Dead material correction in CTB2004 testbeam

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Role of testbeam

- Validate reconstruction:
  - Geant4 physics
  - Detector description
- In simple case, i.e. singe pion, test procedure on data
- For the moment, only study crack between LAr and Tile

Requirements

- Demands on DM reconstruction (in order of preference)
  - No tail
  - Good mean
  - Good resolution

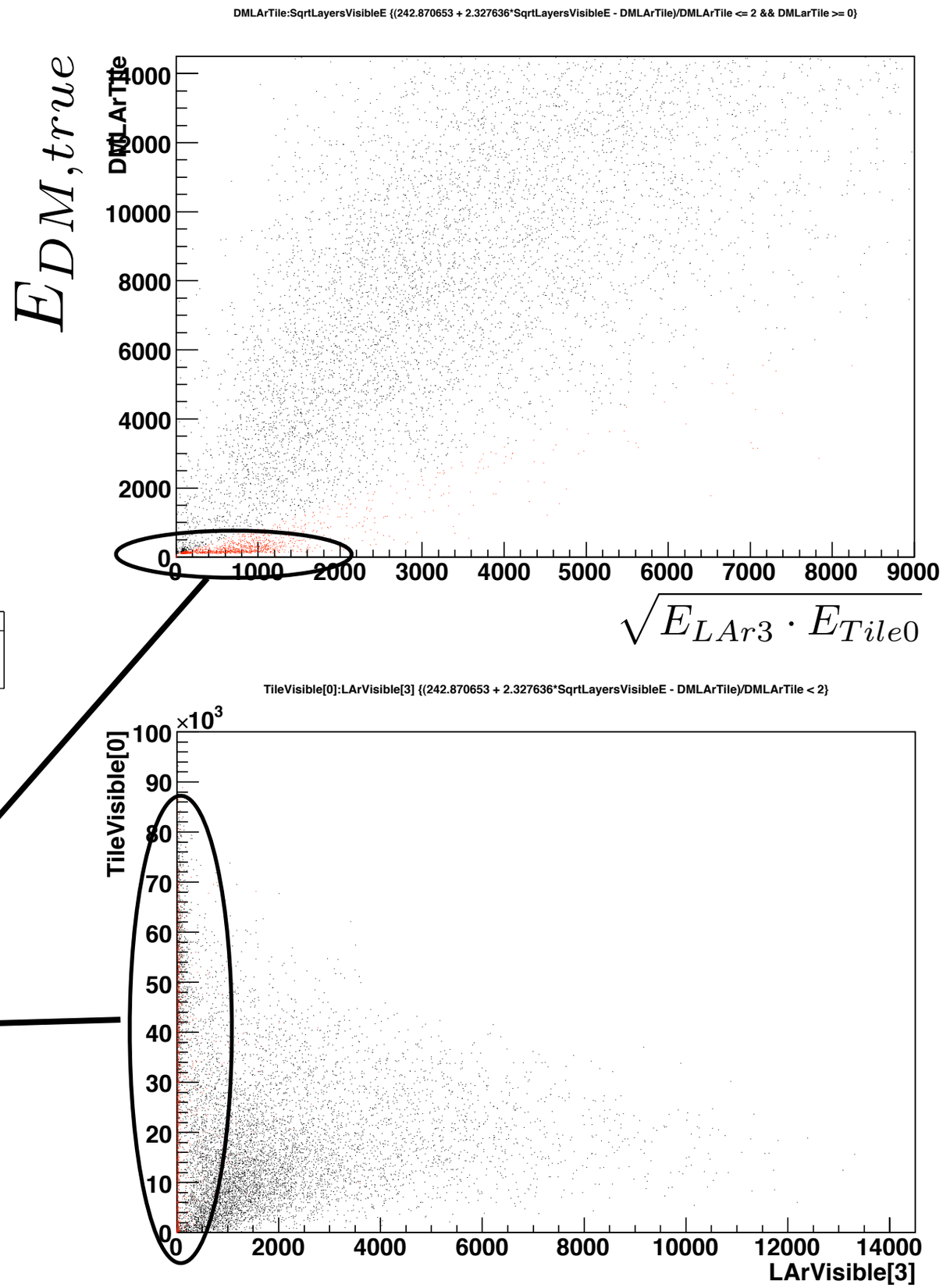
Canonical dead material formula

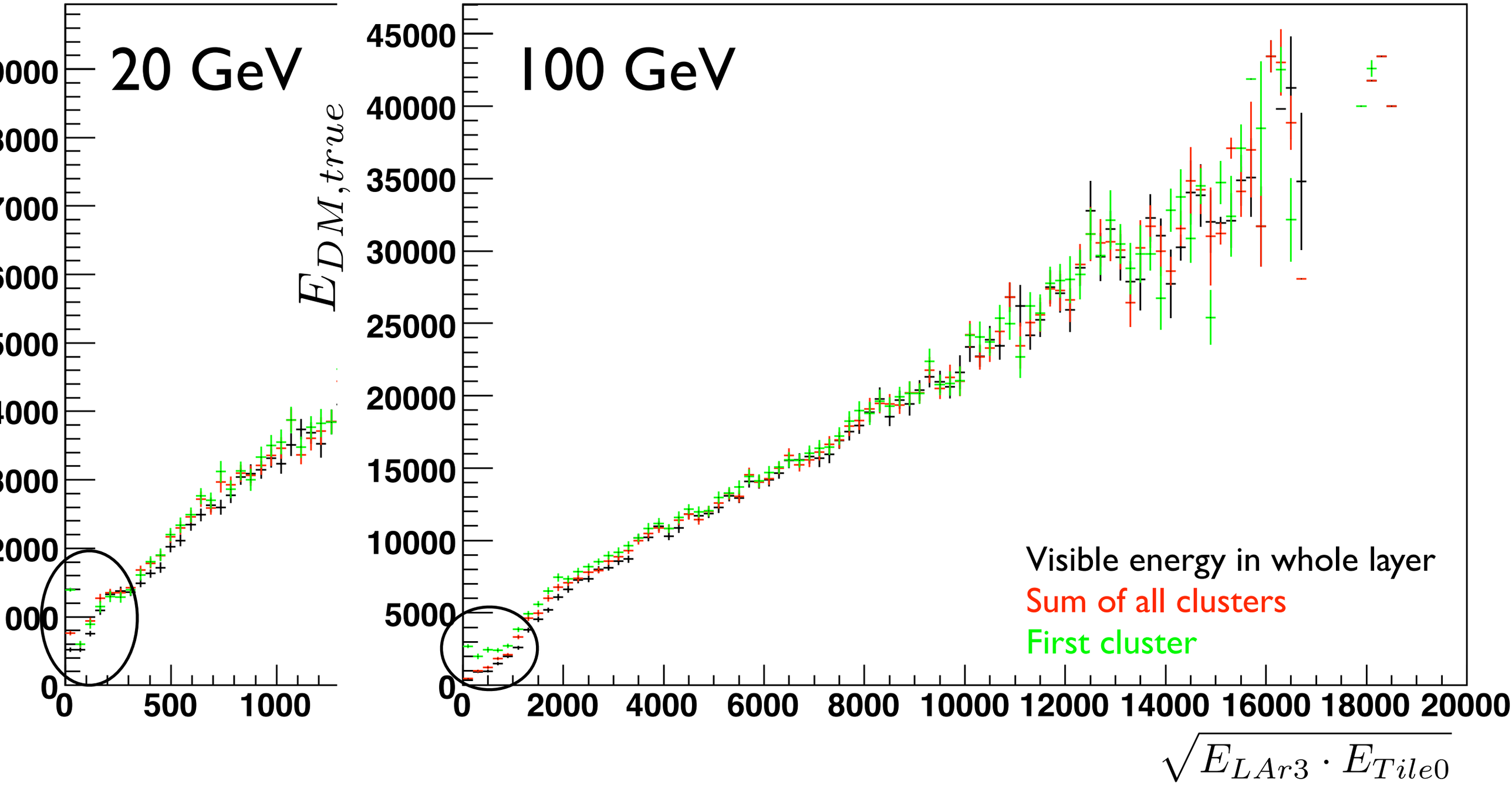
$$E_{DM,rec} = \text{const} \cdot \sqrt{E_{LAr3} \cdot E_{Tile0}}$$

- Plot $E_{DM,true}$ against $\sqrt{E_{LAr3} \cdot E_{Tile0}}$ in a profile histogram and do a linear fit.

“Problem 1”: Tails

- MIP in DM and in LAr3, but not in Tile0.
- Consequence: DM energy overestimated, giving rise to a tail in reconstructed DM energy spectrum. Tail can be suppressed by requiring $E_{LAr3} > MIP$

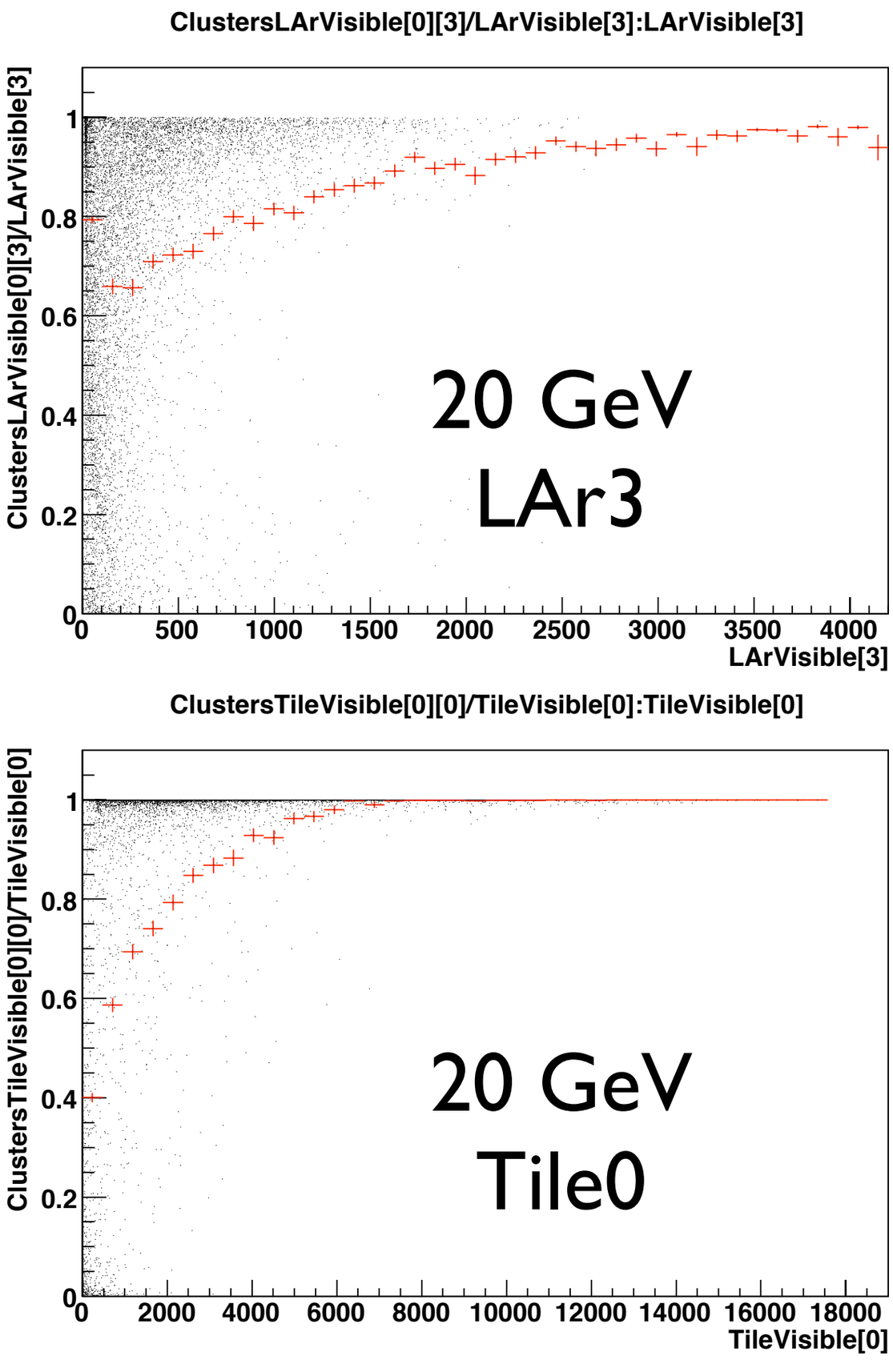


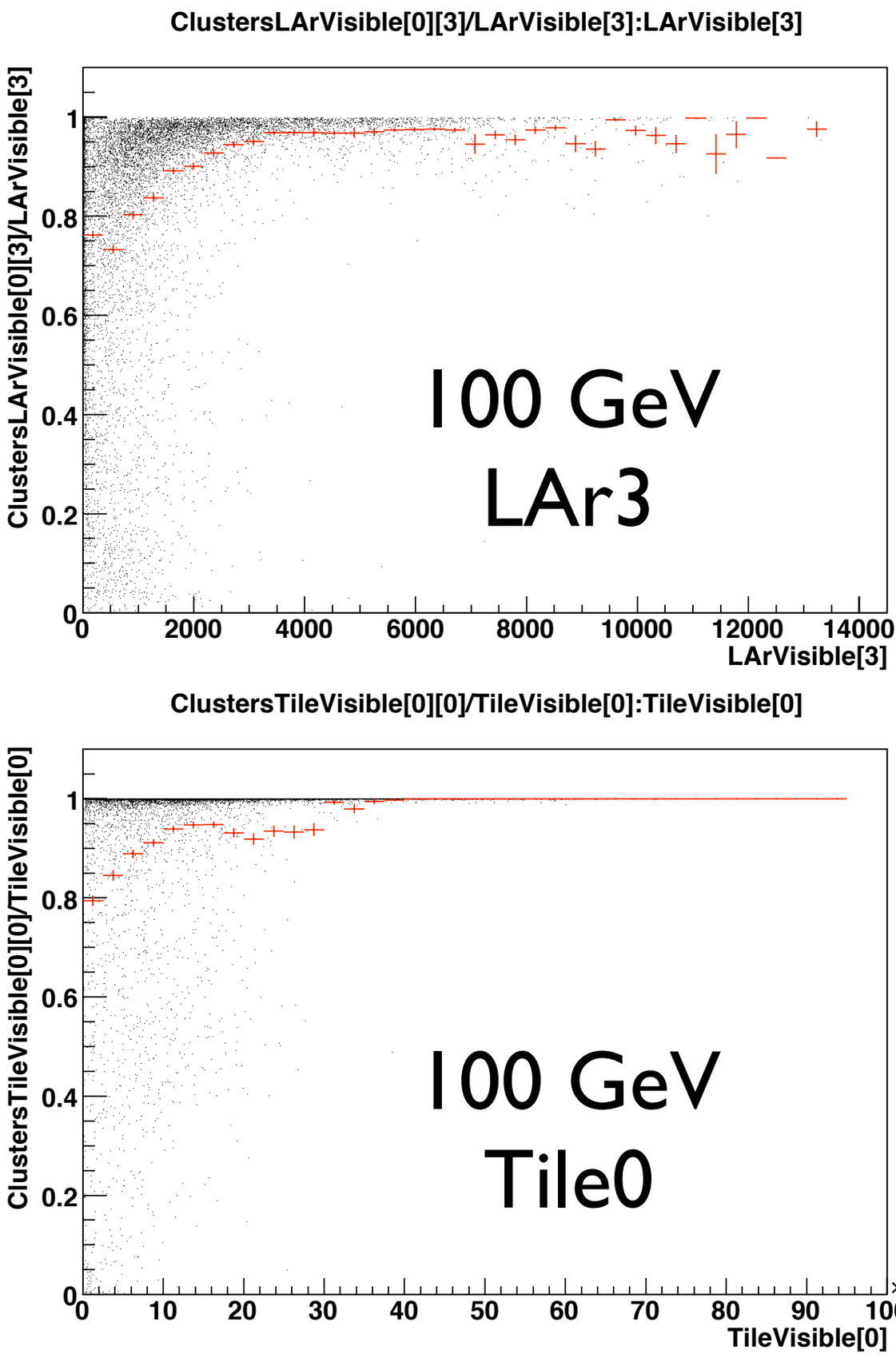


"Problem 2":

Lots of energy missed by first cluster for low energy

Fraction of total layer energy in first cluster, as a function of layer energy



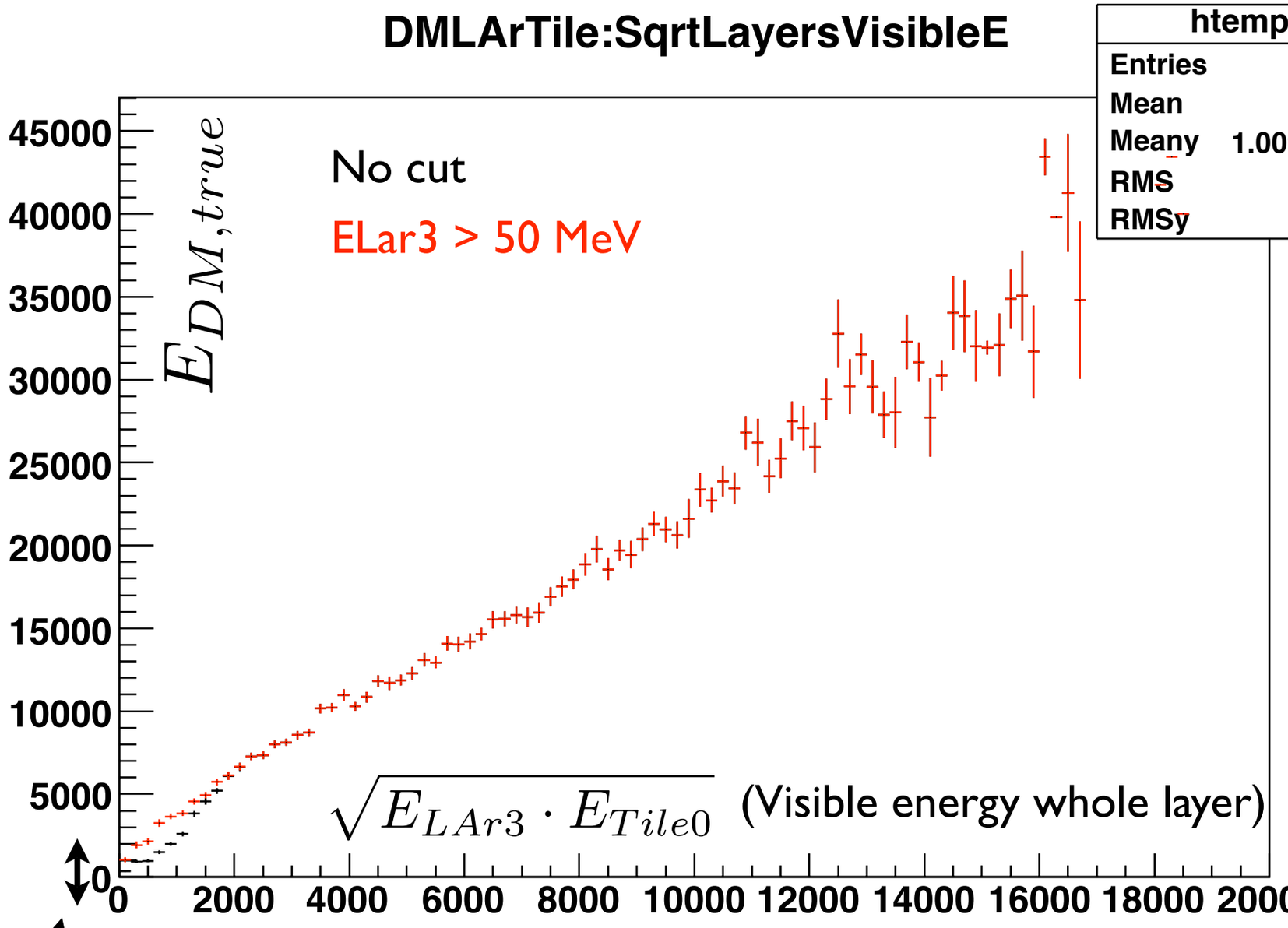


“Problem 3”: Remaining offset

- Clustering effects aside, there remains an offset of a few GeVs. If cutting out LAr3=MIP it gets even larger.

- The opposite of the tail problem (“Problem 1”). No signal in LAr3 and Tile0, but still signal in DM.

- Physical cause of this?



A refined power law?

Is the square root the best function to use? Instead of

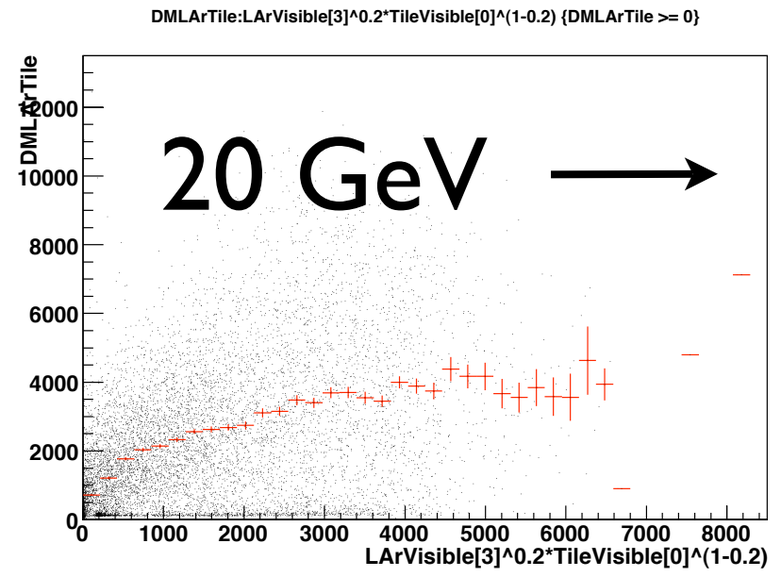
$$E_{DM,rec} = \mathrm{const1} + \mathrm{const2} \cdot \sqrt{E_{LAr3} \cdot E_{Tile0}}$$

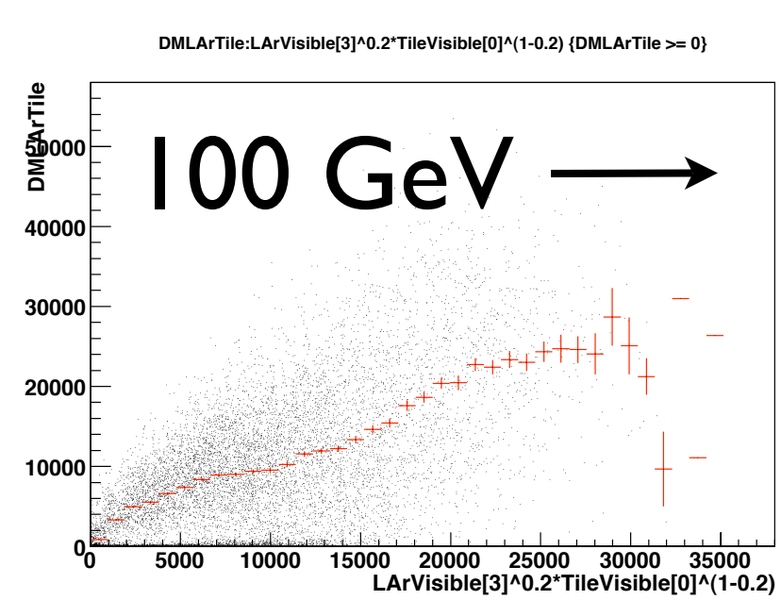
Try

$$E_{DM,rec} = \mathrm{const1} + \mathrm{const2} \cdot E_{LAr3}^{p} \cdot E_{Tile0}^{p-1} \quad (0 \leq p \leq 1)$$

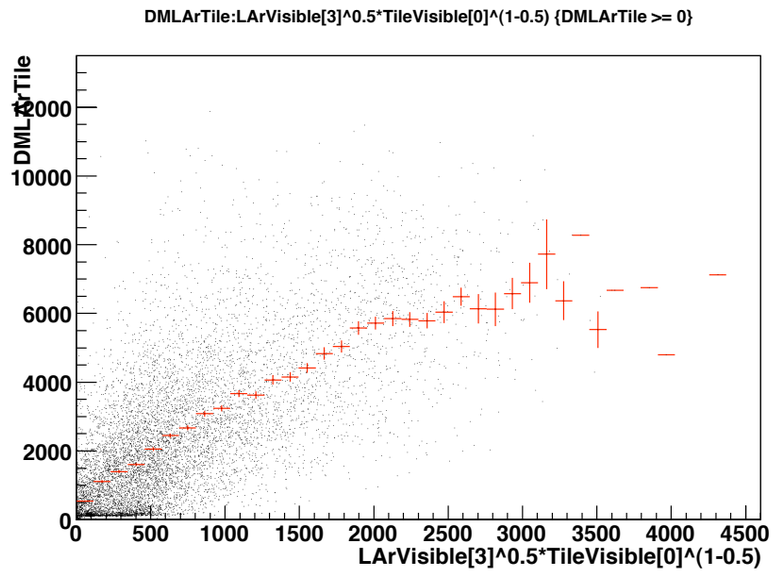
Do the fit for various values of p and compare χ^2, resolution and mean.

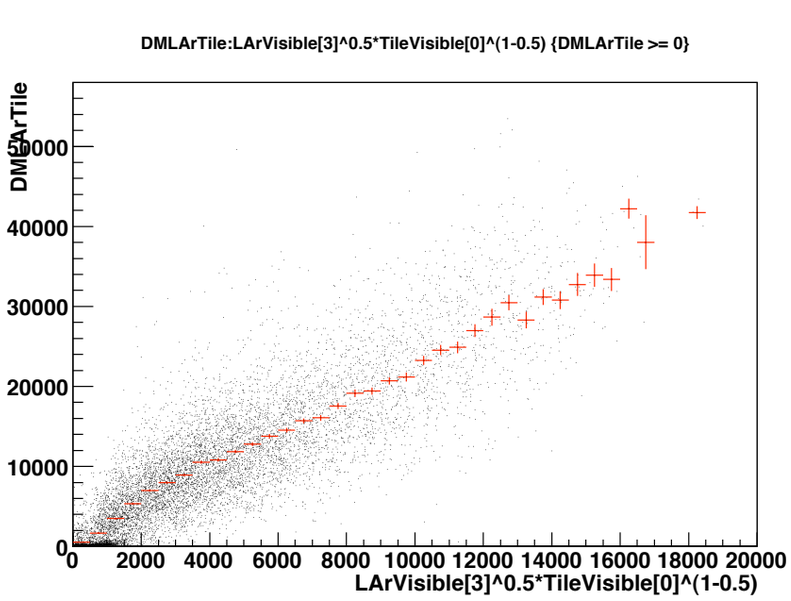
p = 0.2


DMLArTile:LArVisible[3]^0.2*TileVisible[0]^(1-0.2) {DMLArTile >= 0}
20 GeV
DMLArTile
LArVisible[3]^0.2*TileVisible[0]^(1-0.2)

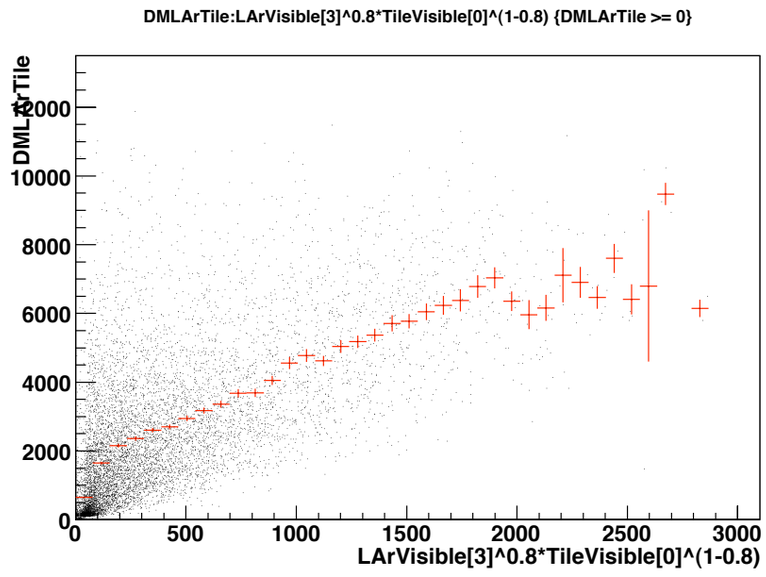

DMLArTile:LArVisible[3]^0.2*TileVisible[0]^(1-0.2) {DMLArTile >= 0}
100 GeV
DMLArTile
LArVisible[3]^0.2*TileVisible[0]^(1-0.2)

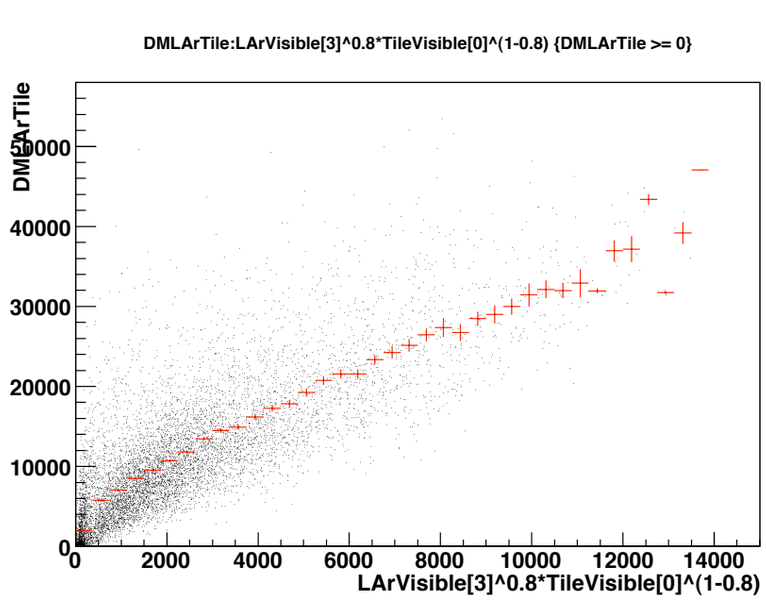
p = 0.5


DMLArTile:LArVisible[3]^0.5*TileVisible[0]^(1-0.5) {DMLArTile >= 0}
DMLArTile
LArVisible[3]^0.5*TileVisible[0]^(1-0.5)

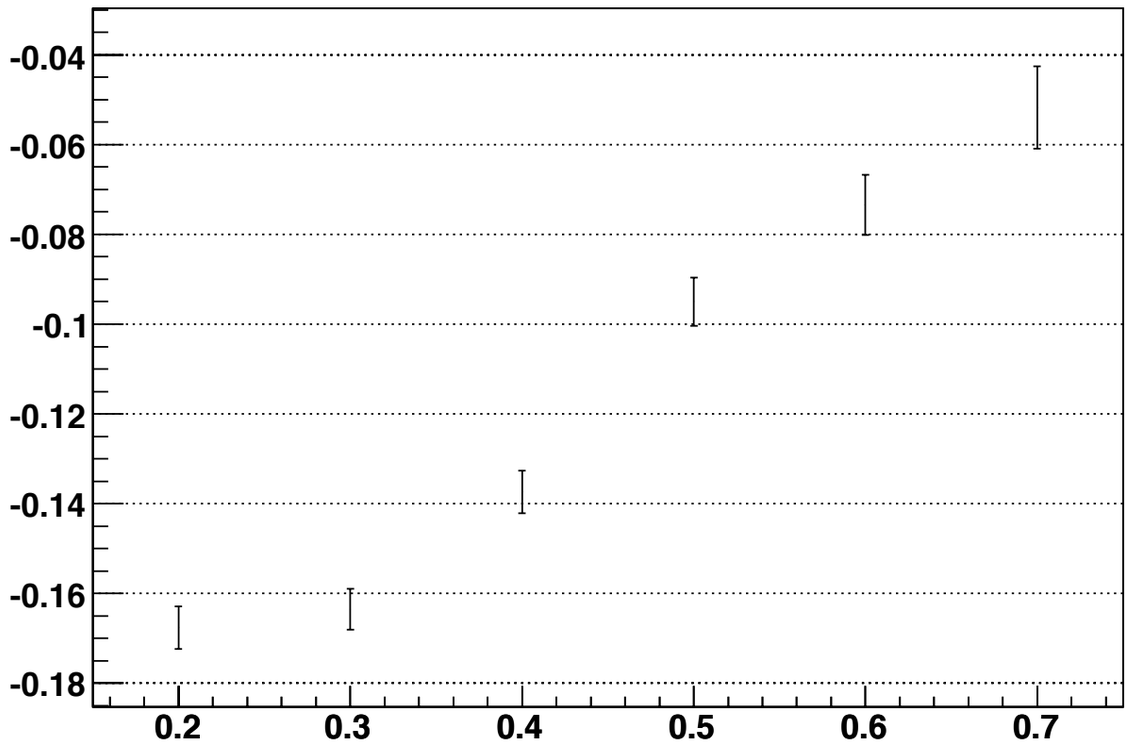

DMLArTile:LArVisible[3]^0.5*TileVisible[0]^(1-0.5) {DMLArTile >= 0}
DMLArTile
LArVisible[3]^0.5*TileVisible[0]^(1-0.5)

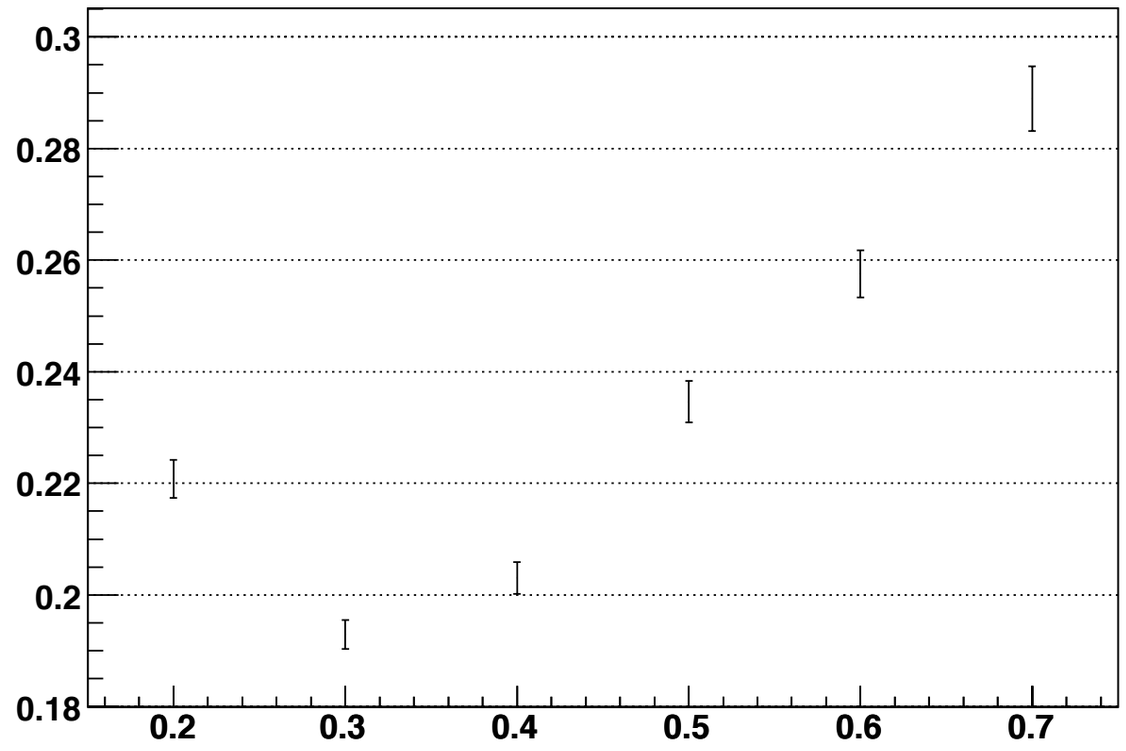
p = 0.8

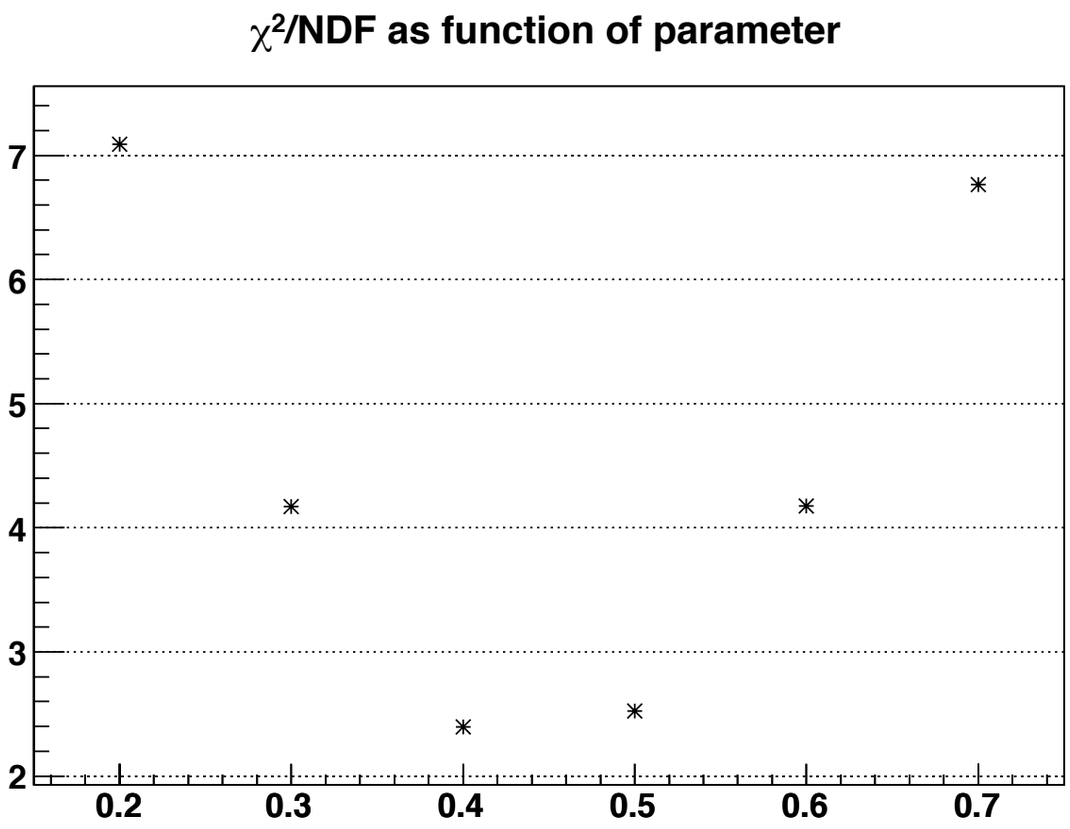

DMLArTile:LArVisible[3]^0.8*TileVisible[0]^(1-0.8) {DMLArTile >= 0}
DMLArTile
LArVisible[3]^0.8*TileVisible[0]^(1-0.8)

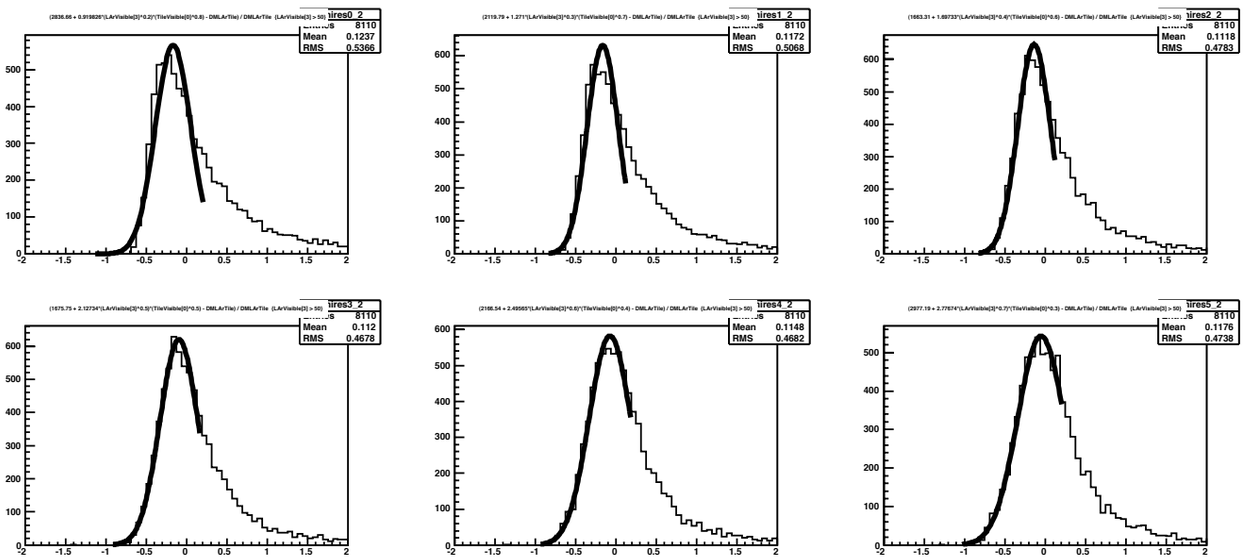

DMLArTile:LArVisible[3]^0.8*TileVisible[0]^(1-0.8) {DMLArTile >= 0}
DMLArTile
LArVisible[3]^0.8*TileVisible[0]^(1-0.8)

100 GeV





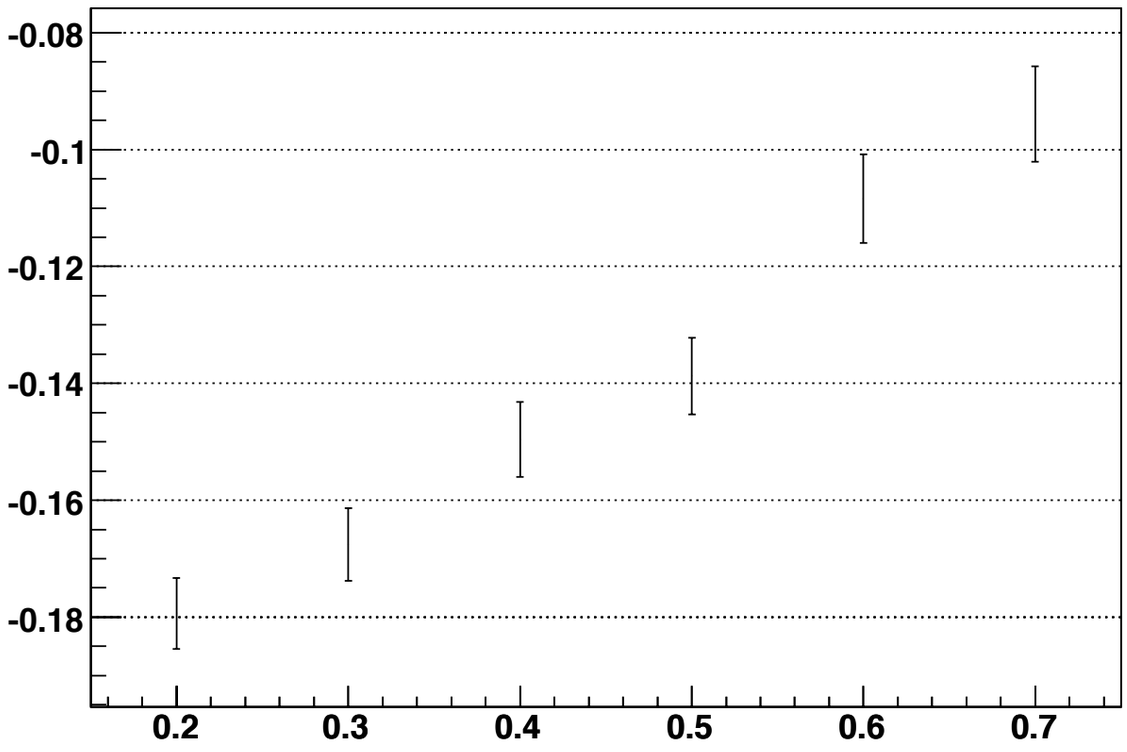


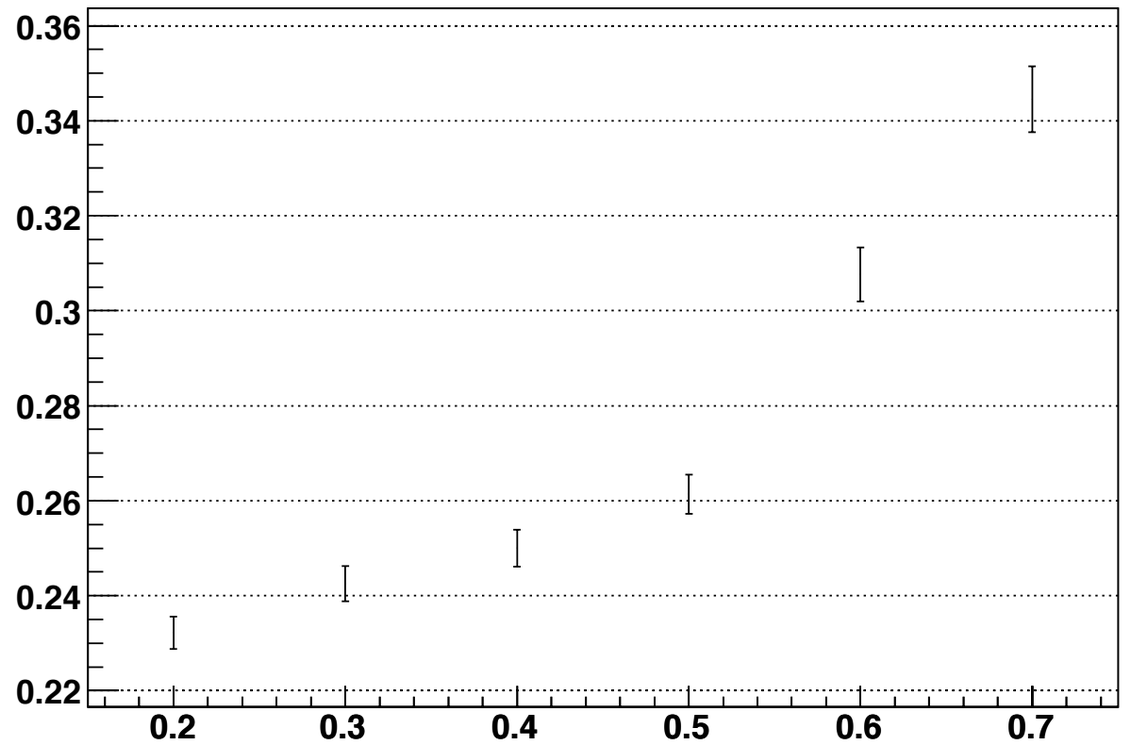


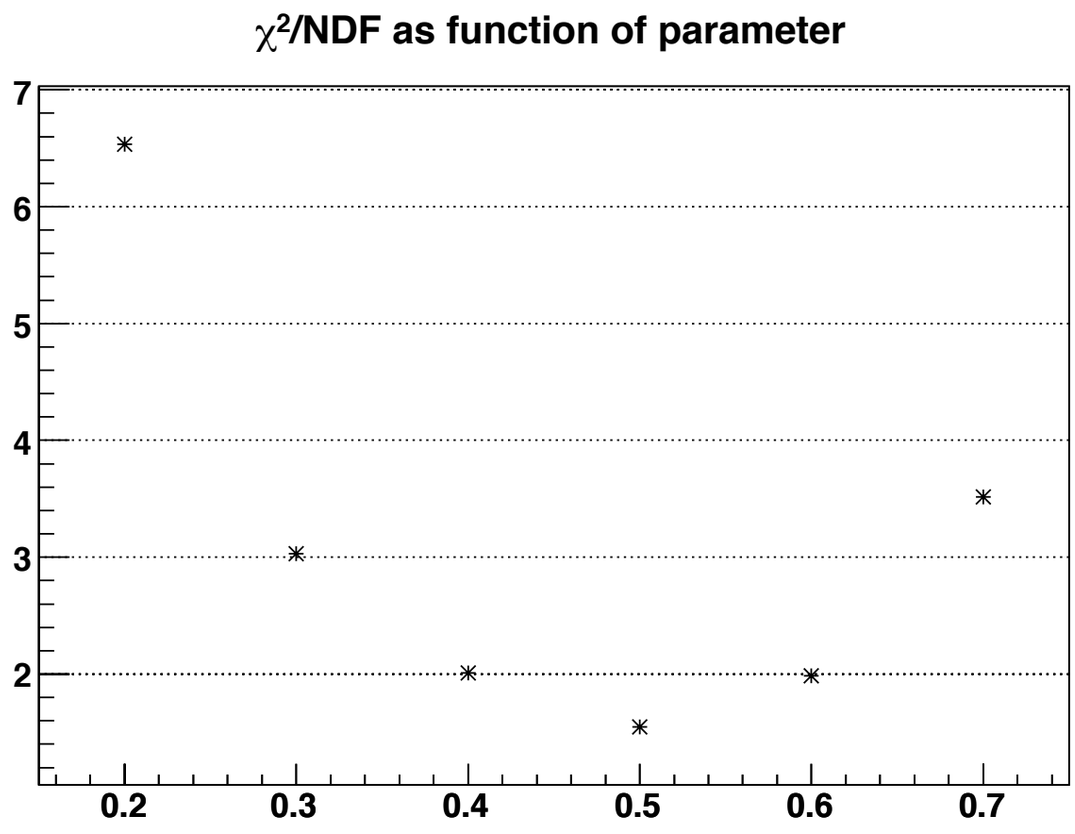
$$\frac{DM_{rec} - DM_{true}}{DM_{true}}$$

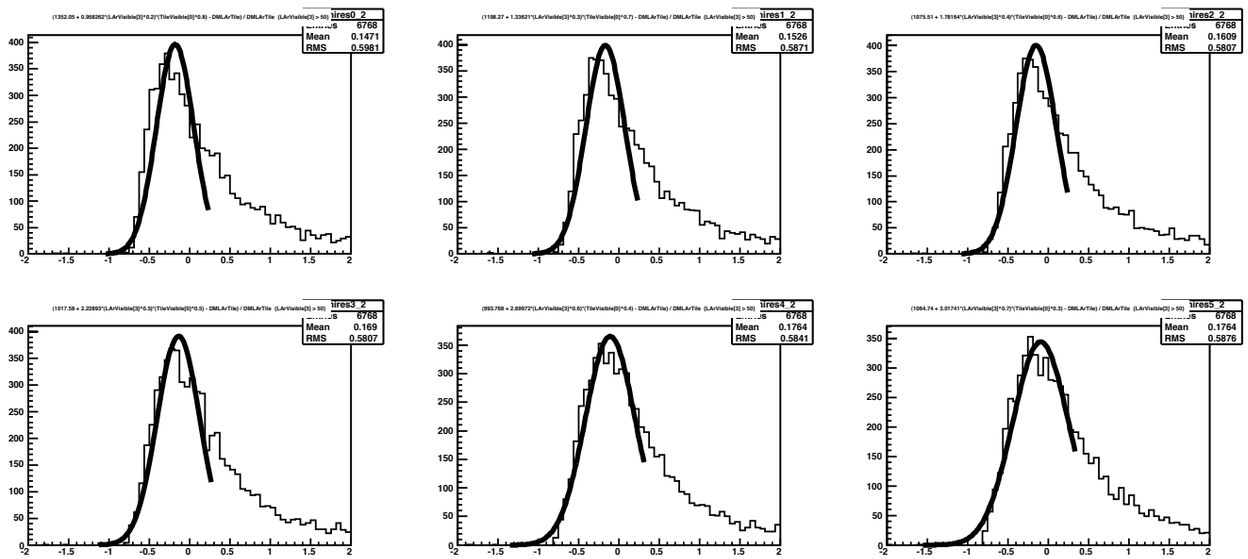
Cut: $E_{LAr3} > 50\text{GeV}$

20 GeV









$$\frac{DM_{rec} - DM_{true}}{DM_{true}}$$

Cut: $E_{LAr3} > 50\text{GeV}$

Possible development

- Find observable sensitive to shower start to get rid of tail? Shower depth?
- Use real data as soon as possible.
- Physical explanation of offset.
- Estimate type of energy deposition in ELAr3, ETile0 to get better resolution: MIP, hadronic shower, EM showers.
- Leakage and upstream losses.
- Cluster definition and out-of-cluster correction?