

Background effect on forward EMC geometry option

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Forward endcap geometry

- Due to potential high background in the forward region, LYSO is considered to replace BABAR CsI(Tl) crystals in the endcap.

| Parameter: | ρ | MP | X_0^* | R_M^* | dE/dx | λ_I^* | τ_{decay} | λ_{max} | n^{\ddagger} | Relative output [†] | Hygroscopic? | $d(\text{LY})/dT$ |
|-------------------|-----------------|--------------------|---------|---------|---------|---------------|------------------------------------|--------------------------------------|----------------|---|--------------|----------------------------------|
| Units: | g/cm^3 | $^{\circ}\text{C}$ | cm | cm | MeV/cm | cm | ns | nm | | | | $\%/^{\circ}\text{C}^{\ddagger}$ |
| CsI(Tl) | 4.51 | 621 | 1.86 | 3.57 | 5.6 | 39.3 | 1300 | 560 | 1.79 | 165 | slight | 0.3 |
| CsI(pure) | 4.51 | 621 | 1.86 | 3.57 | 5.6 | 39.3 | 35 ^s 6 ^f | 420 ^s 310 ^f | 1.95 | 3.6 ^s 1.1 ^f | slight | -1.3 |
| PbWO ₄ | 8.3 | 1123 | 0.89 | 2.00 | 10.2 | 20.7 | 30 ^s 10 ^f | 425 ^s 420 ^f | 2.20 | 0.083 ^s 0.29 ^f | no | -2.7 |
| LSO(Ce) | 7.40 | 2050 | 1.14 | 2.07 | 9.6 | 20.9 | 40 | 420 | 1.82 | 83 | no | -0.2 |

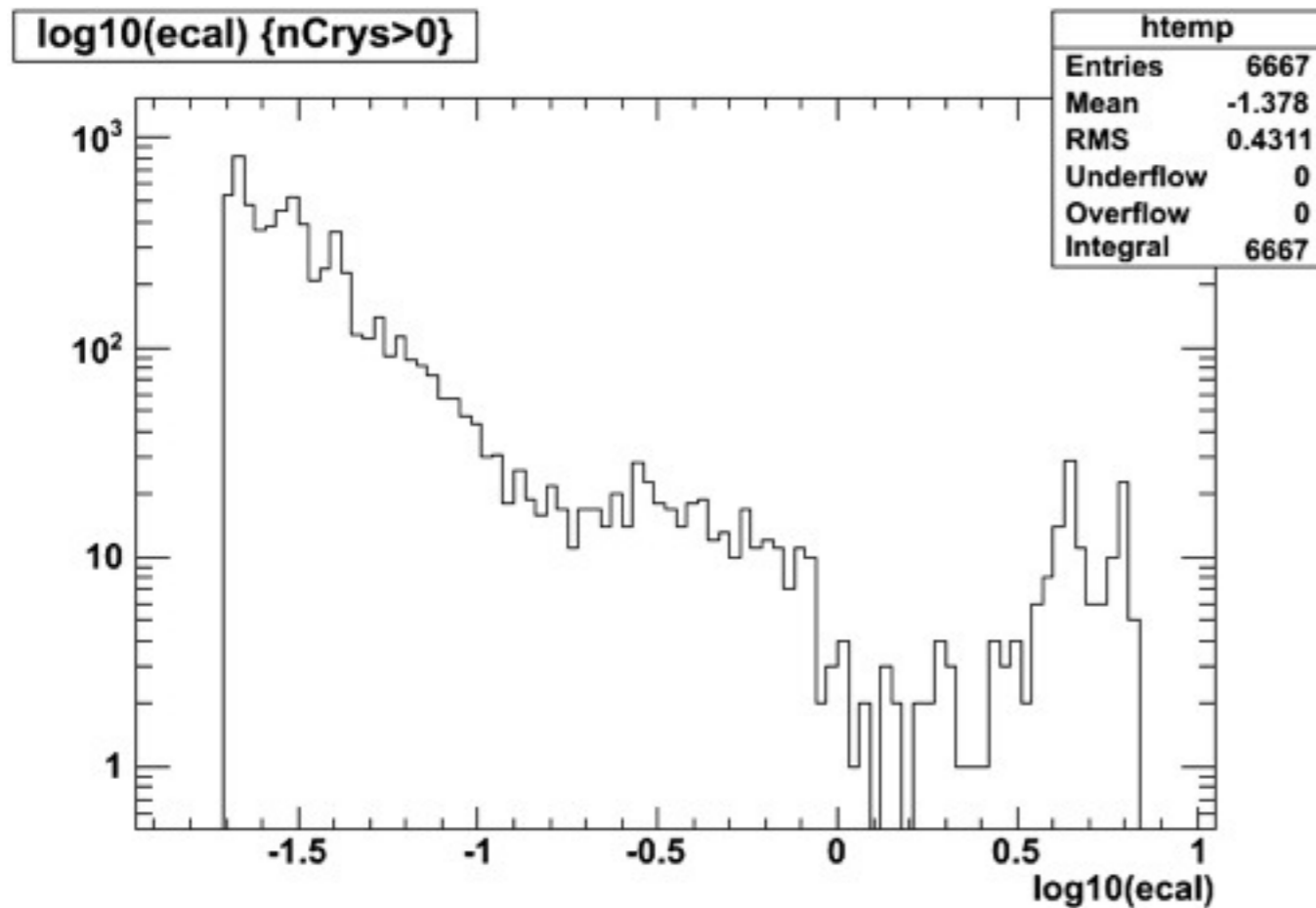
- But LYSO is expensive. Does pure CsI work as well?
 - ▶ Lower light output, different spectrum, larger R_M , similar decay time.
- Here I am only asking one question: does the larger CsI crystal size performs worse in the presence of background, other being equal?

Fastsim configuration

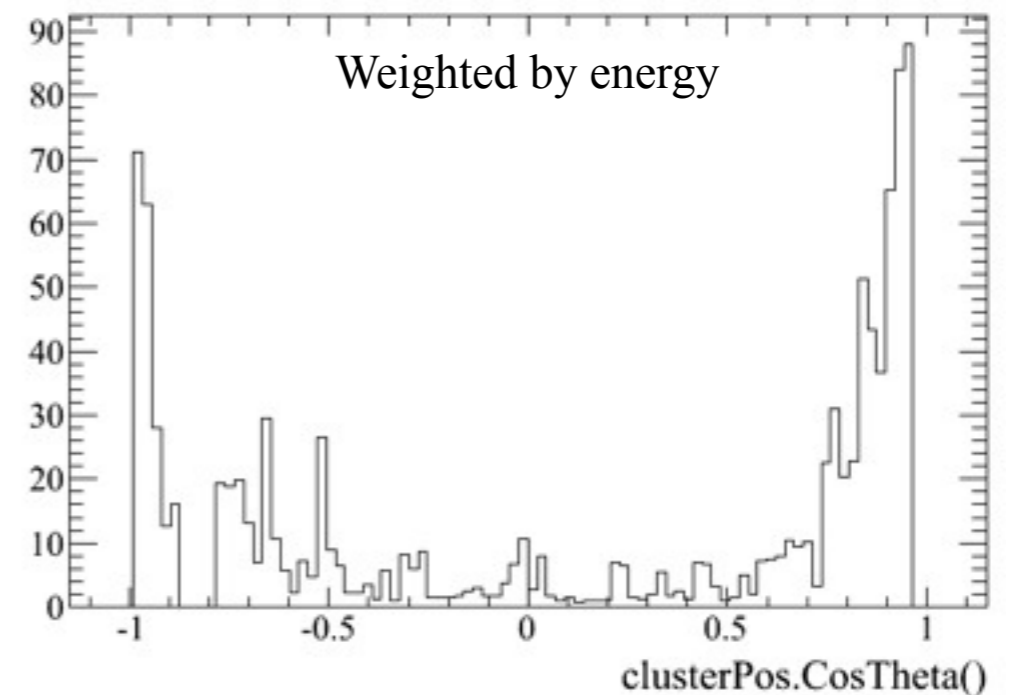
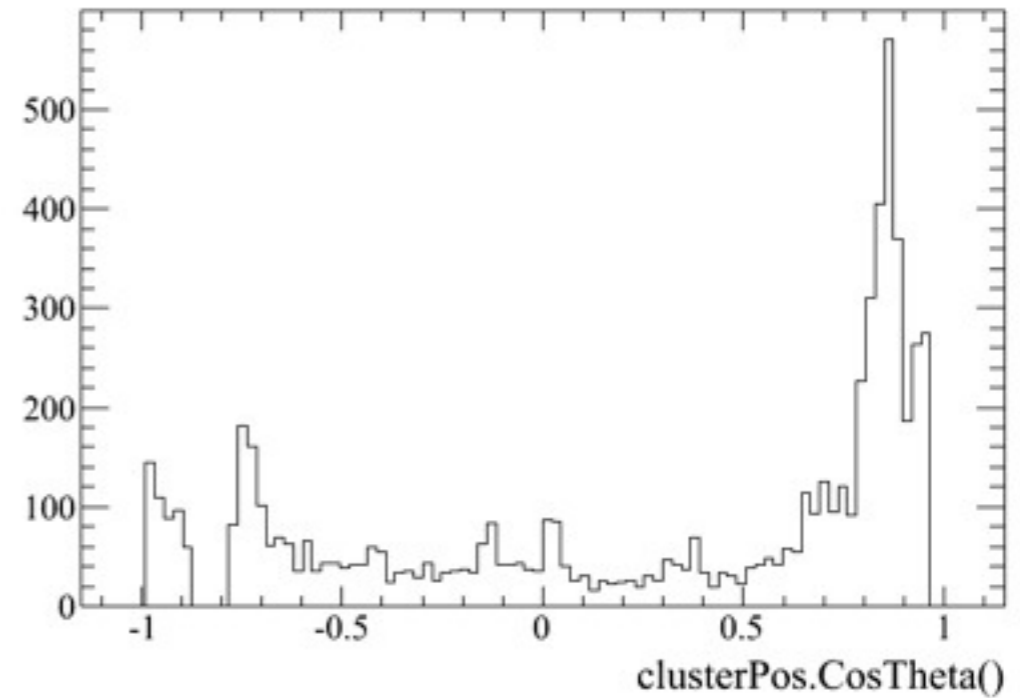
- CsI: 8 rings, crystals/ring = 80, 100, 120. → front face ~ 4.7x4.7 cm, length 30 cm, $R_M = 3.7\text{cm}$
- LYSO: 20 rings, crystals/ring = 175–265. → front face ~ 2.0x2.0 cm, length 20 cm, $R_M = 2.07\text{cm}$
- Other configurations are all the same:
- Particles arrived within ± 25 ns will be recorded, with a certain pulse model to determine how much energy should be recorded.
- Background files use “July 2010” production [/`storage/gpfs_superb/prod/2010_July_bkg`].
- Bunch crossing: 200 MHz.
- Photon threshold: 10 MeV. Neutron threshold: 2 MeV.
- Generate single photons in the forward region. Compare resolutions, etc, with/without background, under two geometries.

Background distributions

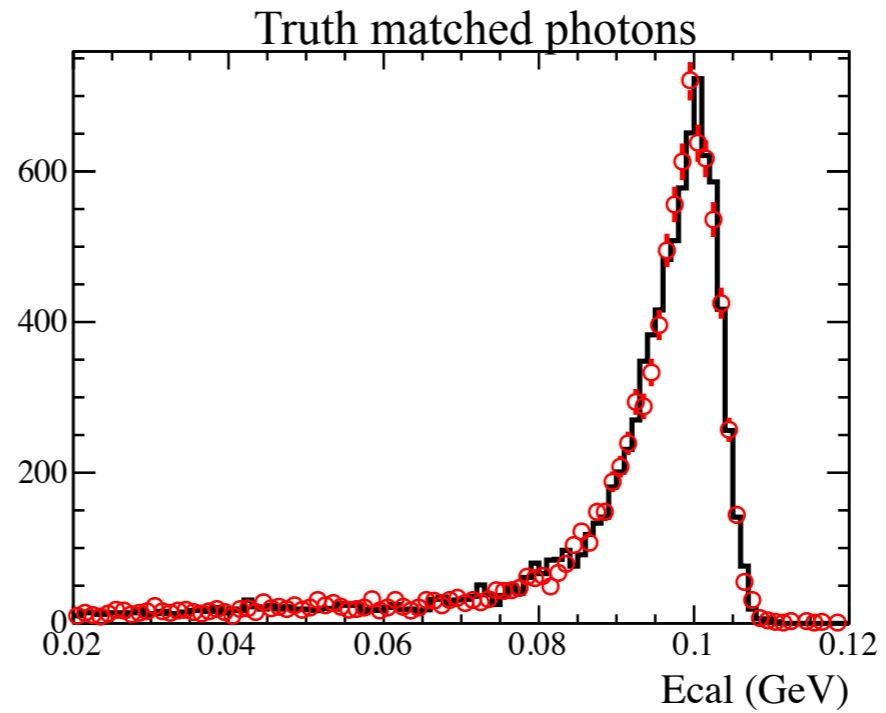
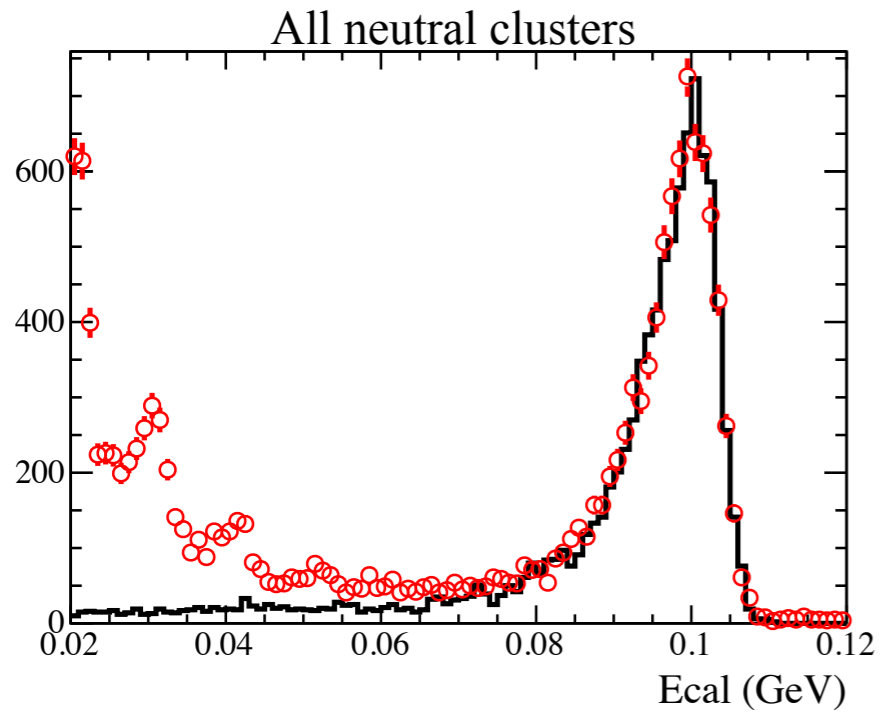
- 10000 neutrino events:



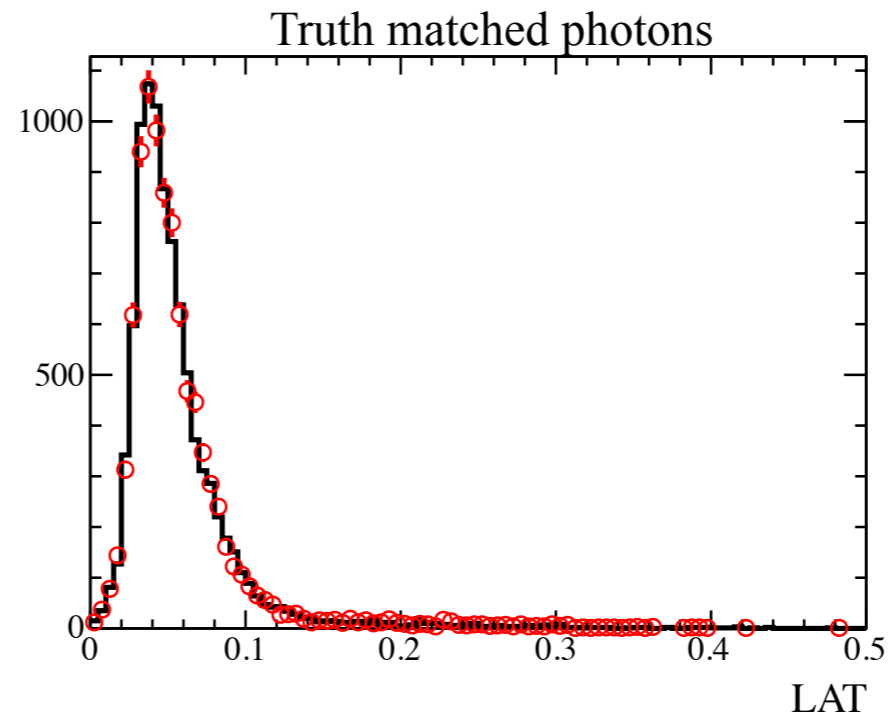
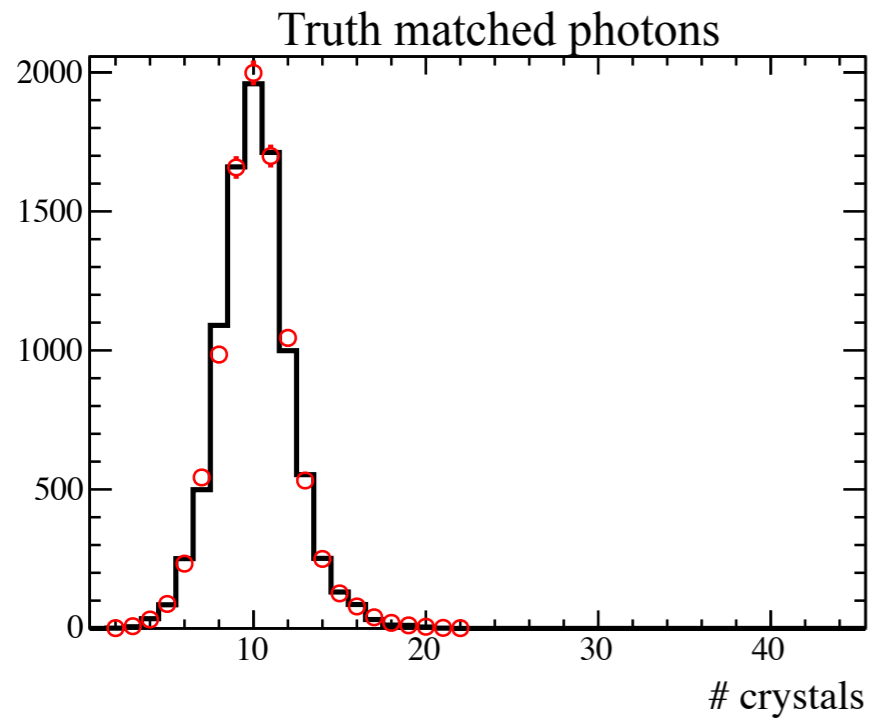
On average there is only 0.67 cluster greater than 20 MeV per event.



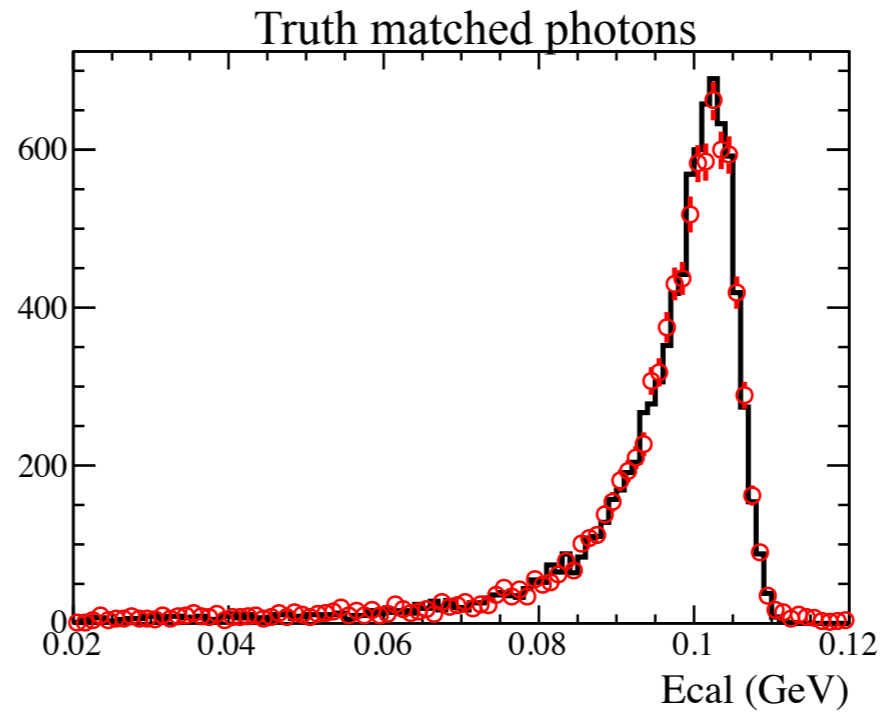
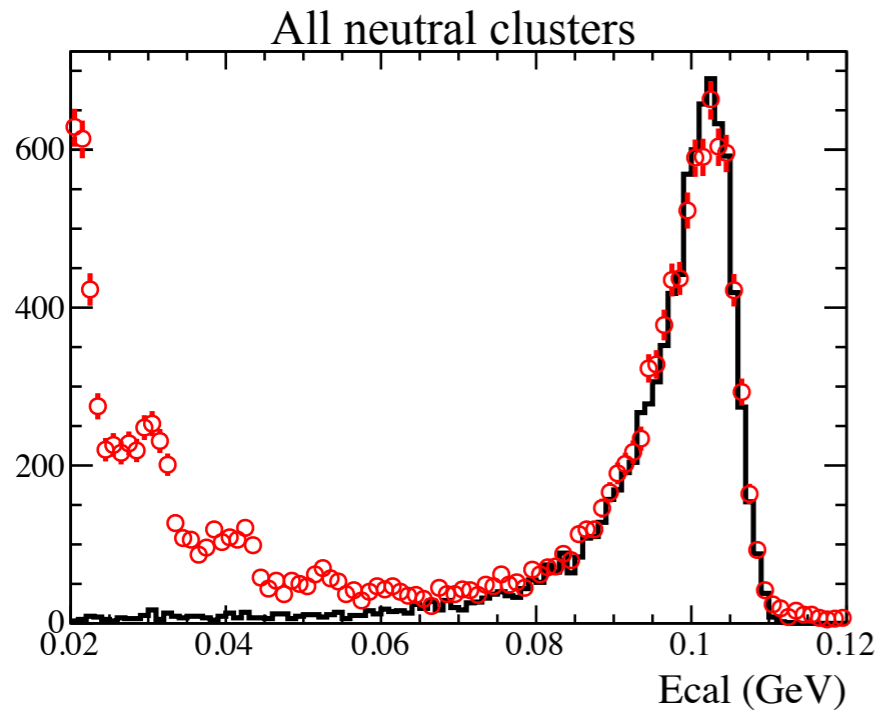
100 MeV: LYSO



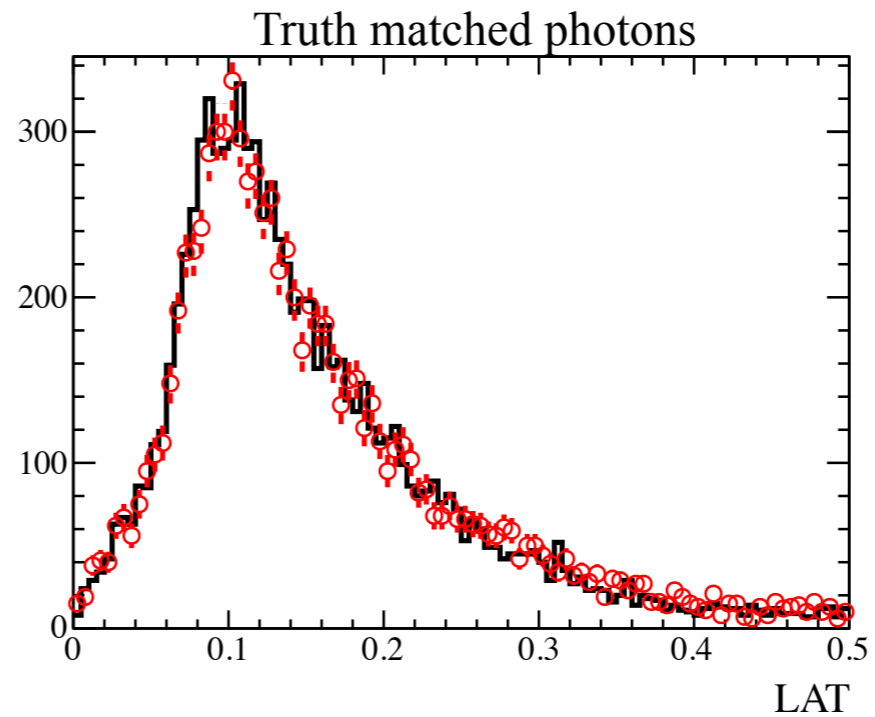
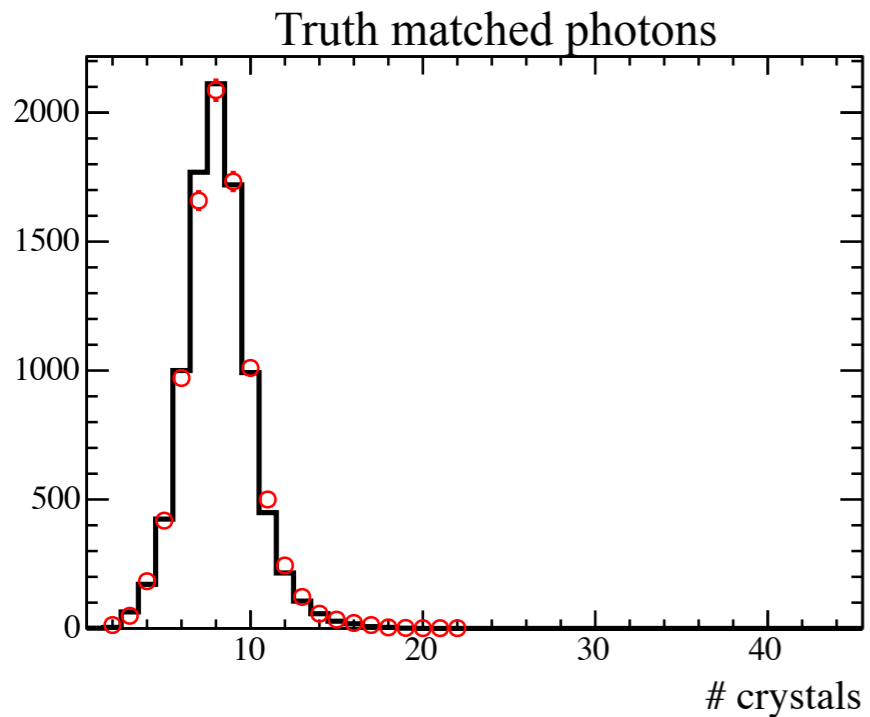
□ no background
○ with background



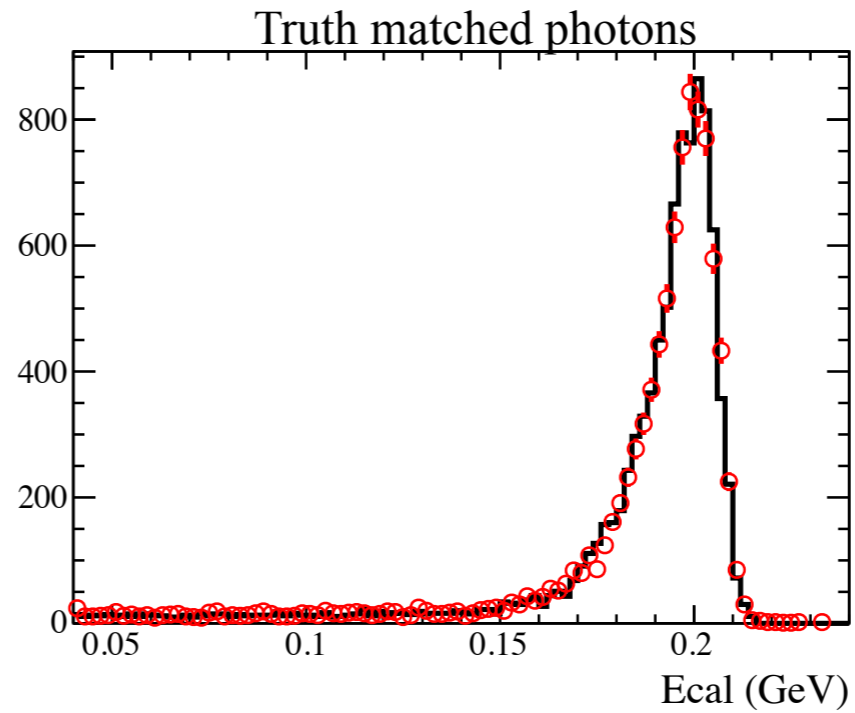
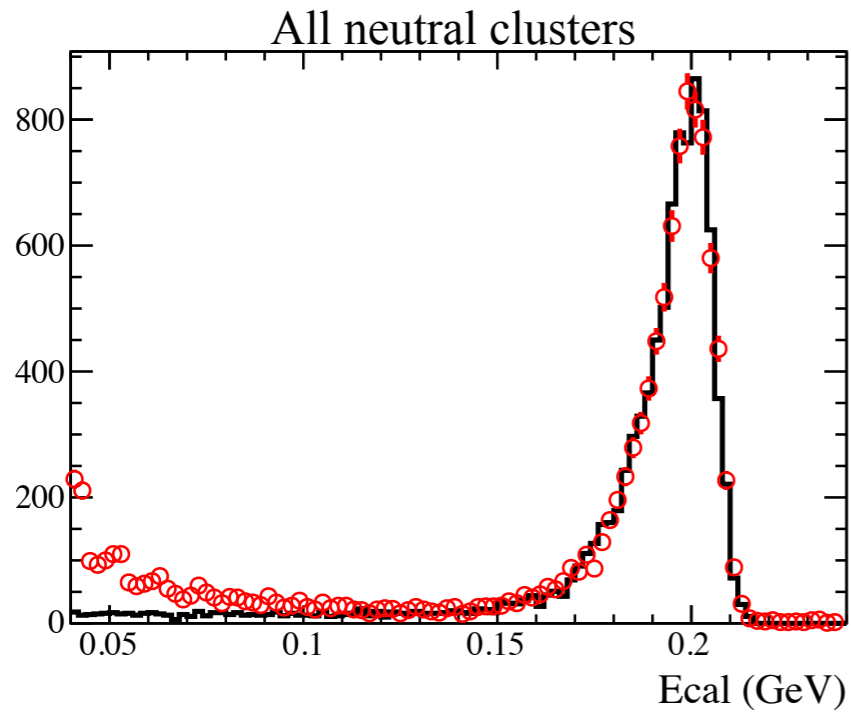
100 MeV: CsI



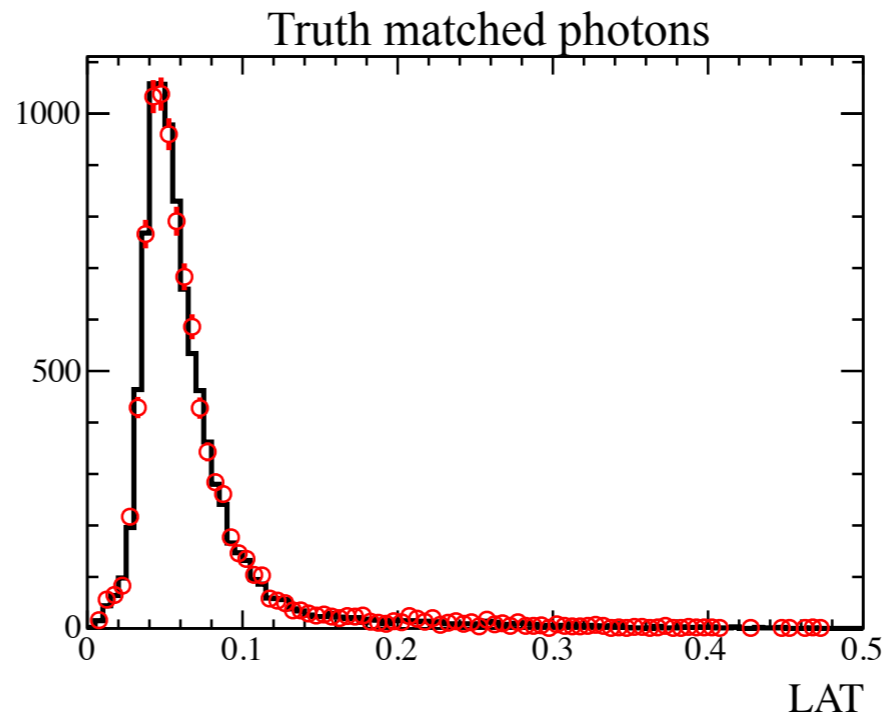
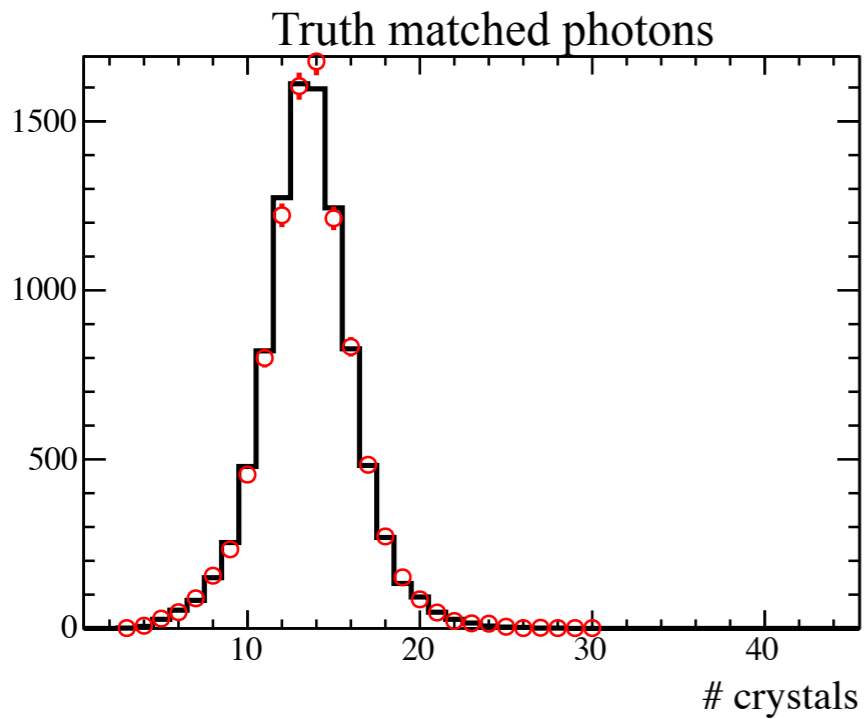
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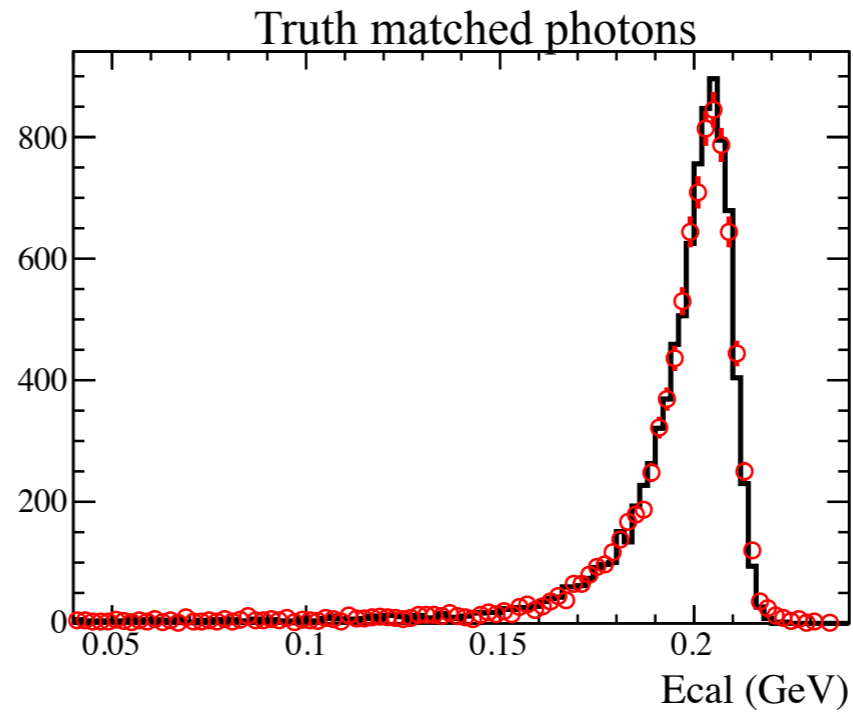
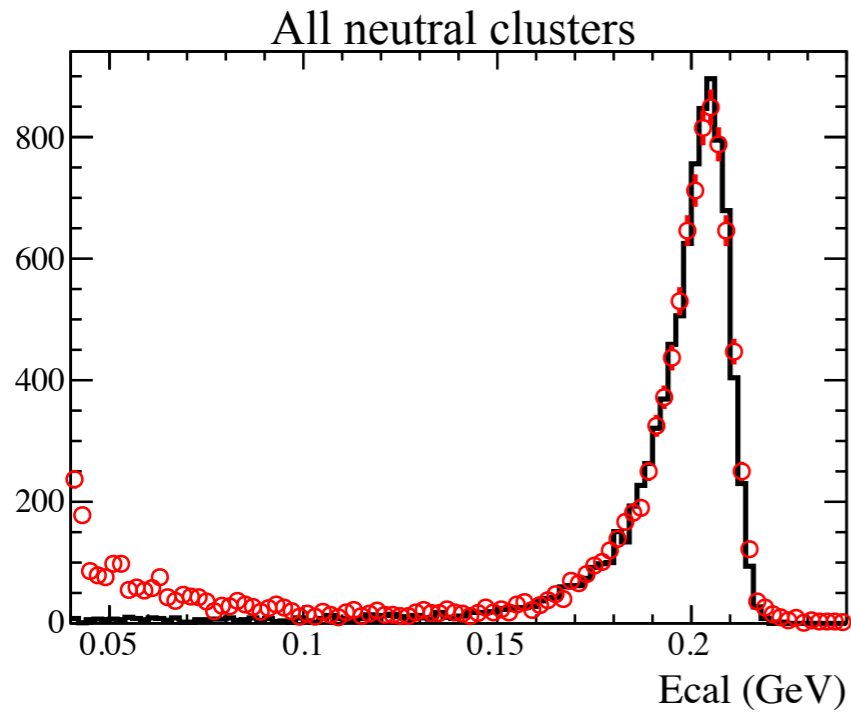
200 MeV: LYSO



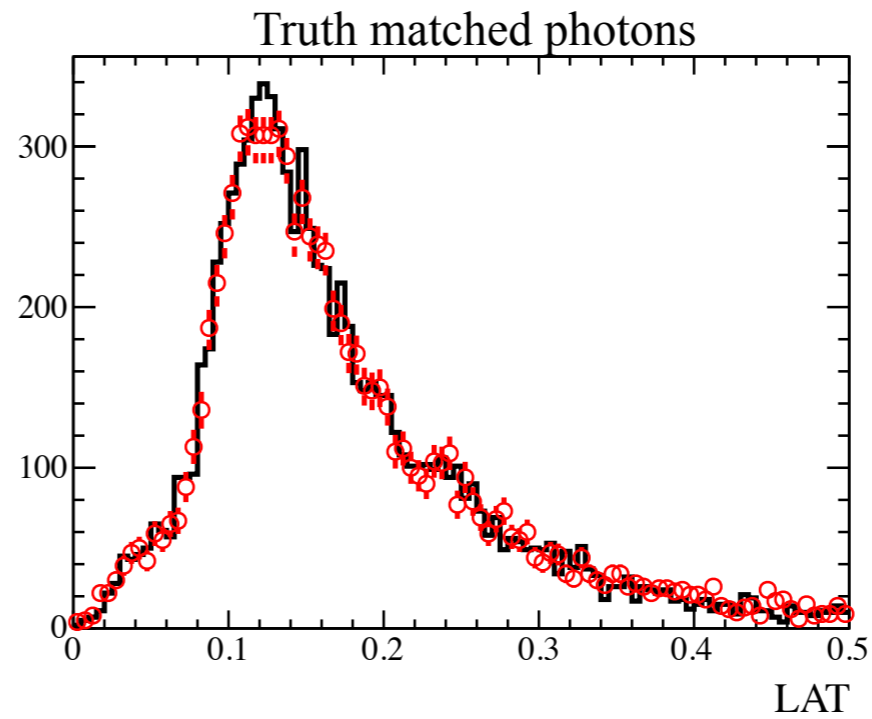
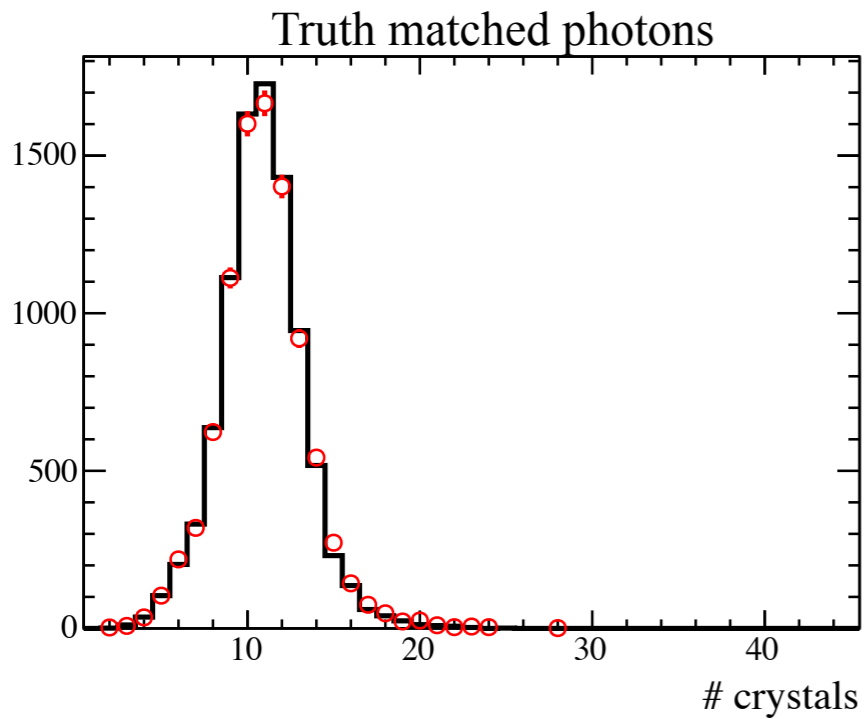
□ no background
○ with background



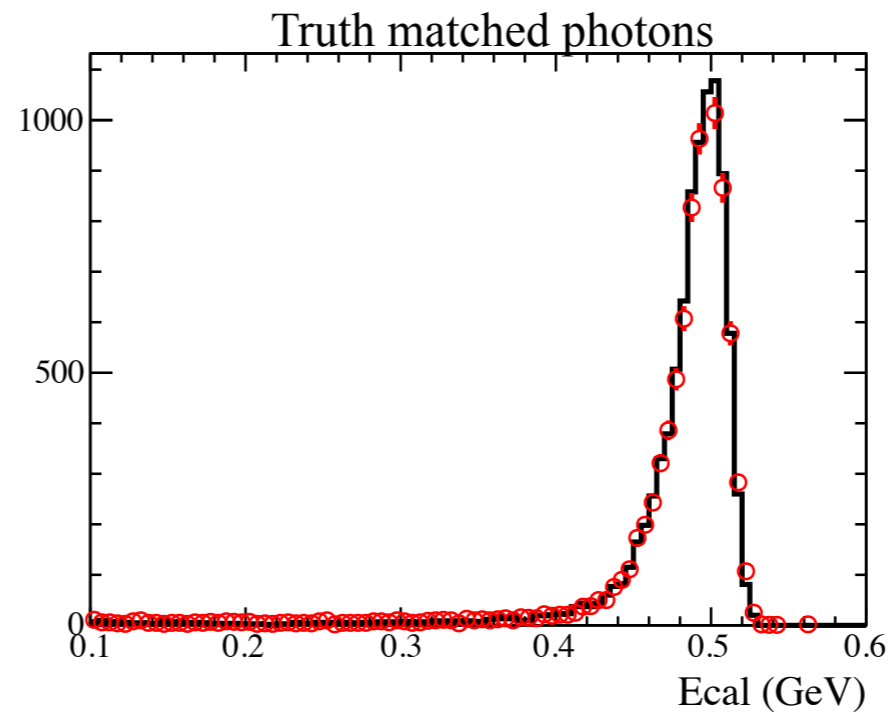
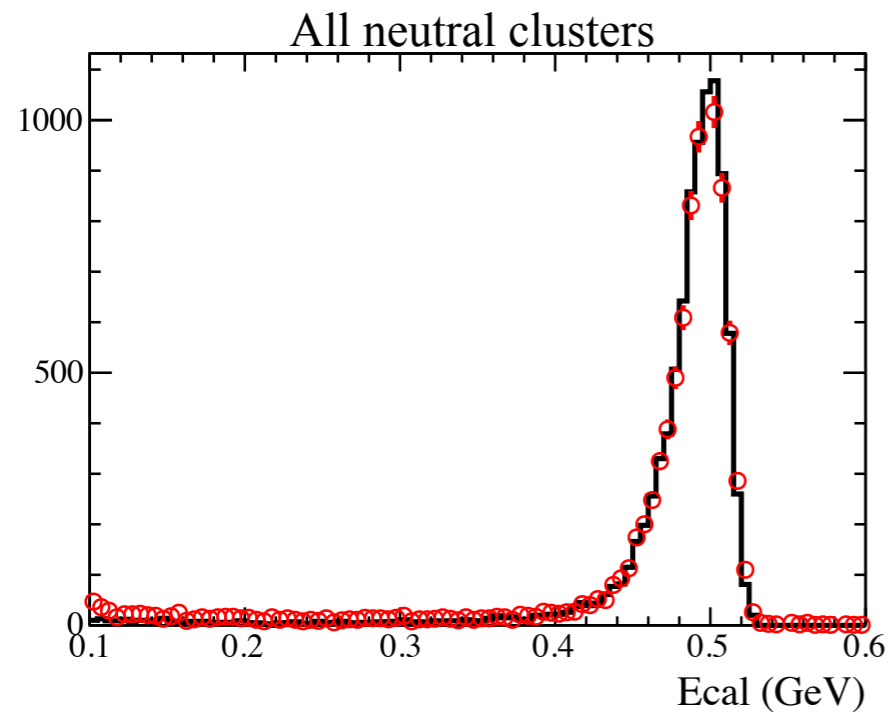
200 MeV: CsI



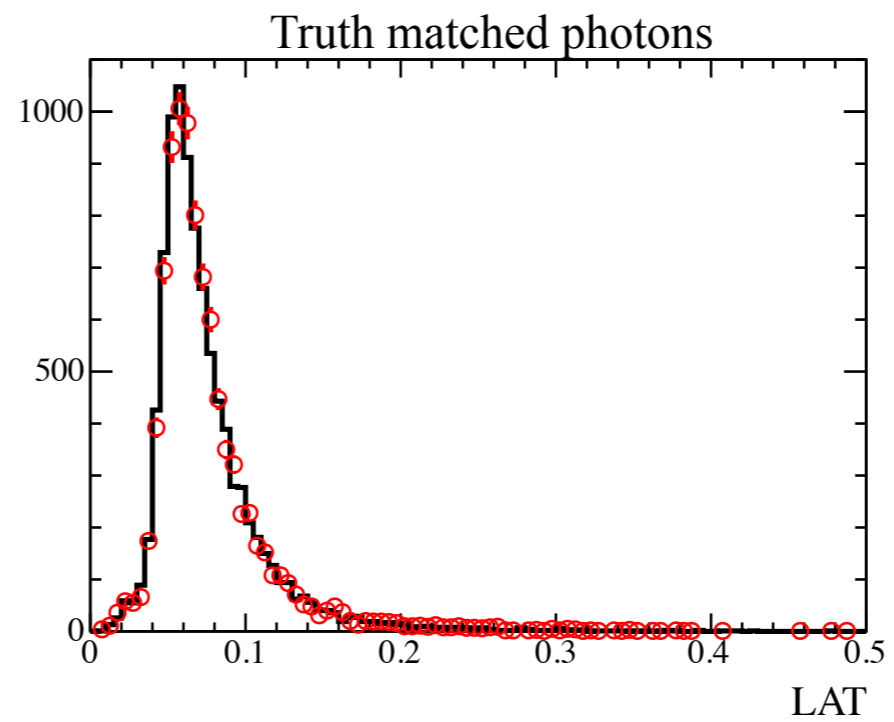
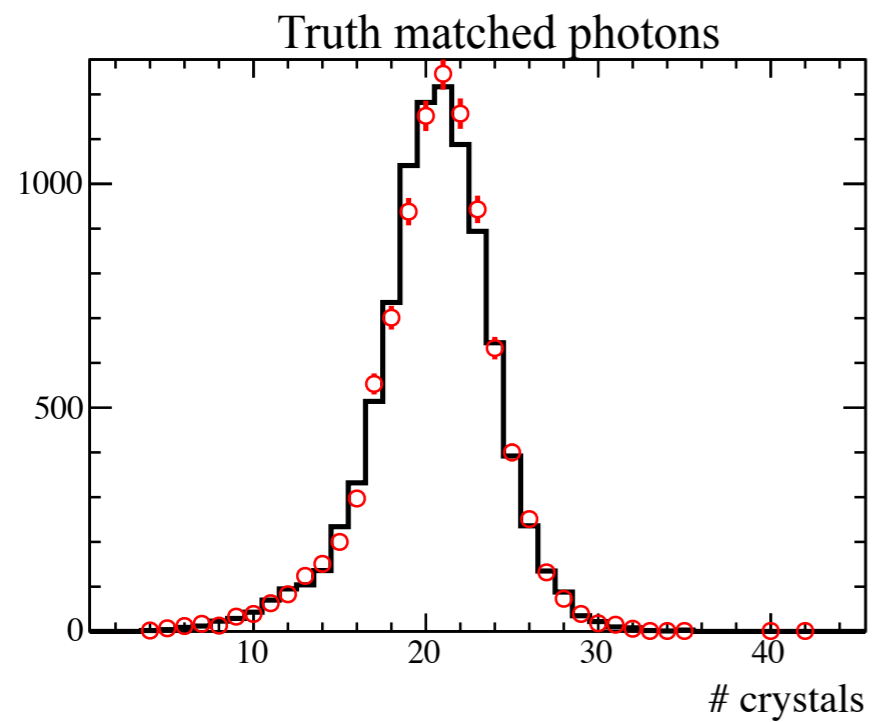
□ no background
○ with background



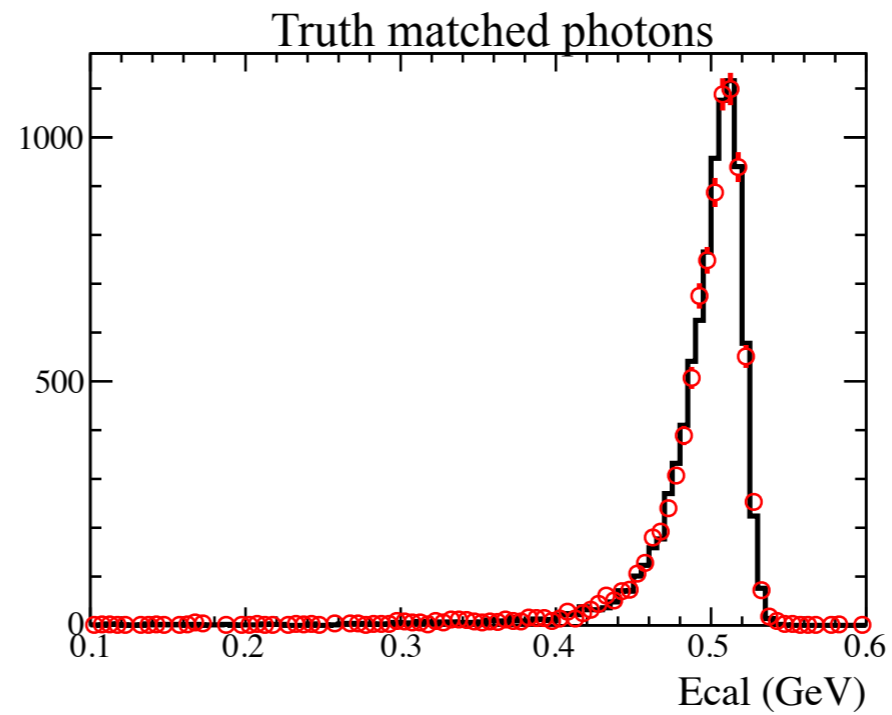
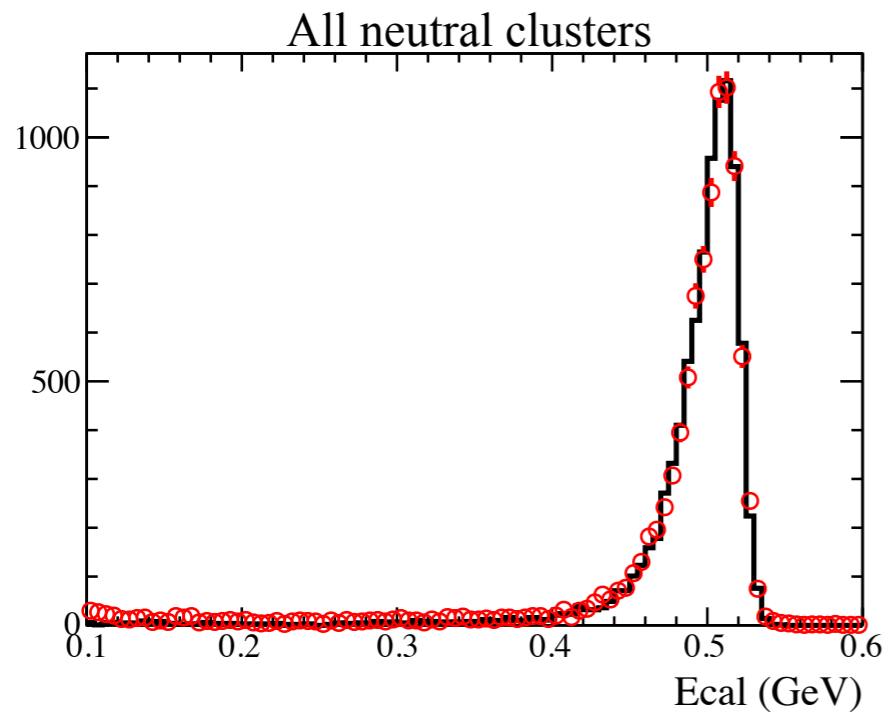
500 MeV: LYSO



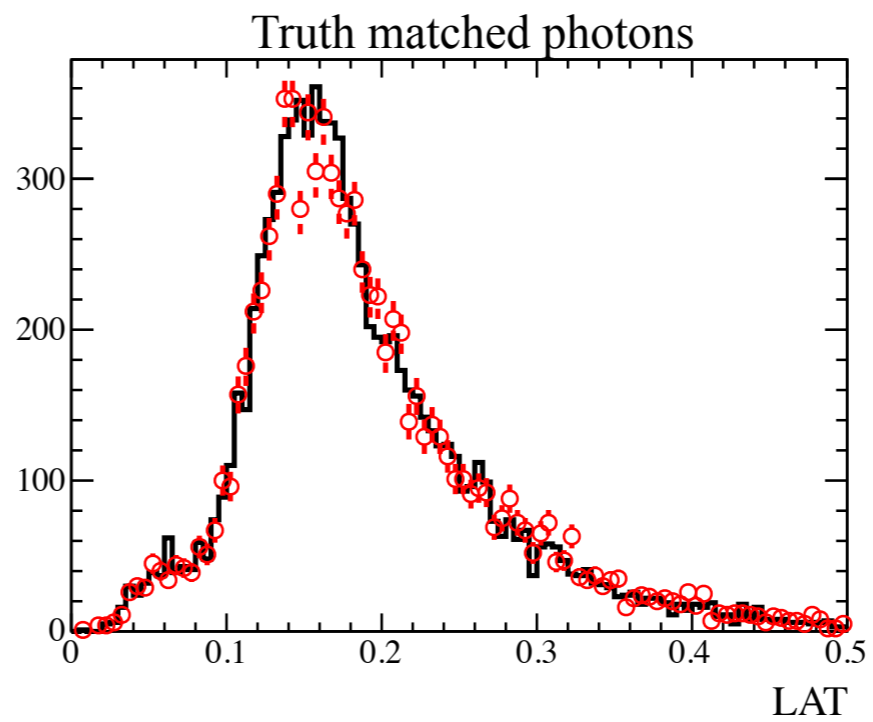
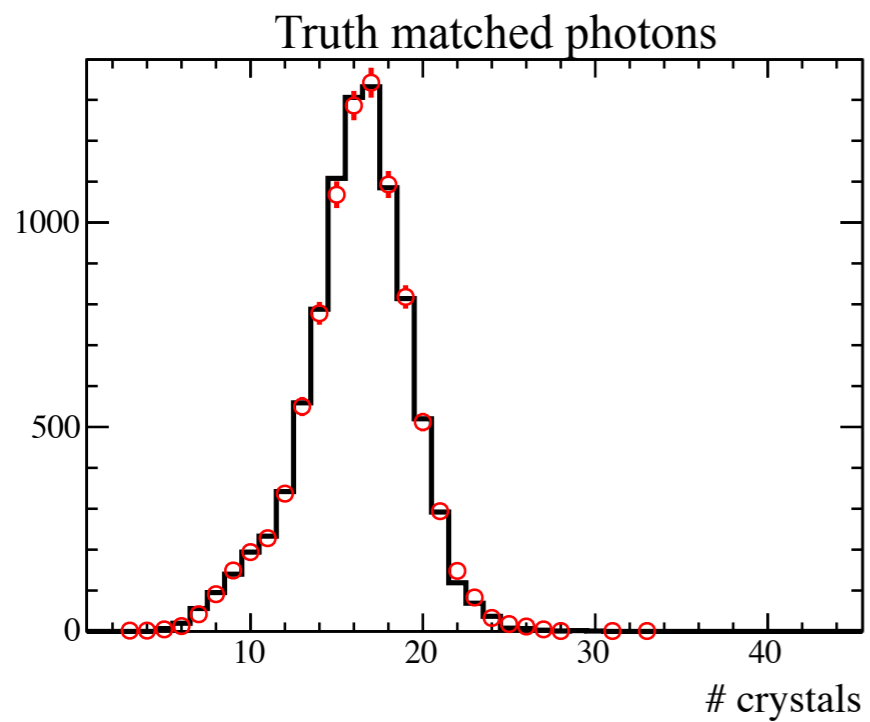
□ no background
○ with background



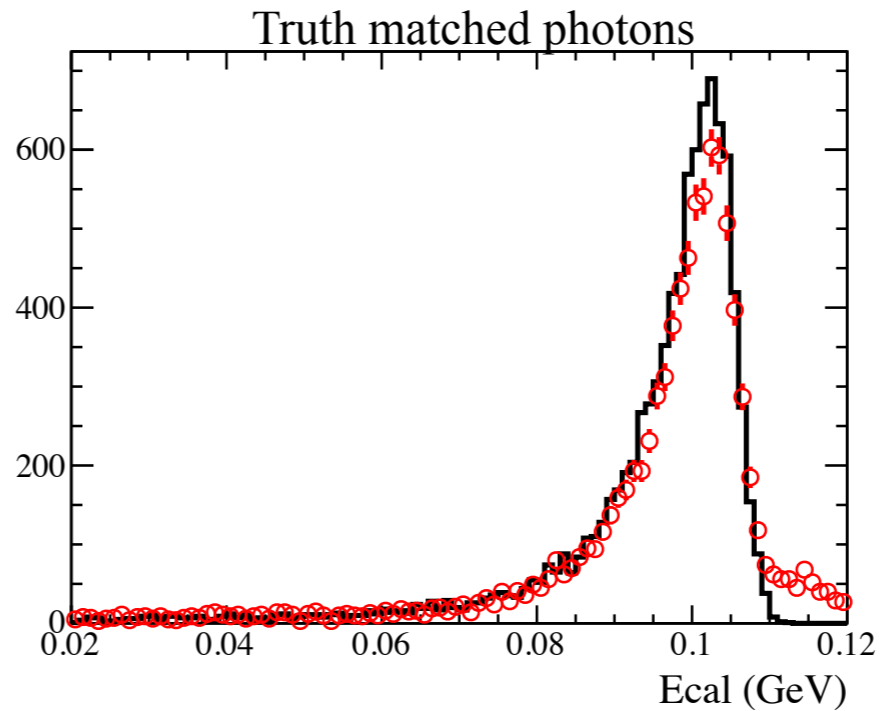
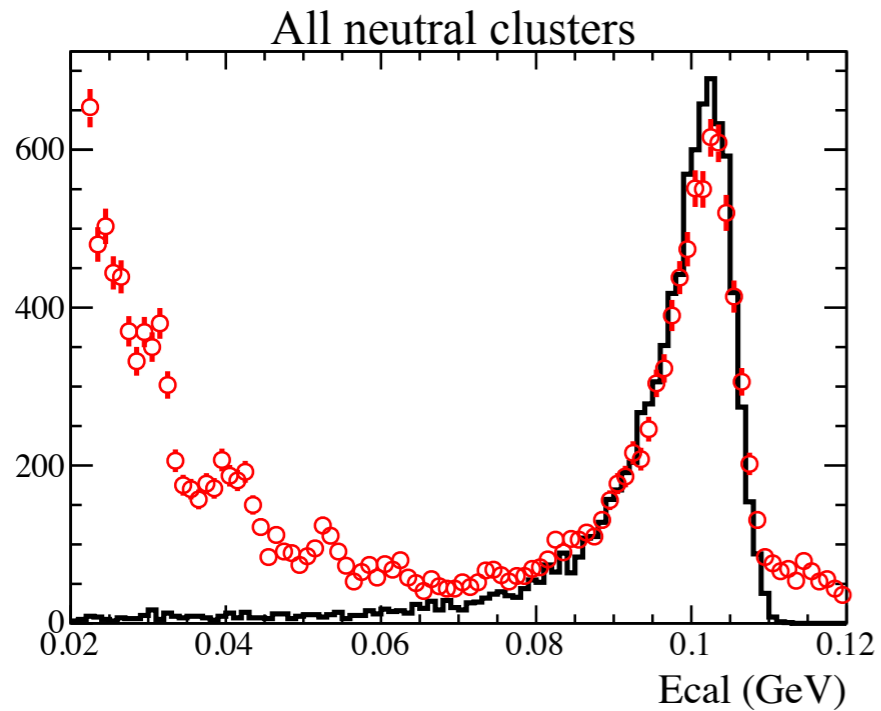
500 MeV: CsI



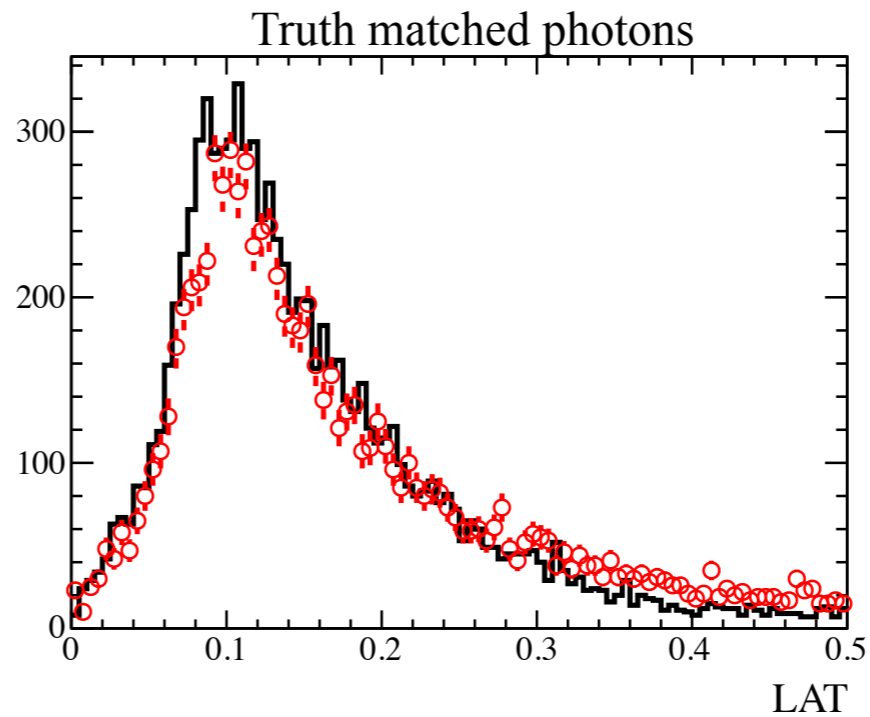
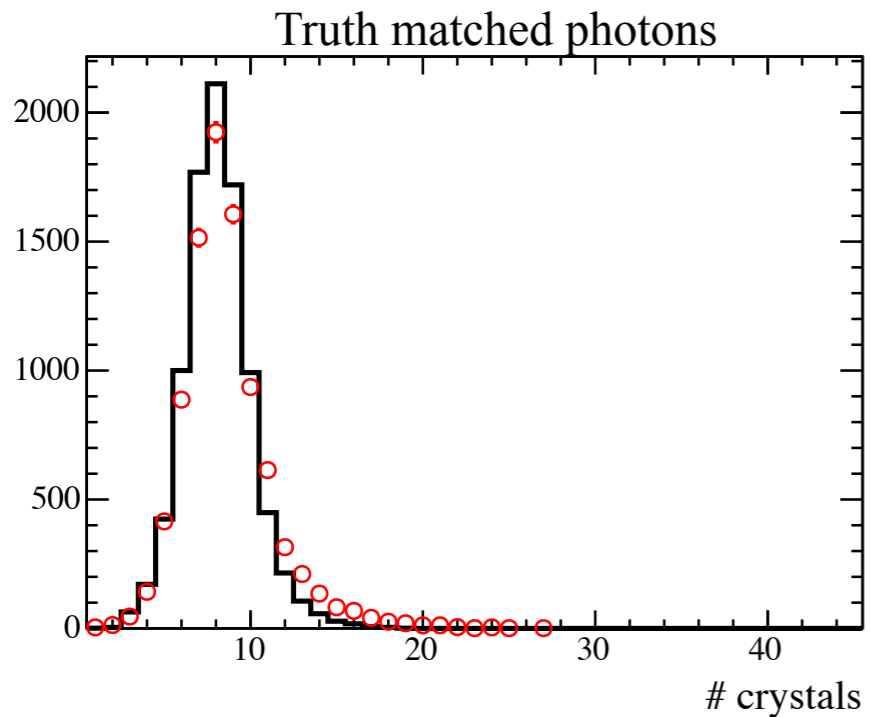
□ no background
○ with background



100 MeV: CsI, inflate time constants 10X



□ no background
○ with background



Comments

- Last summer's background production produces on average about 2/3 cluster greater than 20 MeV to each physics event.
- Background caused no appreciable change to energy resolution, cluster size and lateral moment, both for smaller crystal size $\sim 2 \times 2 \text{ cm}$ and for larger crystal size $\sim 4.7 \times 4.7 \text{ cm}$ in the forward region.