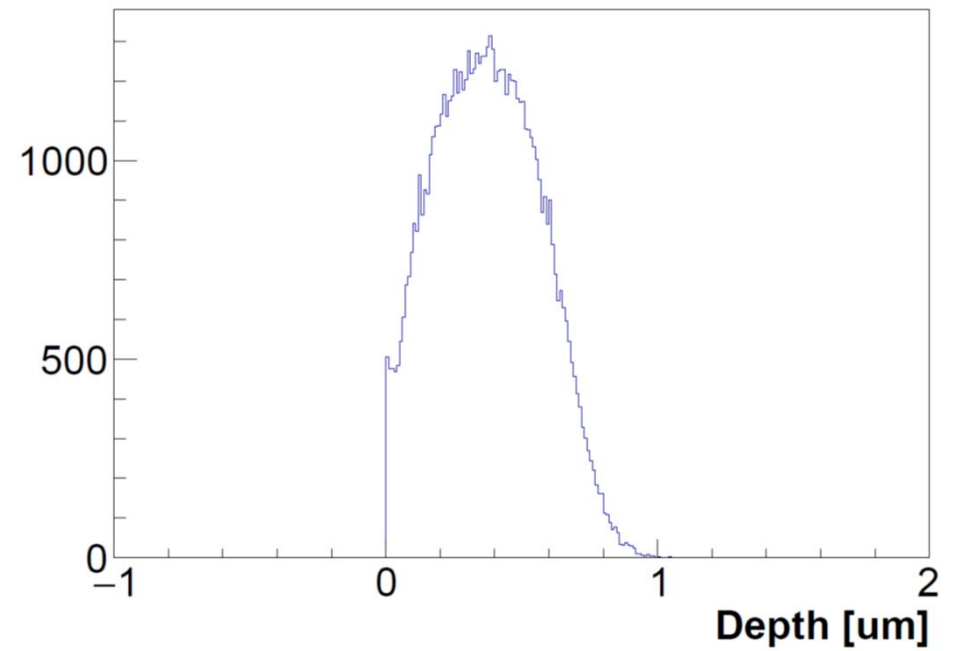
1.618 μm

Tritium implantation into metal

electron_Au

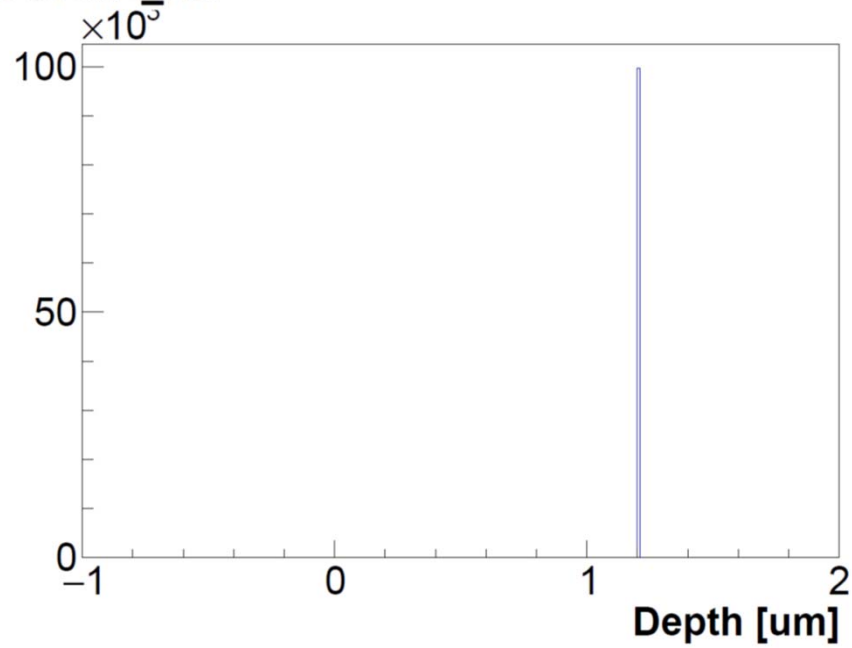


electron_Cu

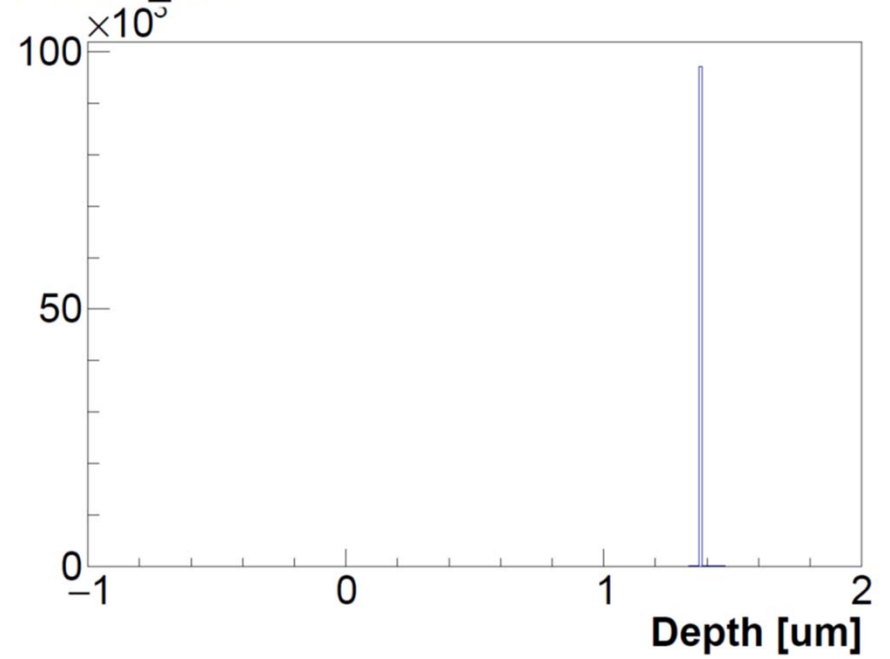


Tritium implantation into metal

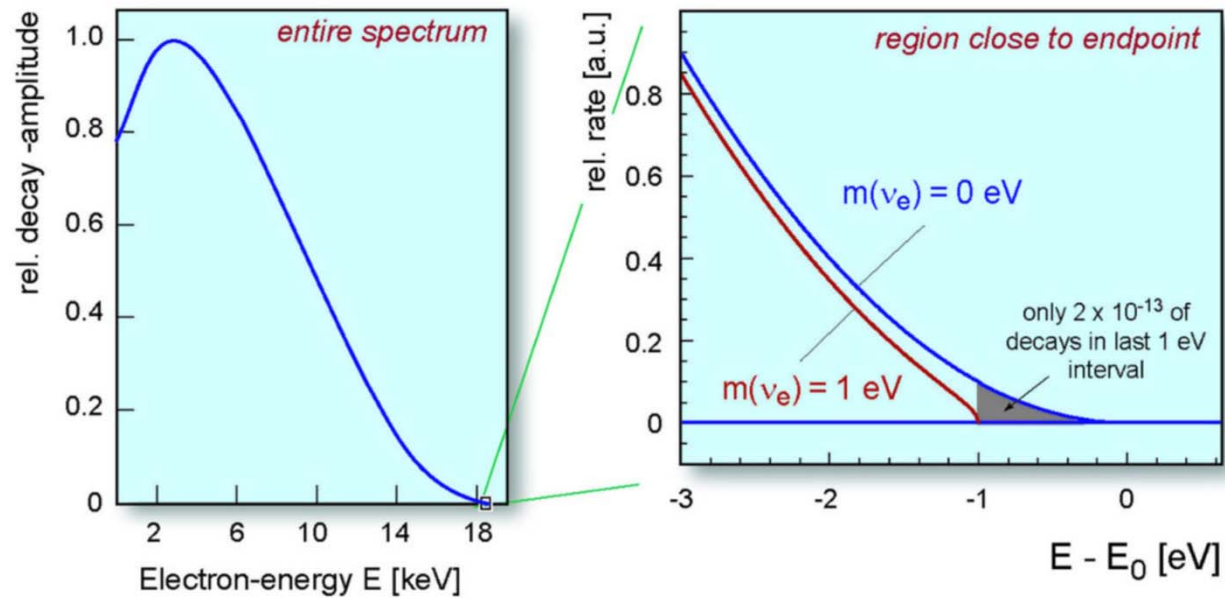
electron2_Au



electron2_Cu



Measurement of beta spectrum near end point



Thank you