Sampling Fluctuation Study Using Electrons

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Overview

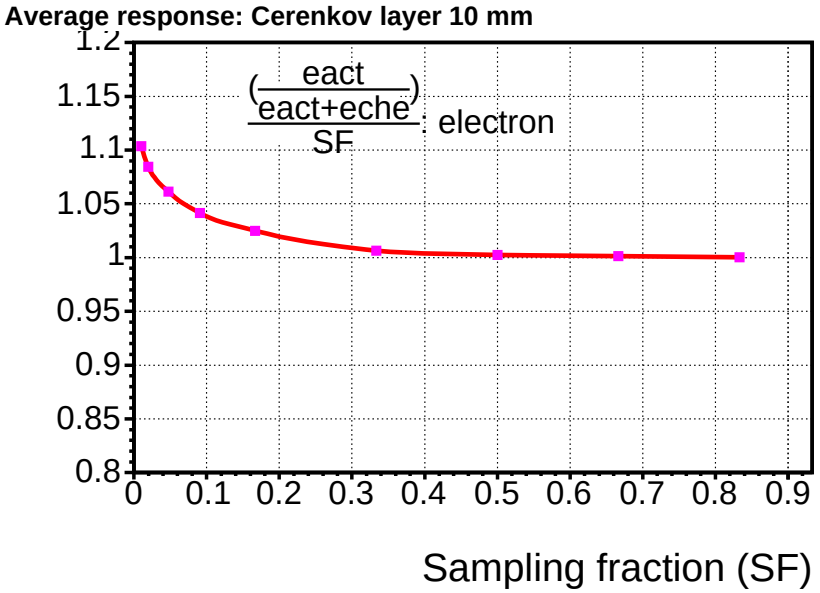
- Same configuration as my talk on October 18th, 2006
  - 400 layers of Cerenkov layers and active layers — All made of lead glass
  - Cerenkov layer depth (dche): 10, 20, 50, 75 mm and for each kind of Cerenkov layer depth:
    - vary active layer depth (dact): 0.1, 0.2, 0.5, 1, 2, 5, 10, 20, 50 mm
- Check only the total energy deposited in Cerenkov and active part
- Convert the depth to sampling fraction

$$SF \equiv \frac{dact}{dact + dche}.$$

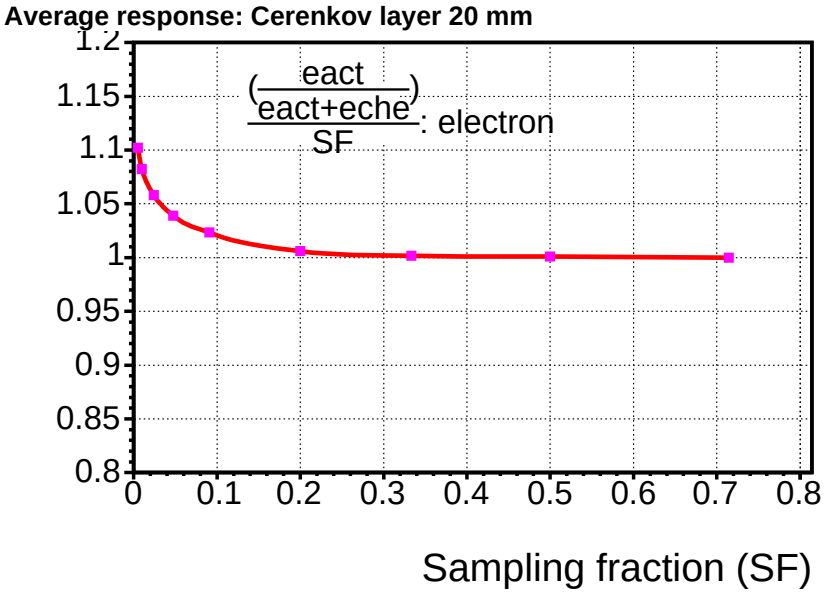
- This time we use 20 GeV electrons (instead of pions)!
- Check the following variables vs. SF:
  - Response: $\frac{eact/esum}{SF}$
  - Resolution contribution from sampling fluctuation: $\sqrt{20}\frac{RMS(response)}{Mean(response)}$
  - Total resolution : $\sqrt{20}\frac{RMS(eact)}{Mean(eact)}$
  - Fluctuation: $\sqrt{20}\frac{RMS(\frac{eact}{SF}-esum)}{Mean(\frac{eact}{SF}-esum)}$

Response

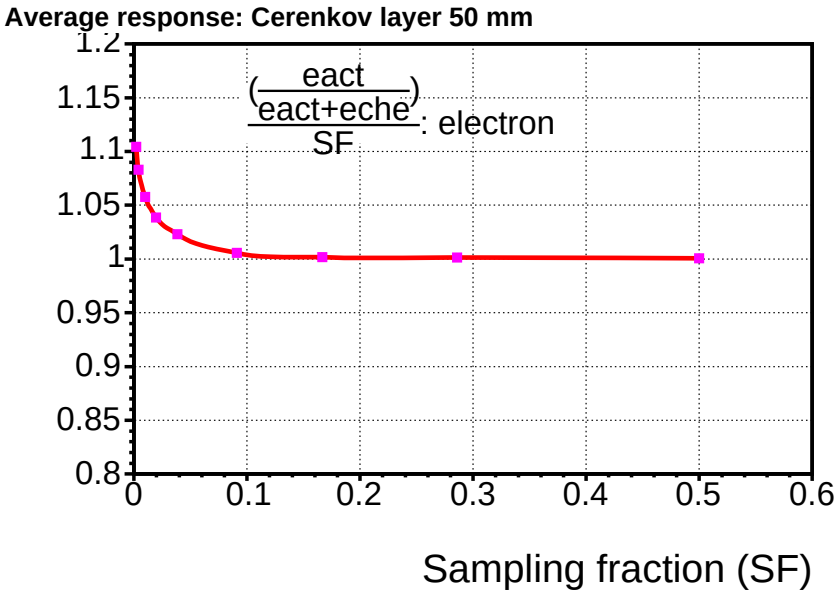
Cerenkov layer 10 mm



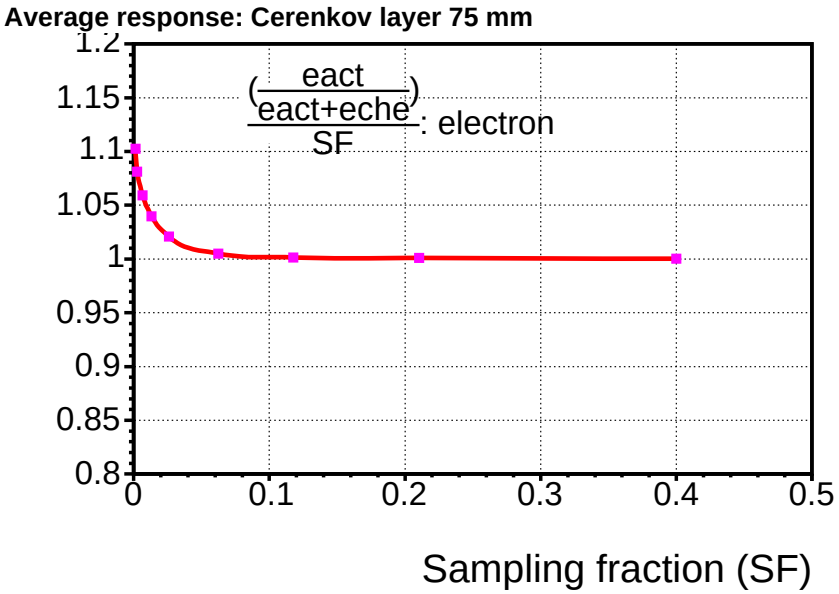
Cerenkov layer 20 mm



Cerenkov layer 50 mm

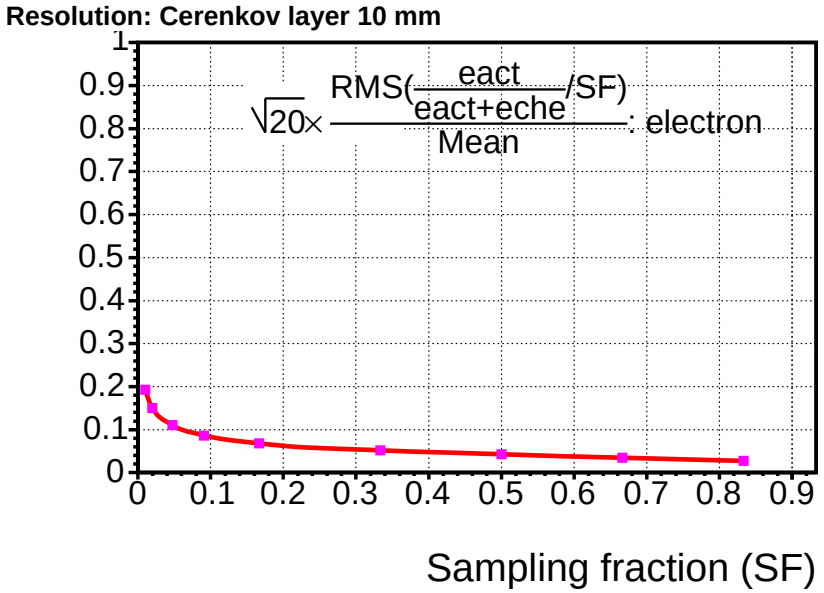


Cerenkov layer 75 mm

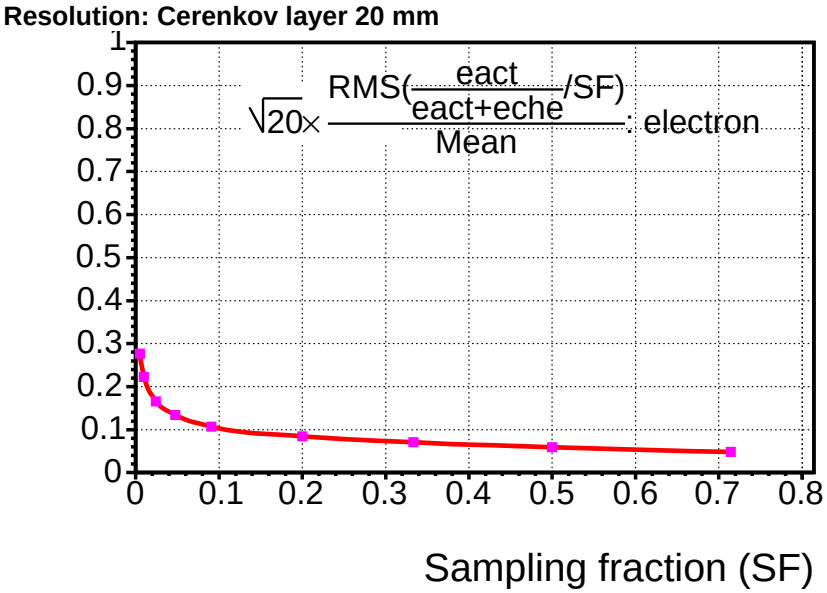


Resolution component from sampling fluctuation

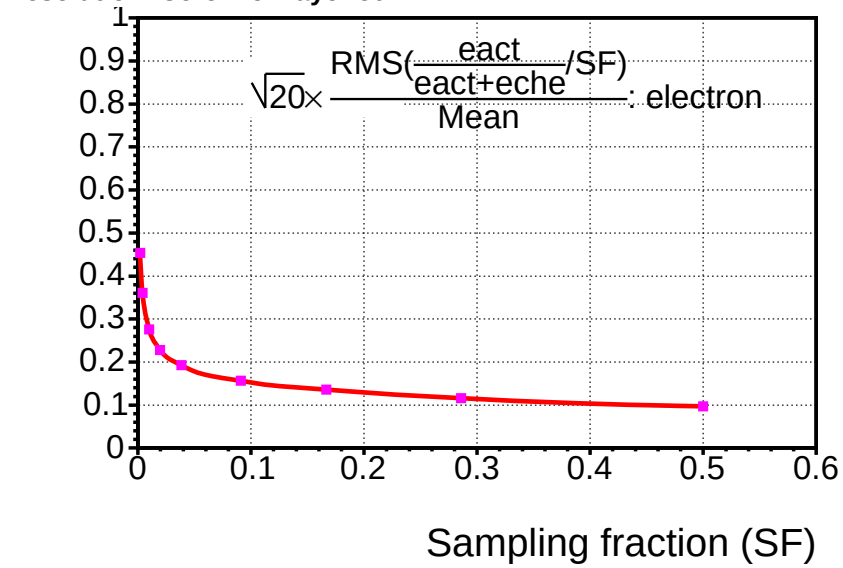
Cerenkov layer 10 mm



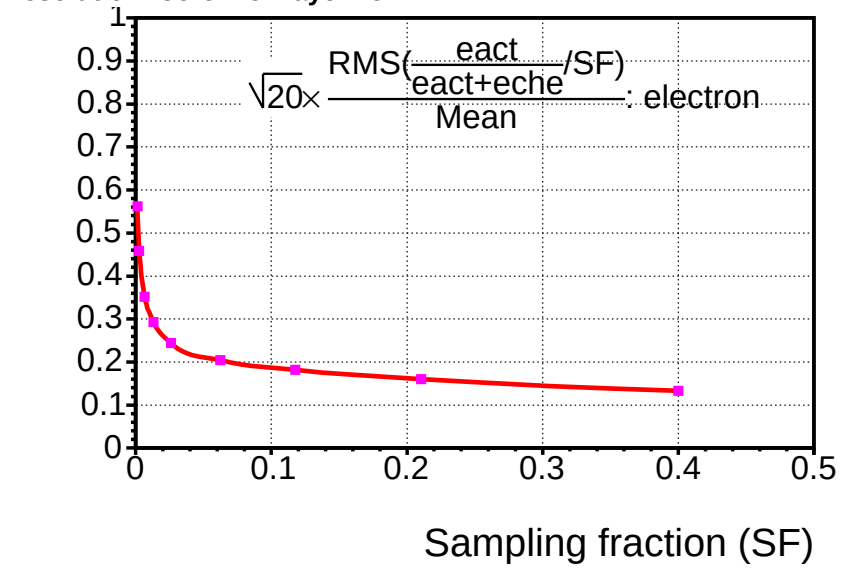
Cerenkov layer 20 mm



Cerenkov layer 50 mm

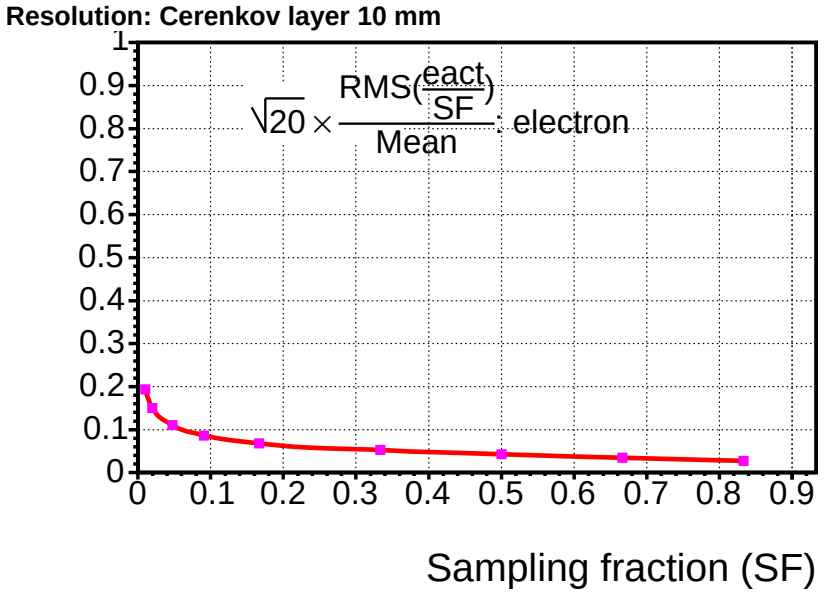


Cerenkov layer 75 mm

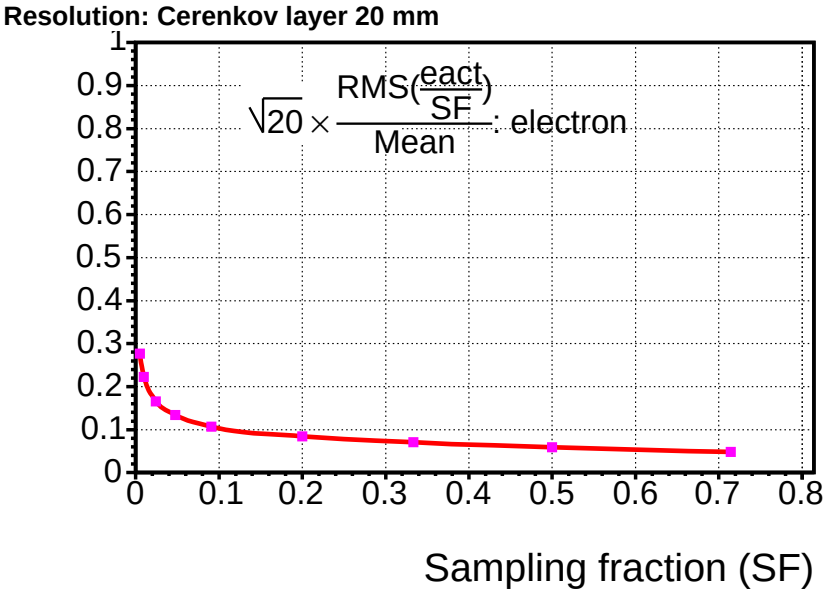


Total resolution of the energy measurement

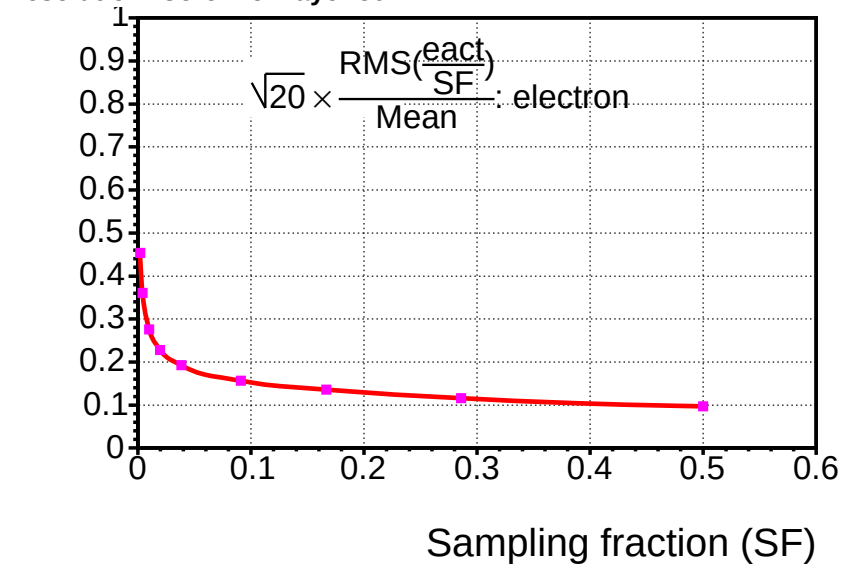
Cerenkov layer 10 mm



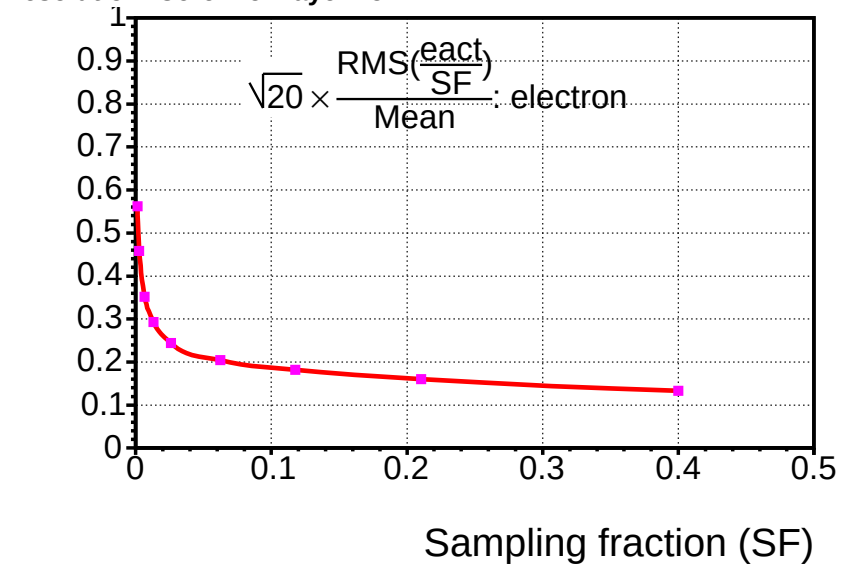
Cerenkov layer 20 mm



Cerenkov layer 50 mm

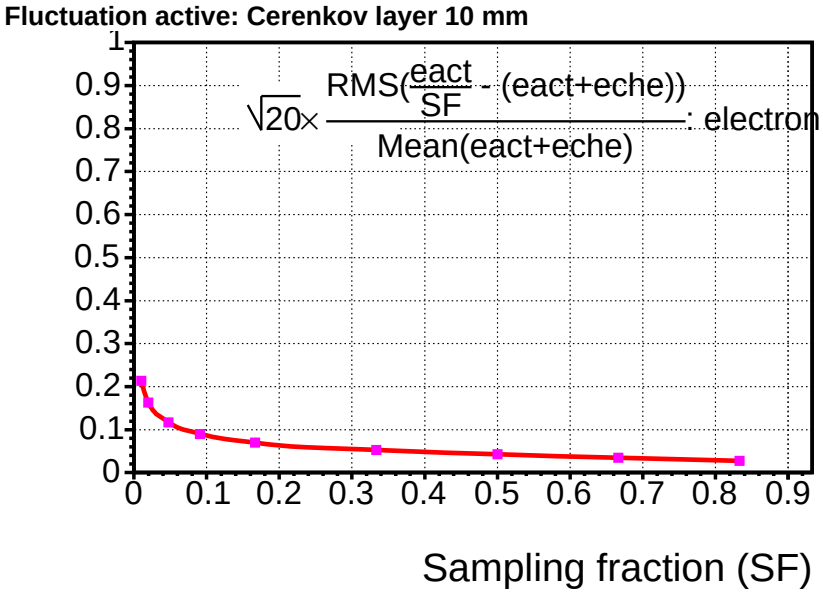


Cerenkov layer 75 mm

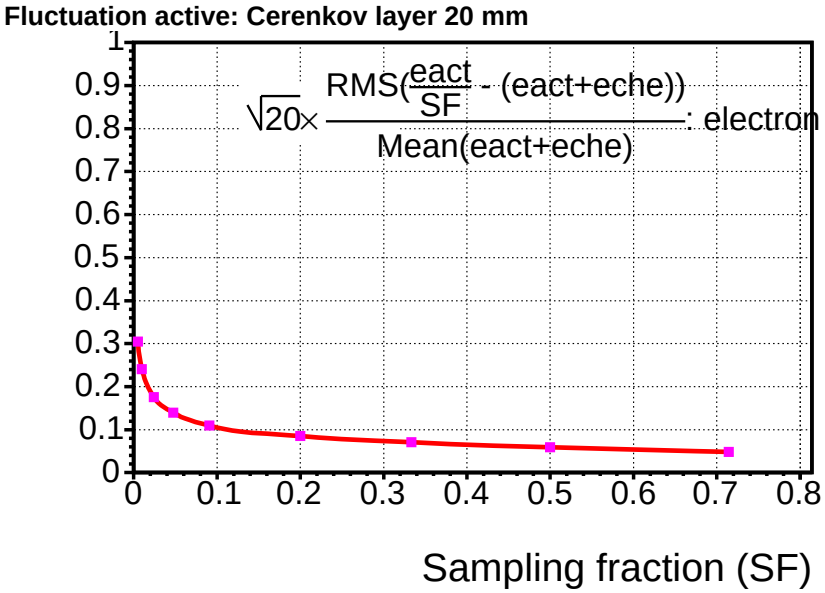


Sampling fluctuation

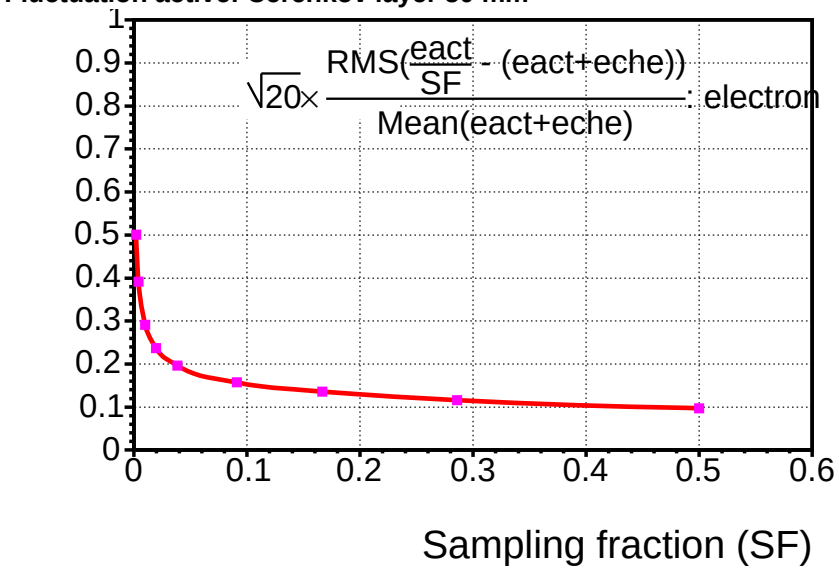
Cerenkov layer 10 mm



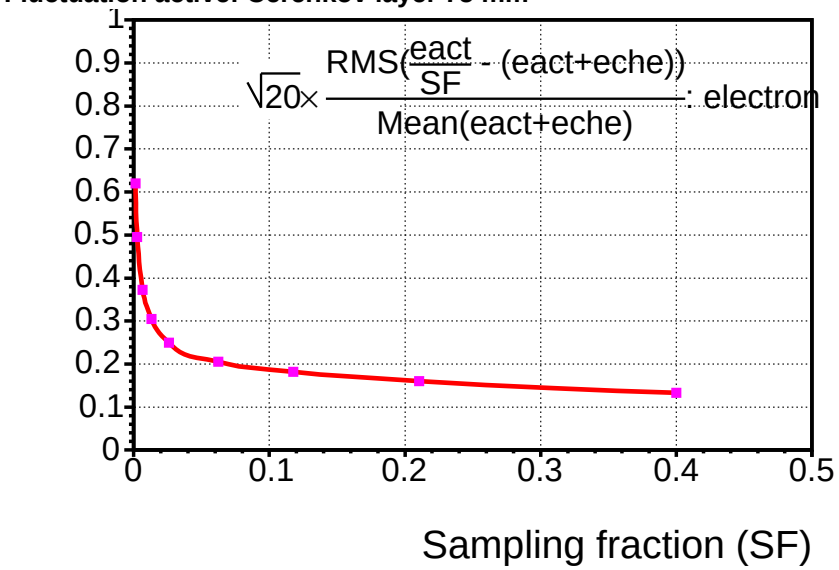
Cerenkov layer 20 mm



Cerenkov layer 50 mm



Cerenkov layer 75 mm



Conclusion

- For the same sampling fluctuation, electrons have better energy resolution than pions.
- Electrons' energy resolution are dominated by the sampling fluctuation.