

Numerical study of the effect of secondary electron emission on the dynamics of electron clouds in gyrotron guns

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- Code `espic2D` does not take account (yet) for secondary electron emissions, induced by ions collected at the electrodes. Let us denote these ion-induced electron emissions by IIEE from now on.
- Goal: Implement a module to add those IIEE to `espic2D`

- We seek an expression for the **electron yield** γ
- It is expected that γ depends on the **incident particle energy**, the target density i.e a **material parameter** including cross sections for particle interactions, as well as **transport phenomena** occurring for produced electrons.
- Semi-empirical model: **Schou** (1988) [Hassel92]

$$\gamma = \Lambda \cdot \beta \cdot \left. \frac{dE}{dx} \right|_e \quad (1)$$

- In the above Eq.(1), Λ includes the cross sections for collisions with energy deposition, β accounts for energy transport by recoil electrons, and dE/dx corresponds to the energy deposited in the solid by the ion colliding with electrons (subscript e).

[illegible]

- Research of tabulated values (semi-empirical model) for the physical parameters:
 - dE/dx from [Janni]
 - β and $\Lambda = \Lambda_{exp}$ from [Hassel92]

Figure: Energy loss values from [Janni82]

EPFL Appropriate fit for the data

- In order to implement the energy loss of deposited ions, we need to find the appropriate fit:
To do so, one has to determine the **energy distribution of ions collected at the electrode**, and match it with the energy loss curve.
- In Fig.(2), the energy loss of protons in Aluminum has been plotted on the expected energy range of 20 keV to 1 GeV (see red curve).
E.g if the protons are mainly distributed in parabolic region (green) → quadratic fit
Else a linear fit may be more appropriate.

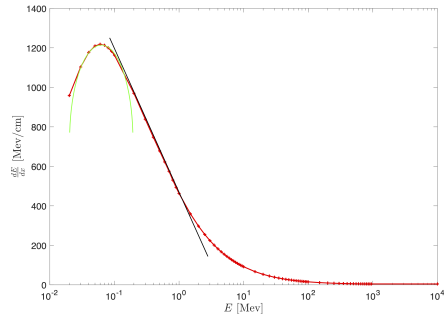


Figure: Energy loss for protons in aluminum (red) - possible fits for the data in interesting regions (green - black)