MONTE CARLO SIMULATION OF EXCESS NOISE IN HETEROJUNCTION AVALANCHE PHOTODETECTOR

A. Ghosh and K. K. Ghosh
Center for Science Education and Research
P-1, B.P.Township,Calcutta-700094
West Bengal,INDIA

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1.Work :-

Multiplication Noise is calculated in InGaAs / InP Heterojunction APD.

2. Methodology :-

a) concept of "dead space"—minimum distance described by shooting carrier to occur ionization .
Probability distribution function

$$P(x) = \begin{cases} 0 & \text{for } x \le l_0 \\ \alpha^* \exp[-\alpha^*(l_0 - x)] & \text{for } x > l_0 \end{cases}$$

α^* = ionization coefficient in the hard threshold dead space model
l_0 = dead space
x = path described

Hard threshold :- High rate of change of ionization probability with energy.

- AT the heterojunction hard threshold approximation is used.

b) Monte Carlo method :-
Determination of α^* by random picking up of ionization path length
c) Modeling in Monte Carlo

- Analytical parabolic model for InGaAs
- Analytical non-parabolic model for GaP
- Optic phonon scattering

RESULTS AND DISCUSSION

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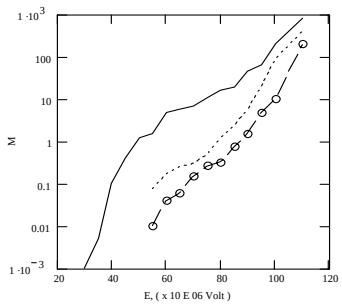
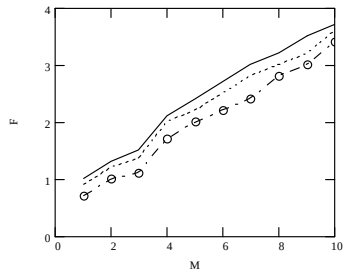


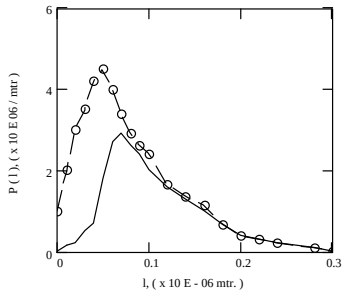
Multiplication vs. Electric Field

- The dead space effect is seen as a shift of the multiplication curve to the right of the origin.



Excess Noise vs. Multiplication

- Noise in heterojuntion APD is less compared to that in component material.



Path length probability distribution

- The electron ionization path length probability is more peaked in short length heterojunction APD.

CONCLUSION

Noise in hetero-APD is studied within the framework of Monte Carlo formalism using the dead space concept and random path length technique. Noise is overestimated in early works of no consideration of dead space effect.