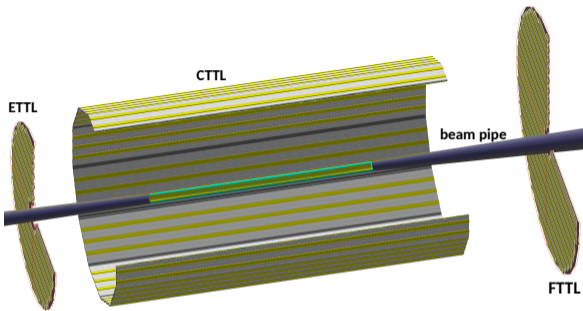# AC-LGAD based - Timing Tracking Layer (TTL)
Start time determination
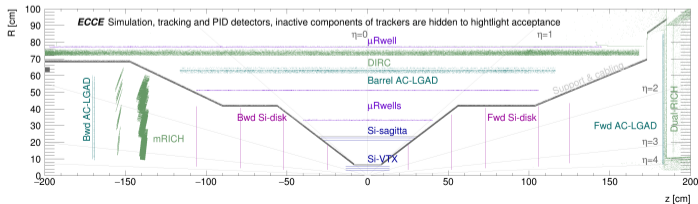
May 16, 2022

Friederike Bock
for the ORNL Relativistic Nuclear Physics Group

**F. Bock, M. Demarteau, M. Fasel, E. Glimos, O. Hartbrich, H. Hassan,
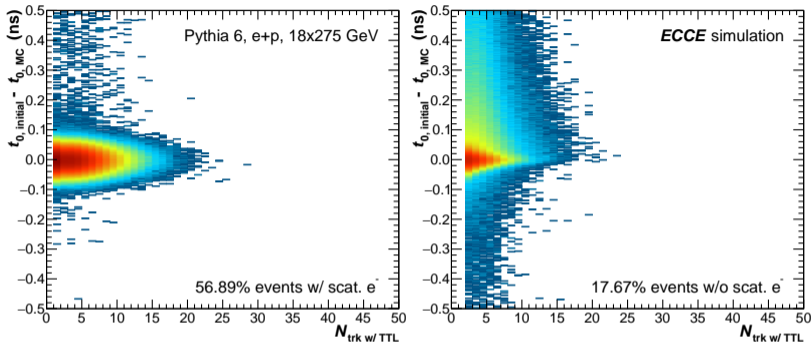F. Jonas, C. Loizides, J. Osborn, M. Poghosyan, K. Read, A. Russu, J. Schambach, N. Schmidt**

Geometry & Basic Assumptions

- Plate design for barrel
- Alternating sensor placement (top & bottom)
  $\rightarrow$ path lenth corrected in simulations
- Small rapidity gap still to be optimized
- Simulations with pixels of 500 $\times$ 500 μm,
  $\sigma_{xy} = 30$ μm & $\sigma_t = 25$ ps

a) scattered electron found

- Scattered electron found if: $p_{e^-} > 3$ GeV/c, $\eta < 0.5$ in calo/ cherenkov detector acceptance
- Assuming calo & cherenkov detectors together can identify electron w/o losses
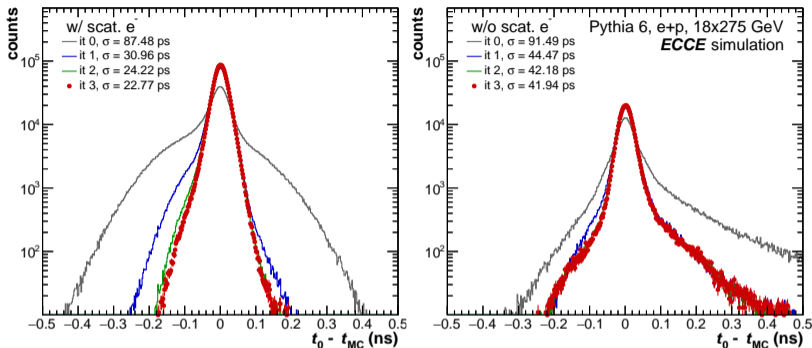
$\Rightarrow$ initial t_0 determined based on scattered electron

b) scattered not electron found

- Assume all particles in event charged pions
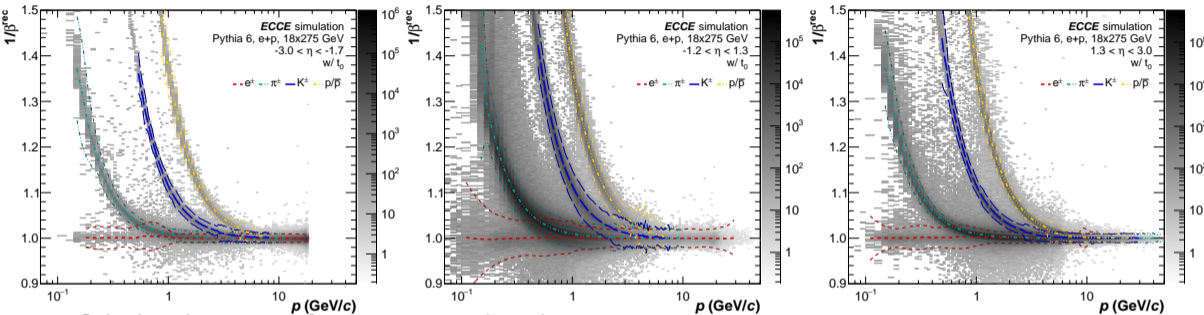- All orginate from common vertex
- Needs at least 2 tracks with TTL hits

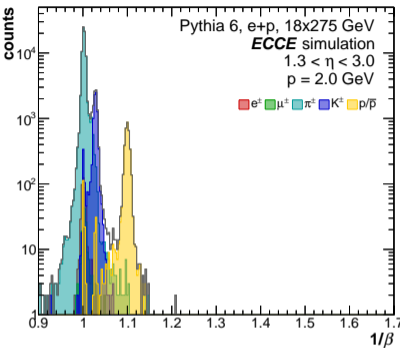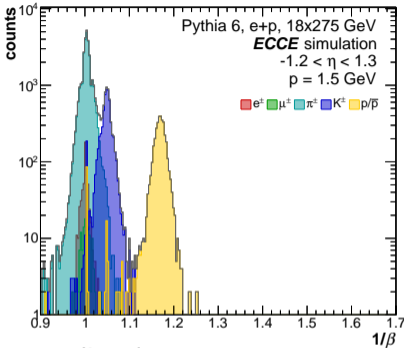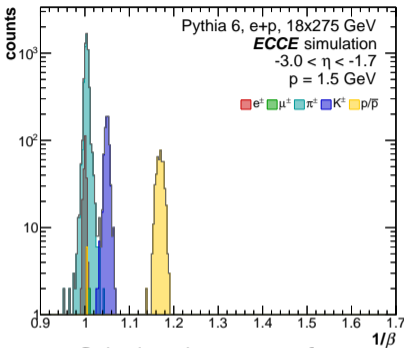$\Rightarrow$ initial t_0 determined based pion assumption

- Common procedure after initial t_0 determination
- For all particles the velocity estimate is based on $t_{part,rec} - t_{0,it-1}$
- In iterations $1/\beta$ is calculated and compared to expectation value for π,K,p and e
  $\rightarrow$ assumed to be corresponding particle if within 1% of expectation value & $p < 6$ GeV/c
  $\rightarrow$ $p > 15$ GeV/c pion mass assumed, except for scattered electron candidates
- Latest after 4 iterations no significant change observed any more

PID performance of TTL

- Calculated t_0 enters for every event directly

- Optimized η coverage in particular towards electron end cap would improve scattered electron finding
  $\rightarrow$ PID discrimination in barrel & forward direction

Pythia 6, e+p, 18x275 GeV
ECCE simulation
-3.0 < η < -1.7
p = 1.5 GeV

Pythia 6, e+p, 18x275 GeV
ECCE simulation
-1.2 < η < 1.3
p = 1.5 GeV

Pythia 6, e+p, 18x275 GeV
ECCE simulation
1.3 < η < 3.0
p = 2.0 GeV

- Calculated t_0 enters for every event directly
- Optimized η coverage in particular towards electron end cap would improve scattered electron finding
  → PID discrimination in barrel & forward direction

Questions?