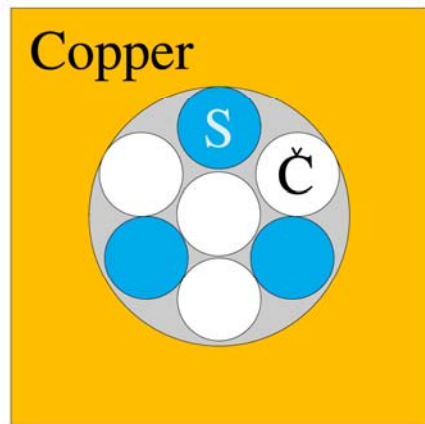# Neutron contribution to Hadron Calorimeter Signal
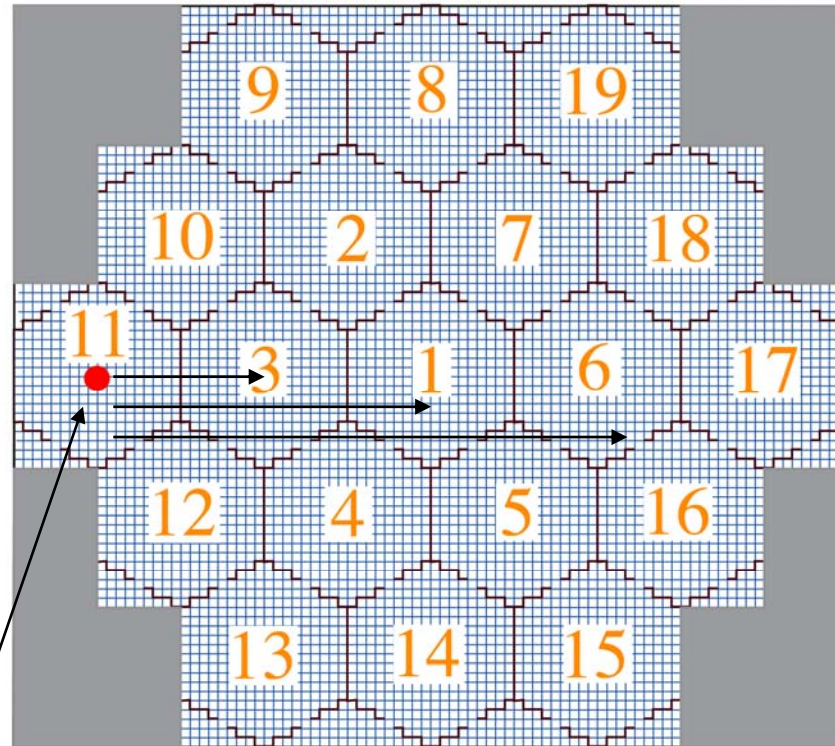
S.Popescu

for DREAM collaboration.

System set-up (1)

Tower 11→3 r=7cm
Tower 11→1 r14=cm
Tower 11→6 r=22cm

Beam entered center of tower 11
0 degree orientation

See talk of J.Hauptman

System set-up(2)

- 2 scintillation counter provided the DAQ trigger
- 4 signals/tower were measured
- Signal was split (passively) into 3 equal parts:
  - 1 signal sent to a charge ADC with 50fC/count and 16micros for conversion
  - 2 other to a FADC at a rate of 200Mhz
  - The 2 signals are measured separately in 2 FADC channel with a 2.5 ns delay
- The PMT were calibrated using a 50 GeV electrons to 1pC/GeV
- We used 100 GeV pions steered into the center of Tower 11.
- S and Č signals were sent via 2X2=4 channels for time structure analysis in FADC
- The measurement were done for Tower 3 ~ 72 mm from the beam axis, Tower 1 ~ 144mm, and Tower 6 ~ 216 mm
- For each run 100 000 events were collected

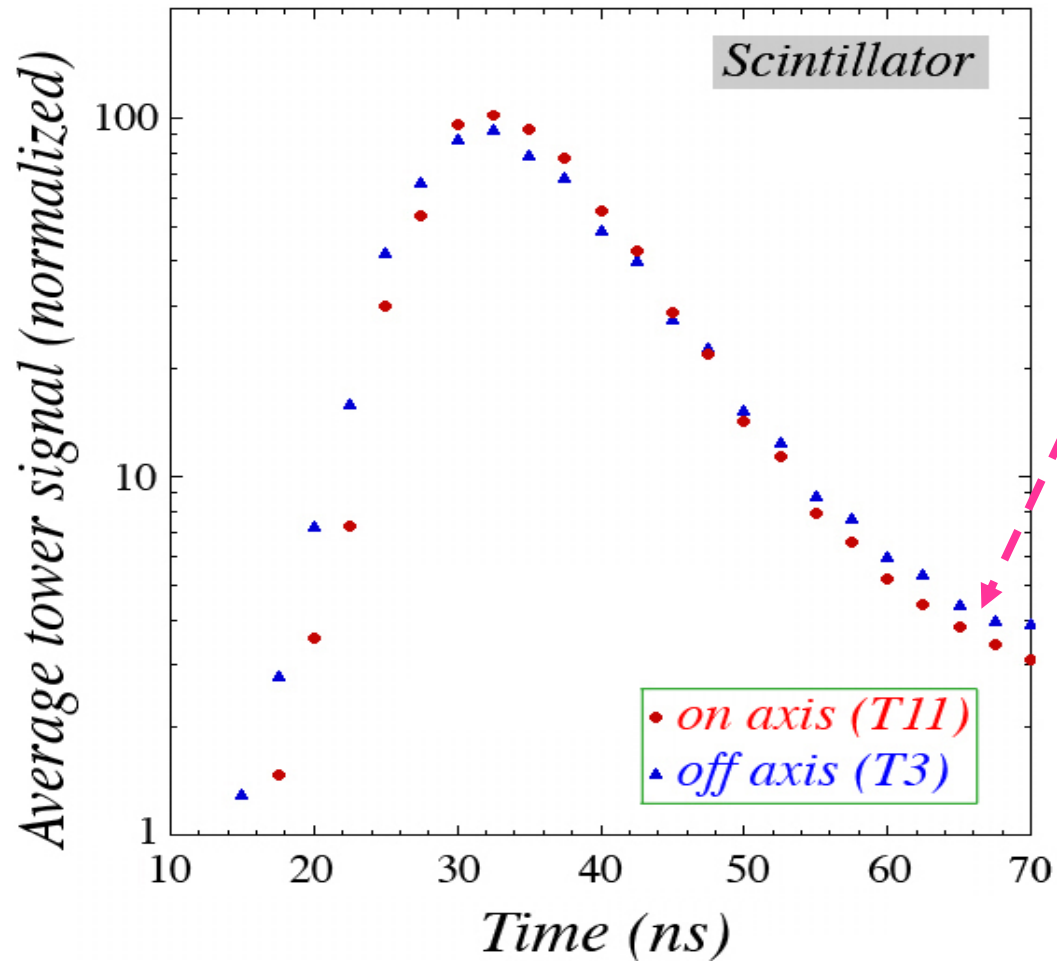# S and Č signal's time structure on T3 and T11
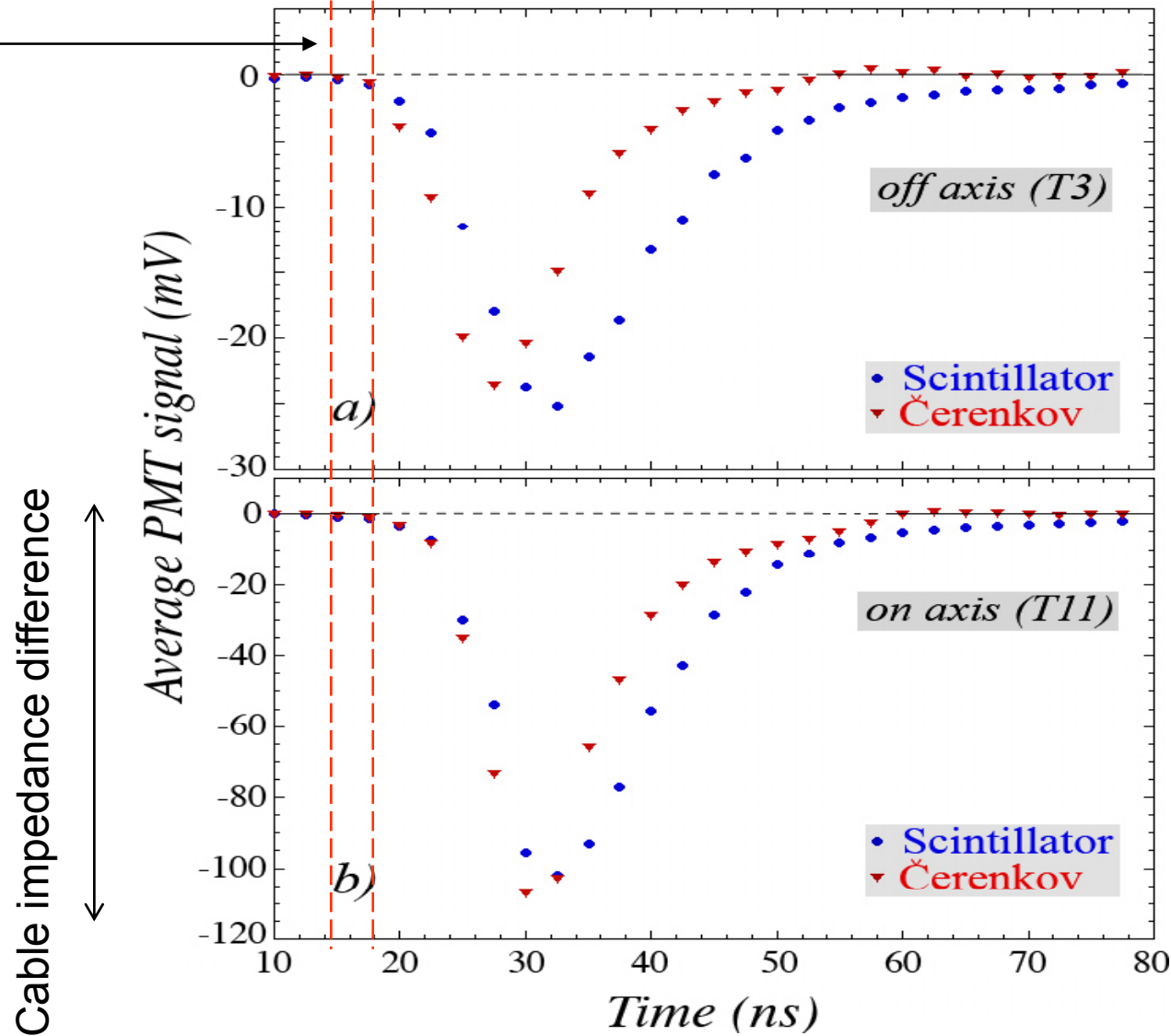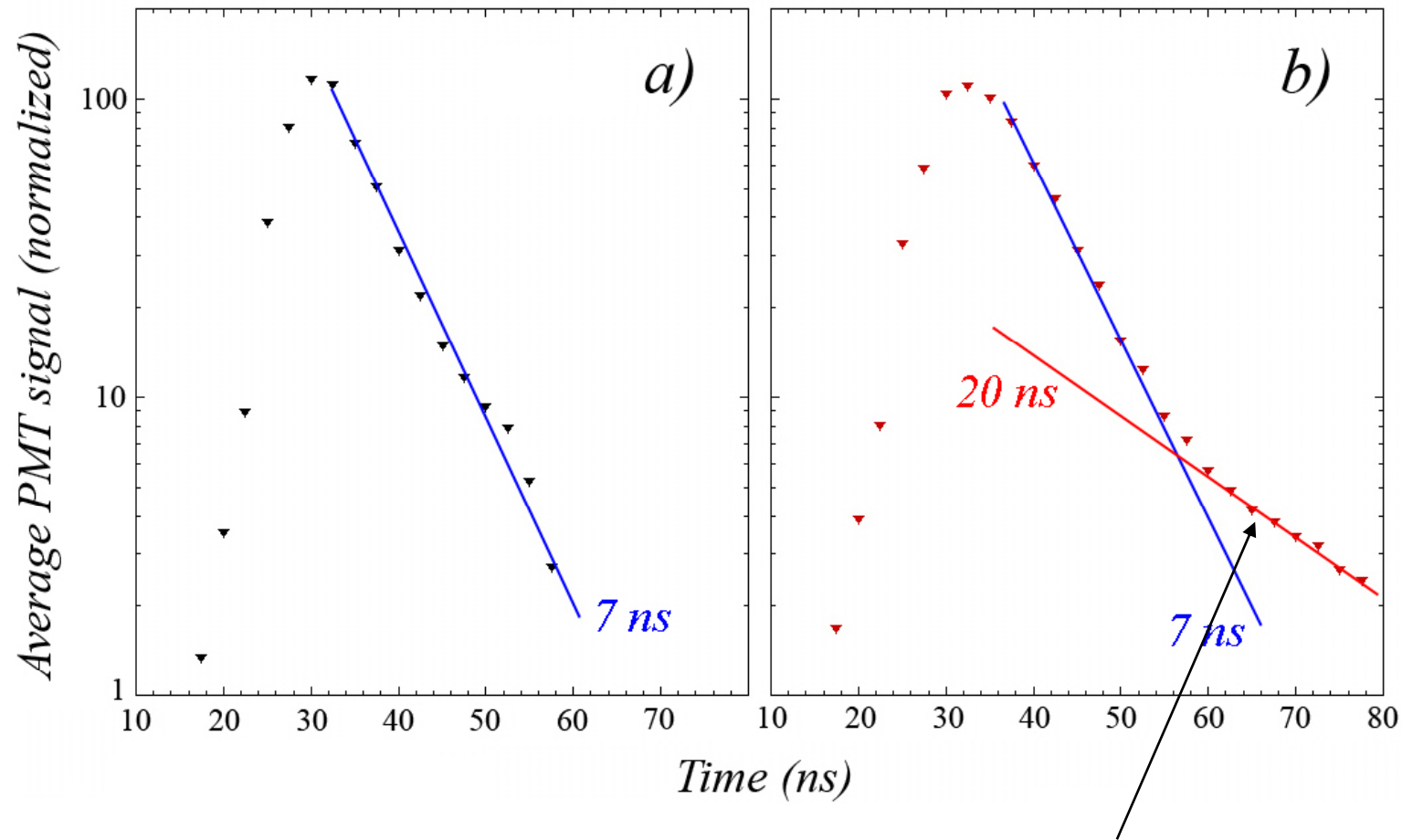
Č signal from T3 and T11
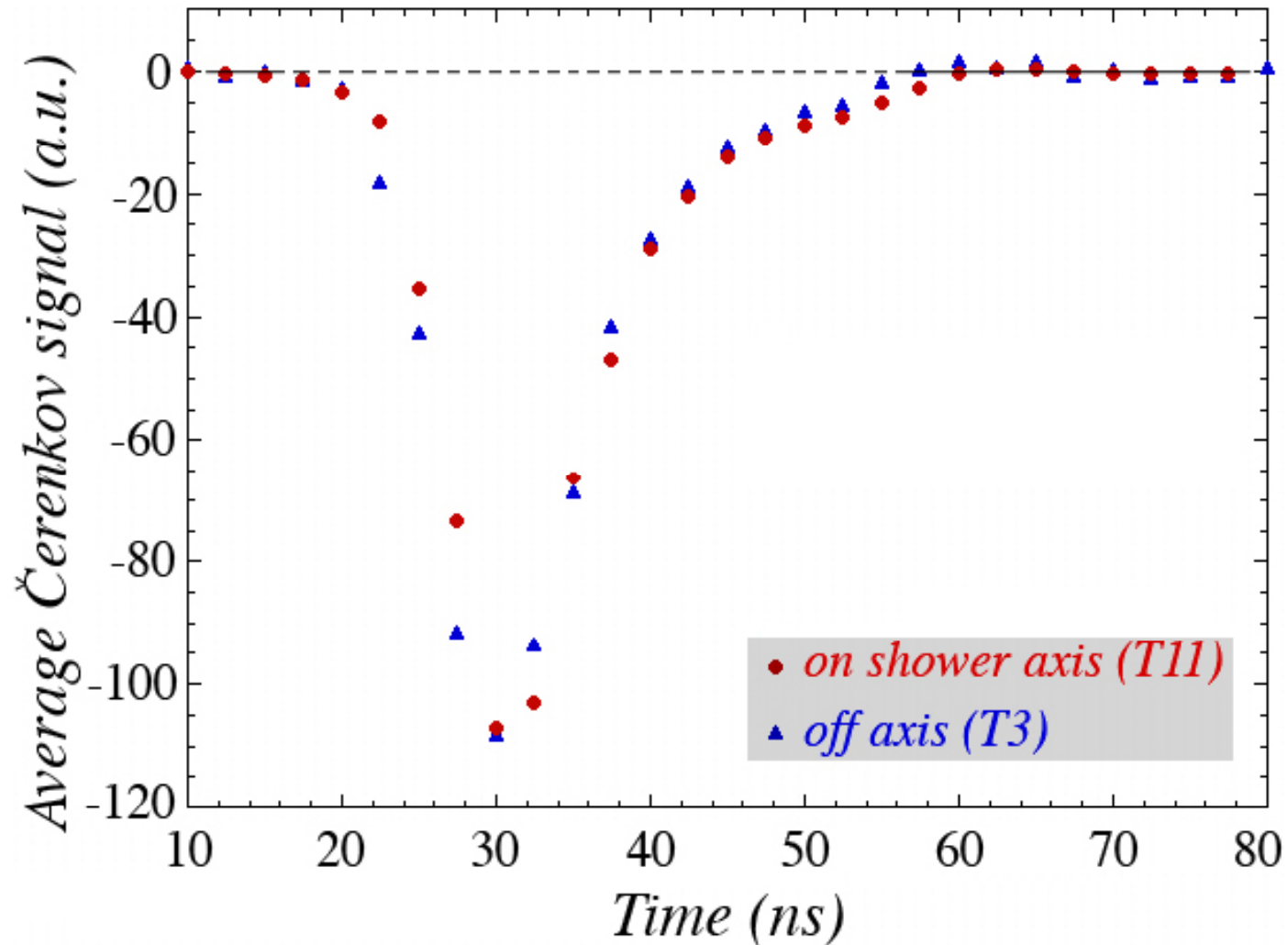
No significant difference – as expected

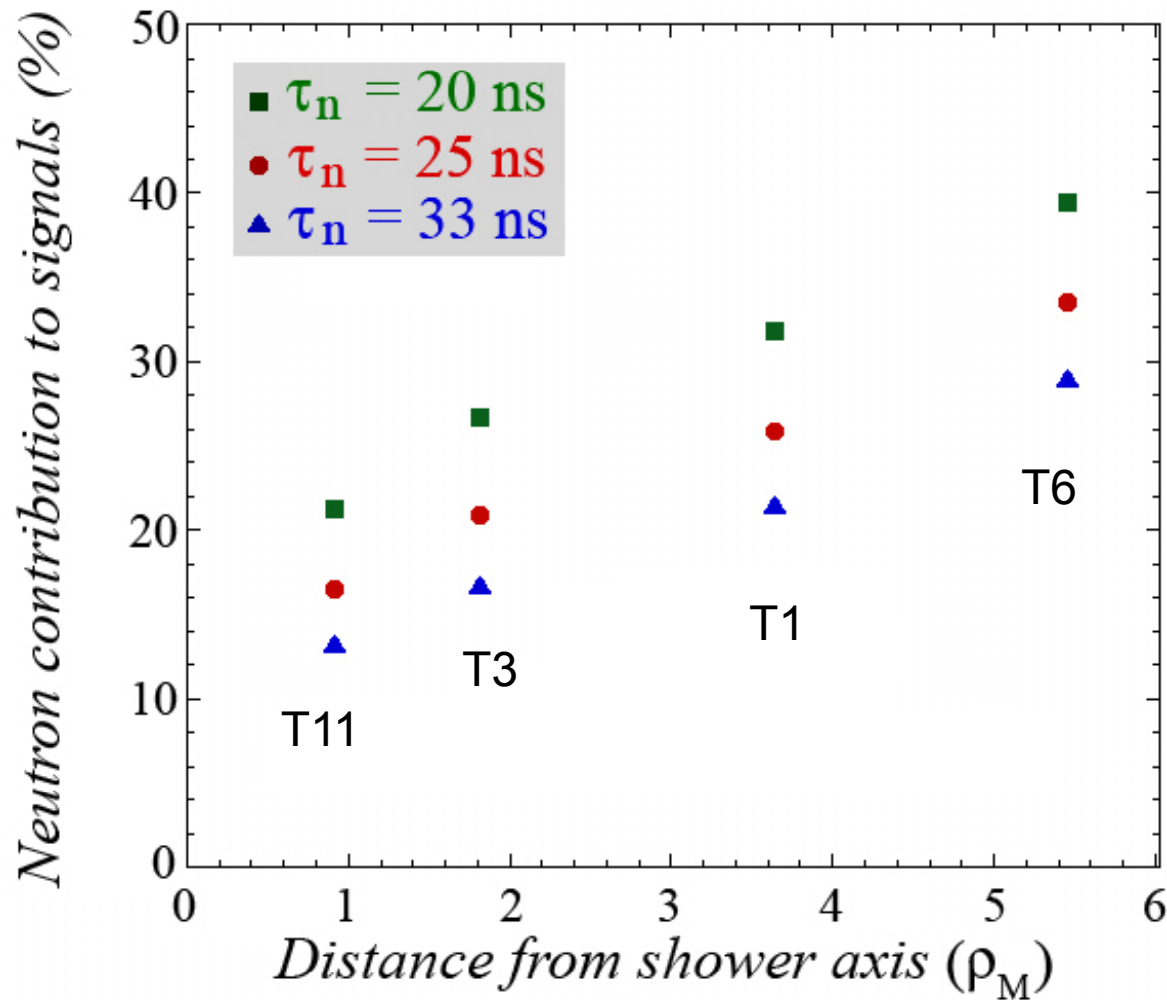# S signal from T3 and T11

-A clear difference between T3 and T11
-Neutron contribution dependence with distance

S and Č signal's time structure on T11

Small and significant difference - contribution from neutron

Position dependence of the neutron contribution

$$N = N_1 e^{-t/\tau_1} + N_2 e^{-t/\tau_2}$$

Parameterized function

Conclusion

- We analyzed the hadronic signal time structure with 400 MHz sampling frequency and 2.5 ns resolution
- We found a clear indication of contribution from evaporating neutrons to the scintillation signal
- Neutron contribution is characterized by an exponential tail with a time constant of 25 ns
- We have found that neutrons contribution is distance dependent$\rightarrow$ fraction increase with distance from the shower axis
- It represents ~ 30% of the tot off-axis signal
- Neutrons do not contribute to Cherenkov signal