Domino Ring Samplers for Dual Read-Out Calorimetry

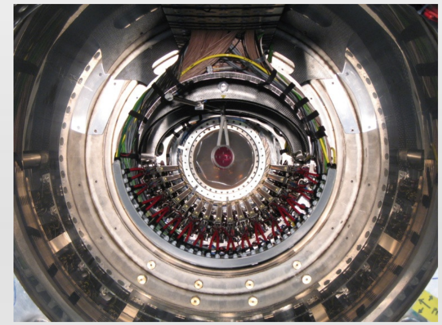
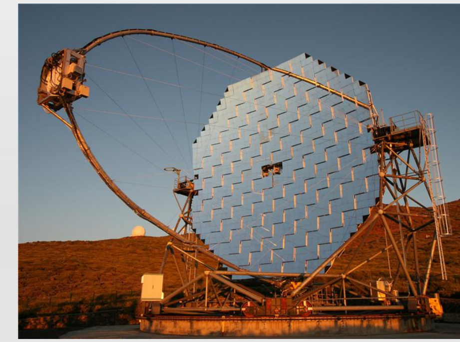
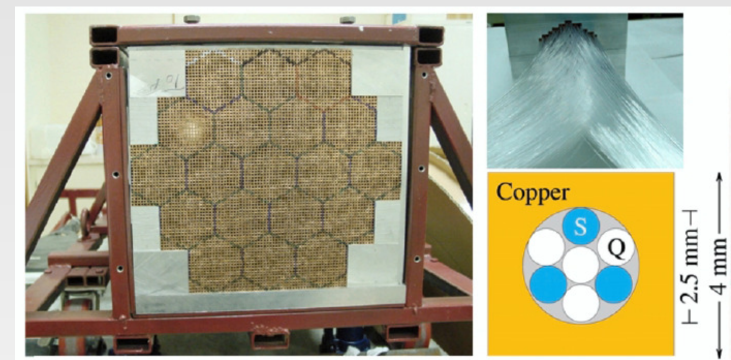
Michele Cascella

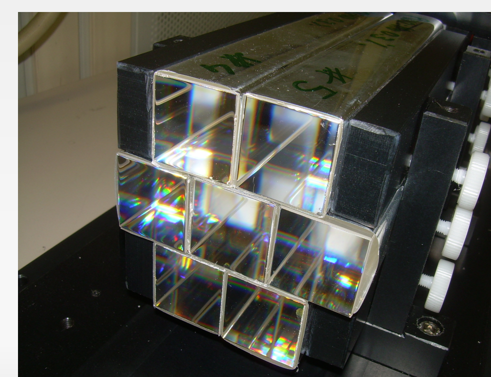
On behalf of the DREAM collaboration

IEEE NSS - Valencia 27/10/2011

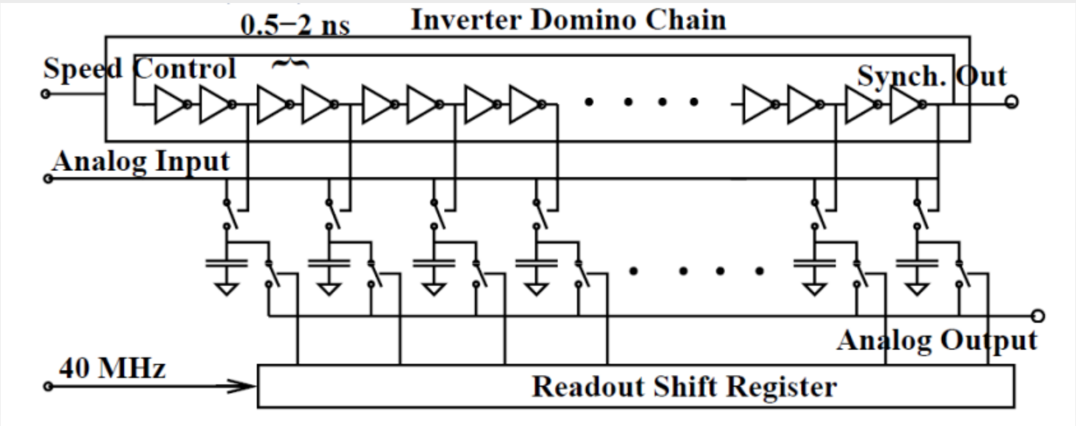
Introduction

- DRS in nuclear sciences
  - MAGIC, MEG
- DRS in DREAM (Dual REAdout Method)
  - Neutron signal in fiber calorimeters
  - Separation of Cherenkov/ Scintillation light in crystals (see S. Franchino and D. Pinci)

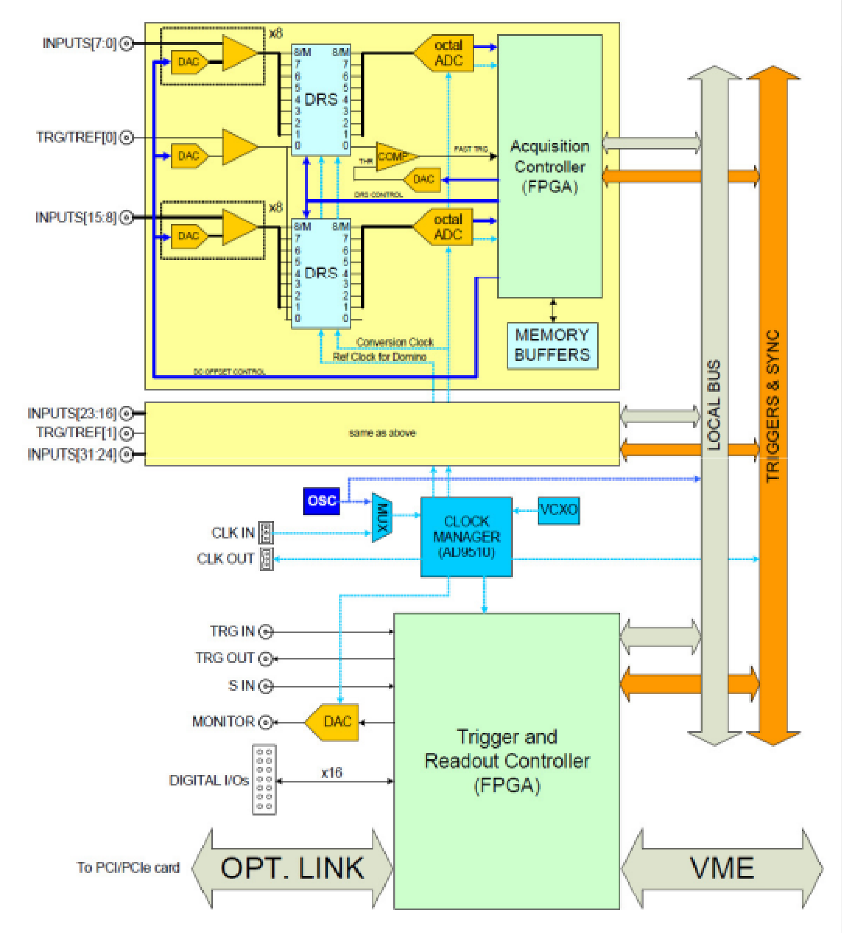




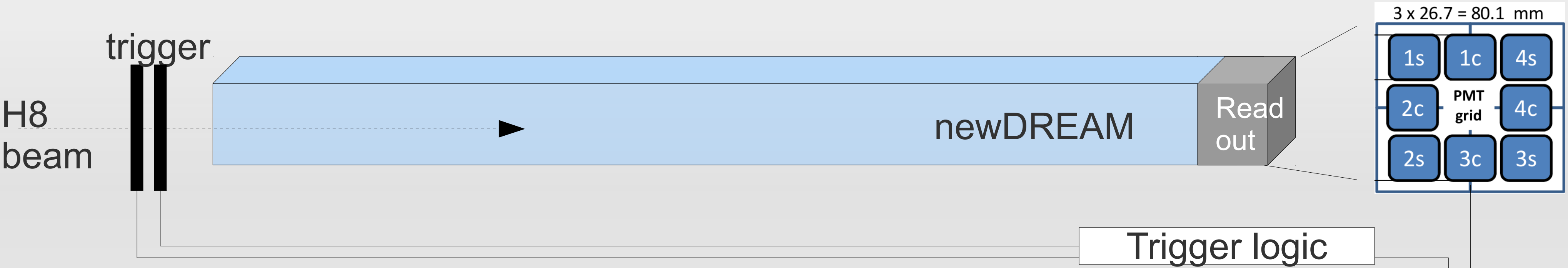
The DRS chip and the V1742 board

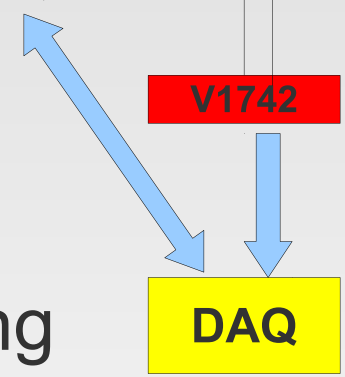


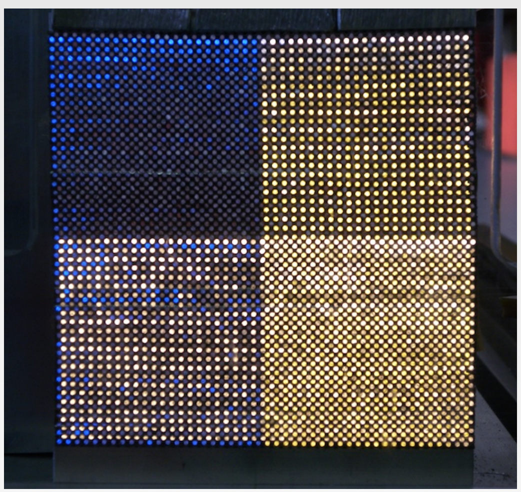
- DRS: domino wave can be stopped at any time. 1024 cap digitized with external FADC
- CAEN V1742: two daughter cards with 2 DRS-IV chips each: 32 analog inputs



The 2011 DREAM test beam setup

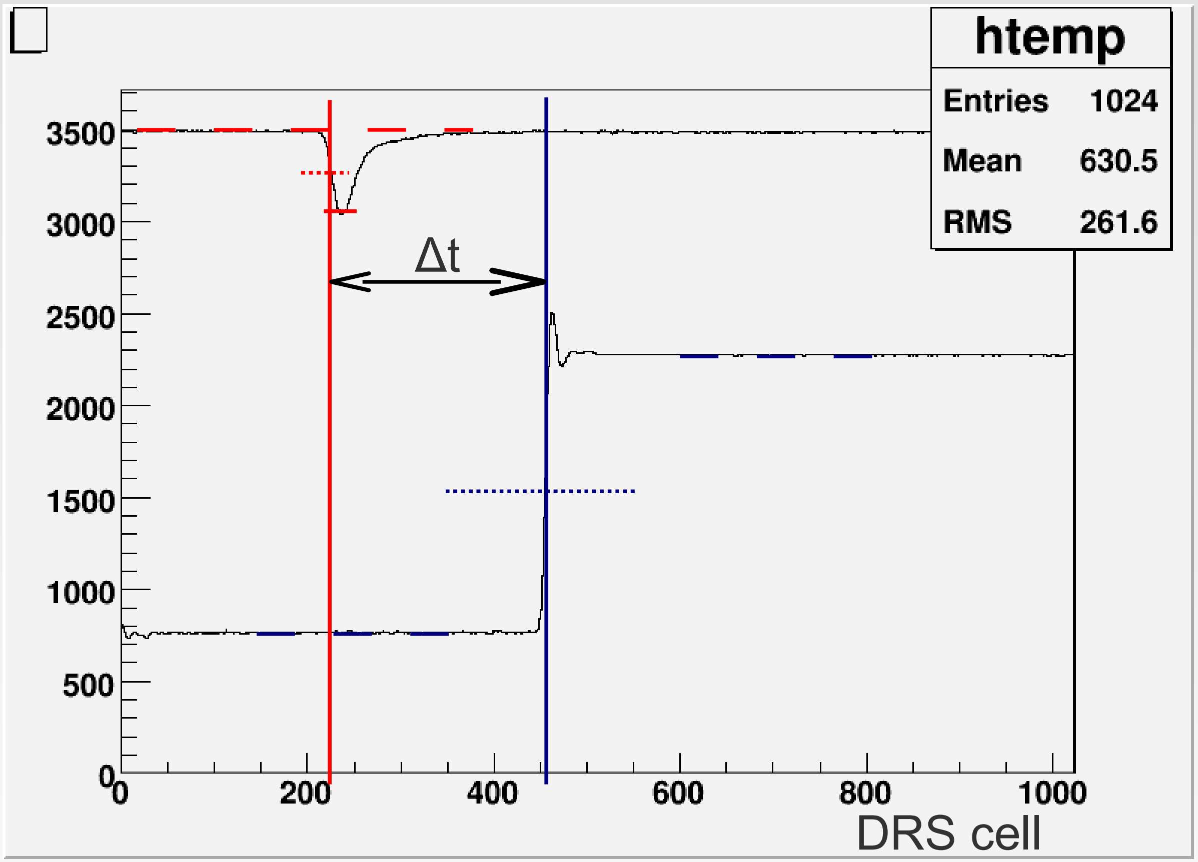






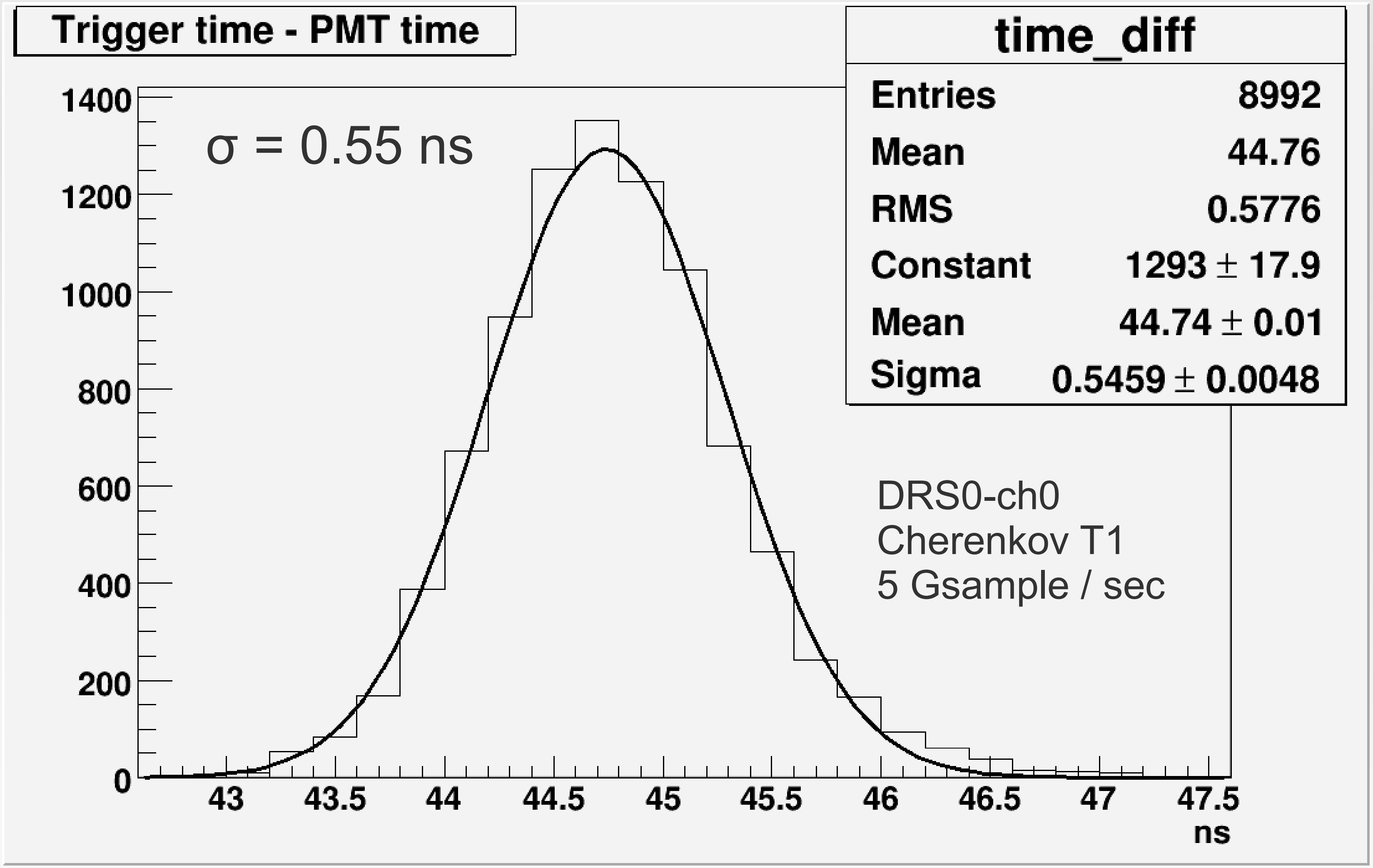
- NewDREAM fiber/Pb module (f_{samp}=5%)
- Alternated clear and scintillating fibers
- 8 PMT readout with V1742
- NIM trigger also acquired as DRS 9th channel

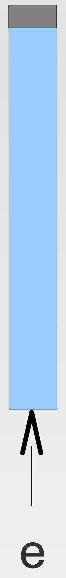
Timing resolution



- Trigger signal is sampled to correct for comparator jitter
- Distance between 50% PMT signal and 50% trigger front

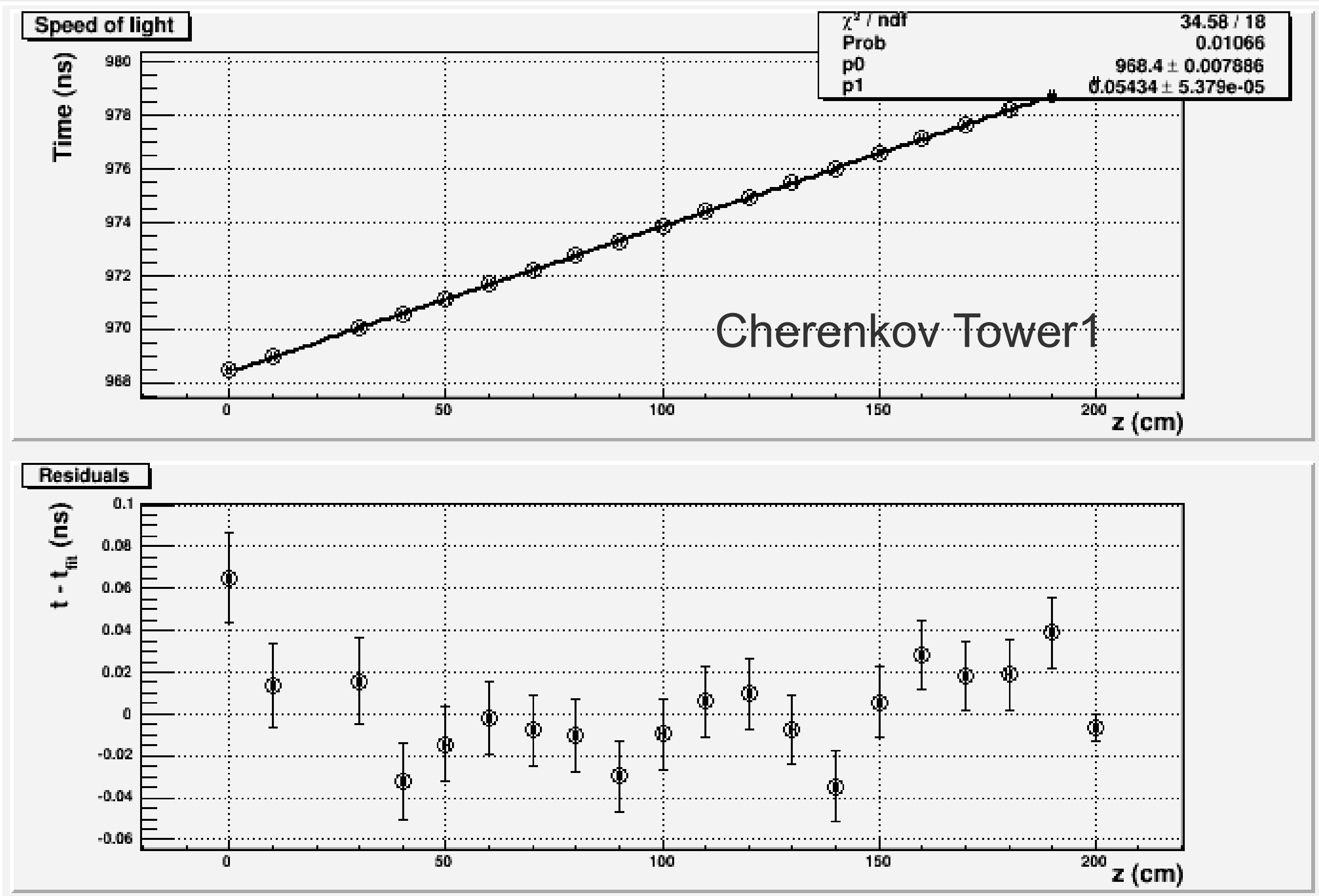
DRS time resolution with electrons

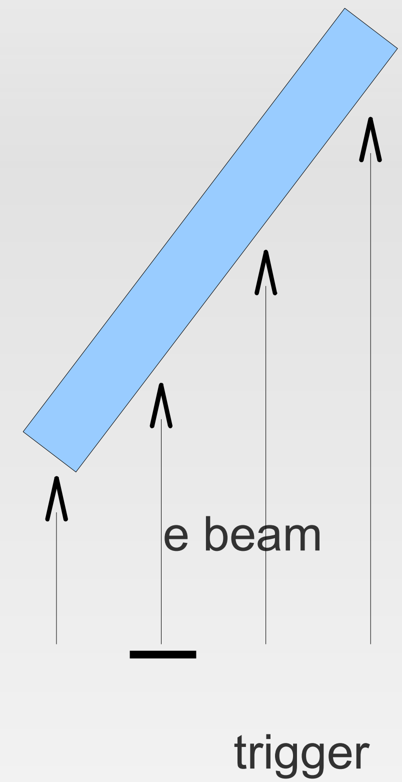




Similar resolution also for Scintillation channels

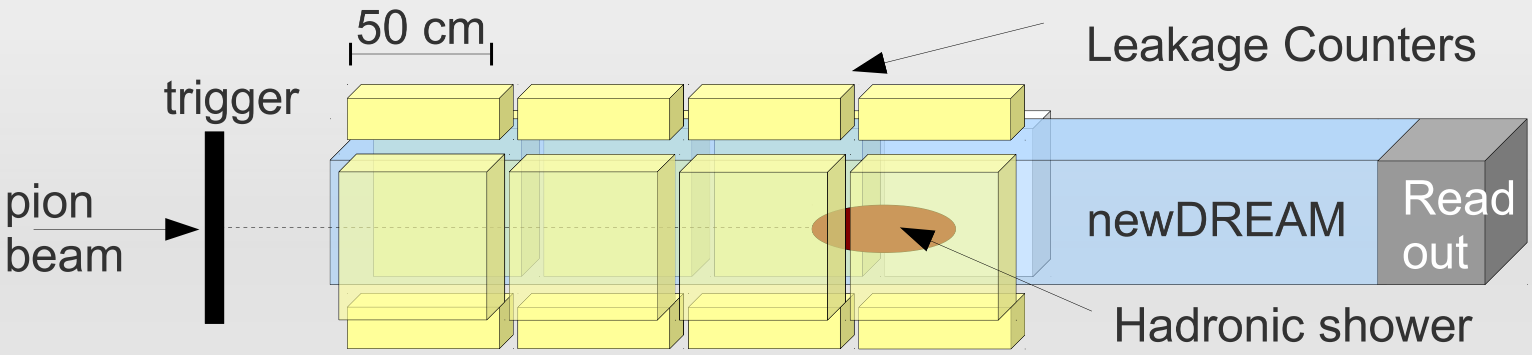
Refractive index measurement

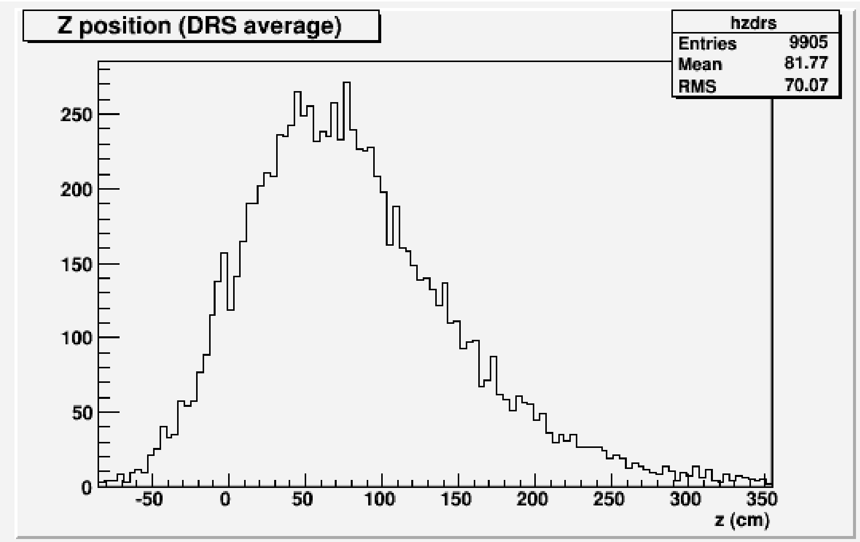


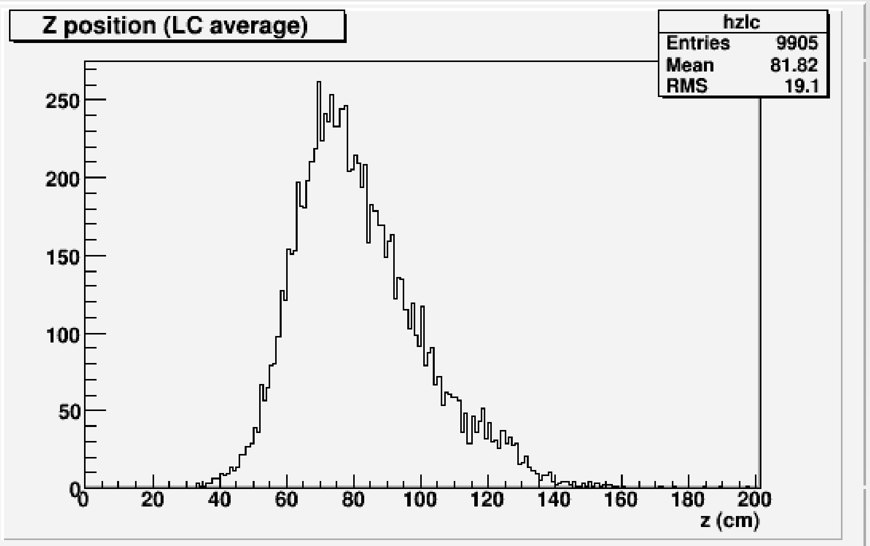


- n = 1.63, 8% larger than nominal value (1.49)
- Residuals WRT fit very good

Depth measurements

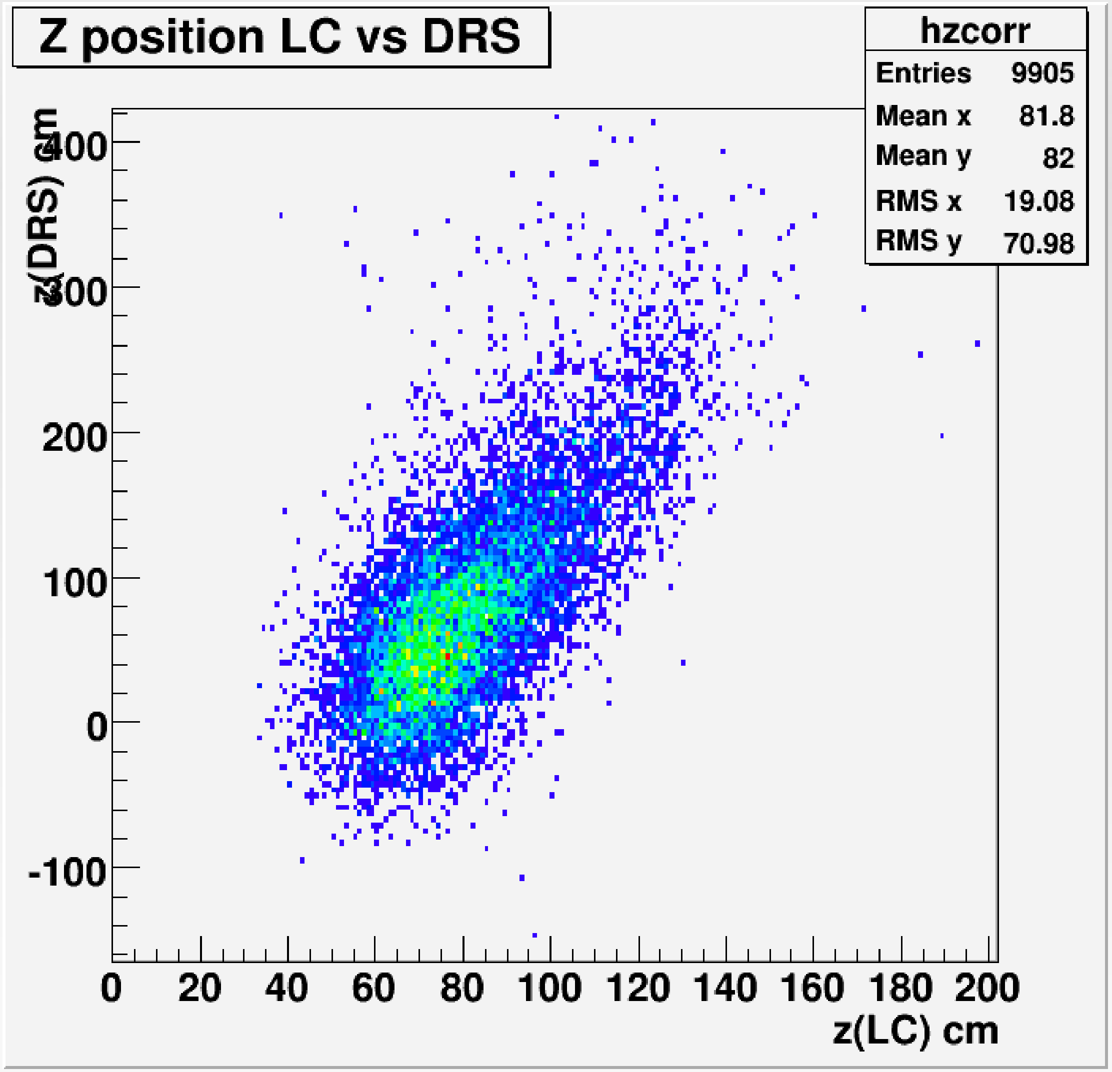






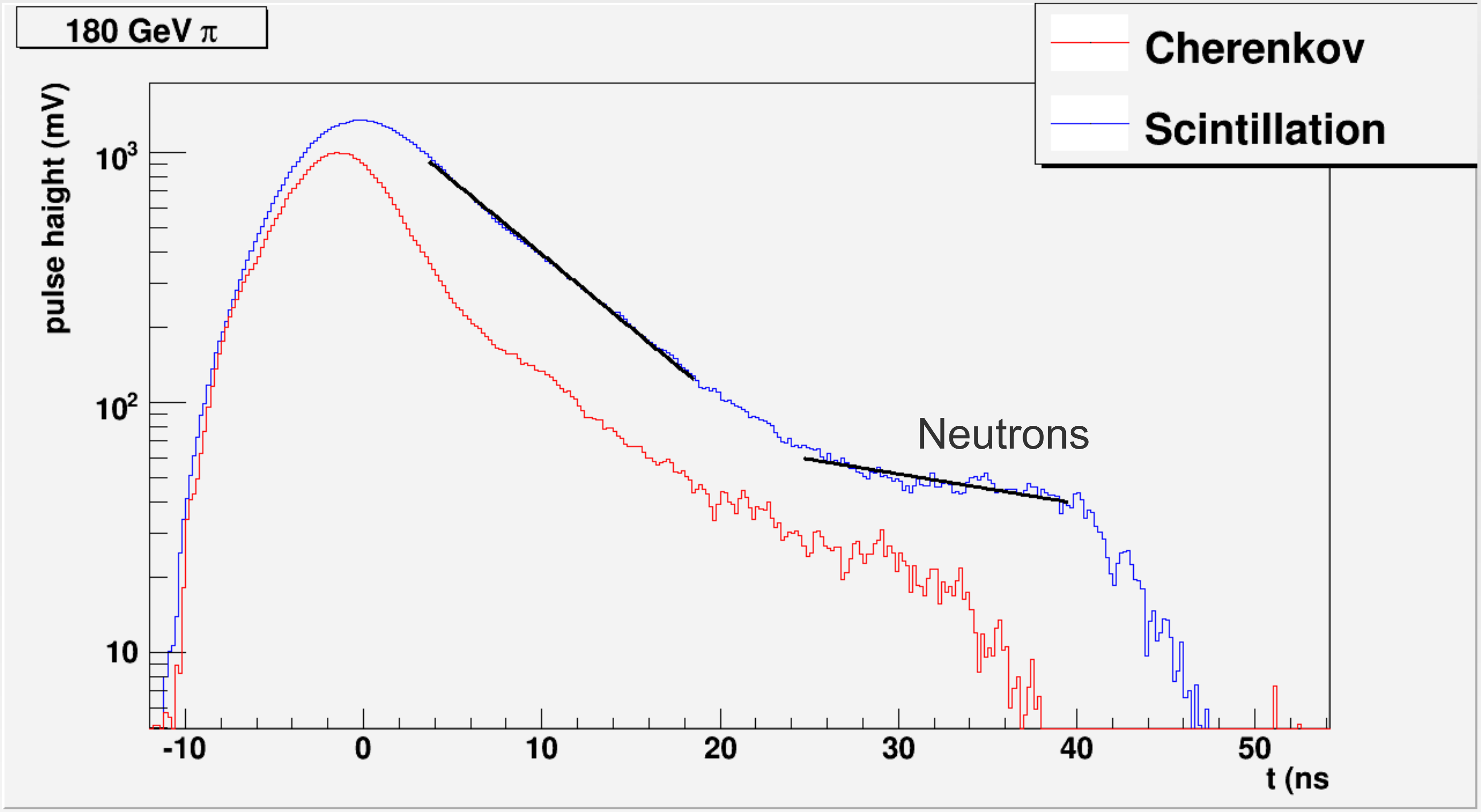
- LC: signal baricenter σ~7cm
- DRS: signal delay (calibrated with z scan)

DRS vs LC comparison



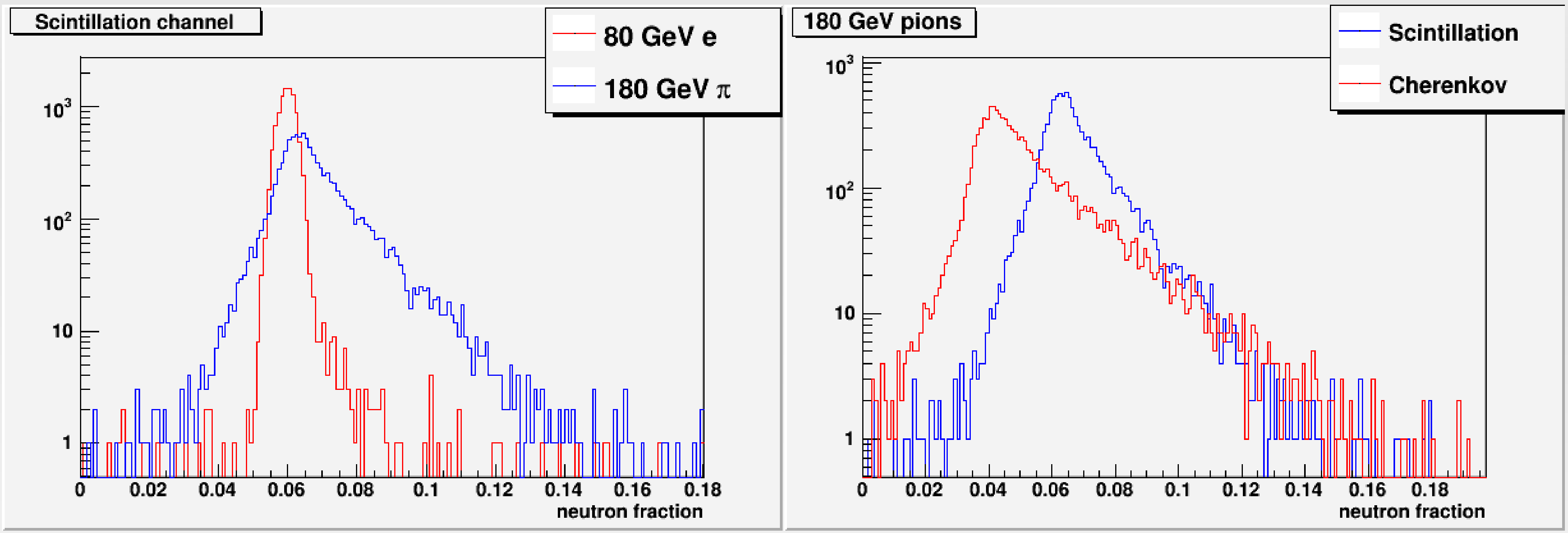
- Good colletation beteen the two methods

Neutron component



- The neutron component of an hadronic shower is slower and produces little Cherenkov light

Neutron component



- n_f fraction of signal integrated between 20 and 40 ns (the 0 is the signal peak)

Conclusions

- The DRS technology is a powerful tool in dual readout calorimetry
- Cherenkov/Scintillation separation in crystals
- Great timing resolution → measurement of the depth of the shower maximum
- Information on the slow scintillation component → event by event estimation of the neutron fraction