Setup

- MegaCells on cryostat
- Tiles on cathode
- trigger efficiency evaluation based on method / figures from Vertical Drift Proposal
Implemented geometry: tiles on cathode, megacells on cryostat

Tiles: 60x60 cm
4 of them
Every
~3x3 m
Implemented geometry: Megacells on the Cryo inner surface: side view

Megacells:
20x60 cm
20 Megacells in a Column
60 columns each cryo side

1 tile == 3 megacells (vertically, can study other groupings)
From the VD proposal

Basic unit: tile == 3 Megacells, total of 60x60 cm²

Efficiency (Xe+Ar if I understand well) = 3%

Trigger requirement: at least 4 tiles giving at least 5 photoelectrons

Trigger capabilities:

100% efficiency for 5 MeV deposition within 4 metres from cathode

100% efficiency for 20 MeV deposition in the whole volume
Fluka Simulations

- Emission: fast component at 128nm, slow component at 175 nm
  \[2.4 \times 10^4\] photons/MeV total
- Included: Rayleigh (90 cm at 128nm, scaling with \(\lambda^4\))
- Cathode transparency 80%
- No reflections on cryostat
- Field cage transparency 70 %
- Anode reflectivity 30%
- Recorded: number of optical photons arriving at each MegaCell or Tile
- On cryostat: group three megacells vertically to define a tile
- Tile efficiency a-posteriori = 3%

- Averages and distributions available for each tile (also for megacells)

- Apply Nphe and majority checks to define trigger
Results 5 MeV

- For 5 MeV edep, the proposal says “100% efficiency within 4m from cathode (60% of the total volume)”

Black: total trigger efficiency  Average 90%
Green: tiles on cathode only  Average 80%
Red: tiles on cryostat only  Average 41%

100% up to 4m with cathode only, in agreement with proposal

100% up to ~5m with full system

With 5% Arapuca efficiency
- total trigger efficiency  Average 99%
- tiles on cathode only  Average 96%
- tiles on cryostat only  Average 58%
Results 5 MeV, horiz. views

Black : total trigger efficiency
Green: tiles on cathode only
Red: tiles on cryostat only

Tiles on cryo are fully efficient for the most external ~3 m
Consistent with 4 m from cathode in the “cathode” configuration, due to additional space between field cage and cryo, and field cage transparency

At the extreme length, all configurations suffer from edge effect.
Results 20 MeV

- For 20 MeV edep, the proposal says “100% efficiency within the whole volume”

Black : total trigger efficiency  Average 99.9%
Green: tiles on cathode only  Average 90%
Red: tiles on cryostat only  Average 90.1%

( black and green are almost superimposed)

At 20 MeV, the on-cathode tiles alone guarantee th full efficiency
Results 20 MeV, horiz. views

Black: total trigger efficiency
Green: tiles on cathode only
Red: tiles on cryostat only

There is no added value from the tiles on the cryo (it would be the same with tiles on the field cage, the tiles on cathode are enough)
Results 10 MeV

Black: total trigger efficiency  
Average 99.8%

Green: tiles on cathode only  
Average 98%

Red: tiles on cryostat only  
Average 64%

(Black and green are almost superimposed)

Also at 10 MeV, the on-cathode tiles alone guarantee almost the full efficiency.
Results 10 MeV, horiz. views

Black: total trigger efficiency
Green: tiles on cathode only
Red: tiles on cryostat only

Small added value from the tiles on the cryo
Playing with thresholds/multiplicities

- Question: would it be possible to recover the efficiency by using different thresholds/ multiplicities?

Average Tile multiplicity as a function of the distance from detector centre, in the horizontal (x) direction (note the x-direction inversion wrt previous plots, just to annoy you..)

Megacells on cryostat ONLY, no tiles on cathode

For different values of the photoelectron threshold

Clearly, 5phe does not allow to trigger too much..even with mult=1
But: lowering the threshold could help in recovering efficiency
Trigger efficiency as a function of the horizontal (x) distance from detector centre,
With different thresholds ($N_{\text{phe}}$) and tile multiplicity ($M_T$)

Black: $N_{\text{phe}} = 2$, $M_T = 3$
Red: $N_{\text{phe}} = 3$, $M_T = 2$
Red: $N_{\text{phe}} = 5$, $M_T = 4$

Megacells on cryostat ONLY, no tiles on cathode
Conclusions..ongoing

- Simulations of the alternative and reference design consistent with those described in the proposal.
- For trigger purpose, tiles on cathode do most of the job. MegaCells on cryo would be ~equivalent to tiles on fieldcage.
- Alternative solution is less effective, especially for low energy depositions,
- Unless different threshold/multiplicity schemes are envisaged.
- ==> simulate background, or ask to those who already did the signal/background separation.