

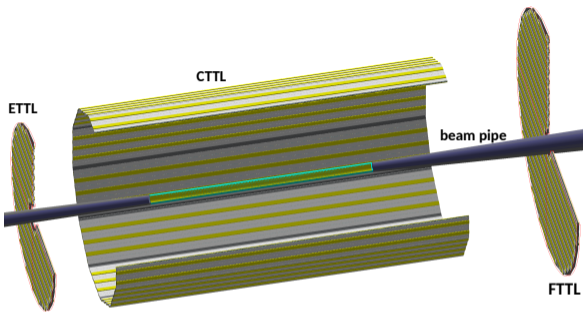
AC-LGAD based - Timing Tracking Layer (TTL) Time resolution variation

July 25, 2022

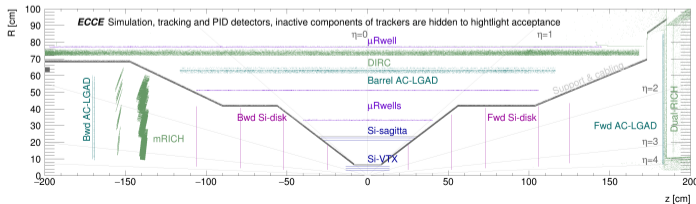
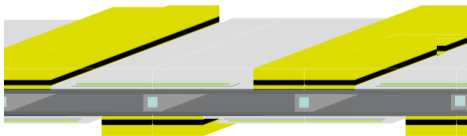
**Friederike Bock
for the ORNL Relativistic Nuclear Physics Group**

**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**

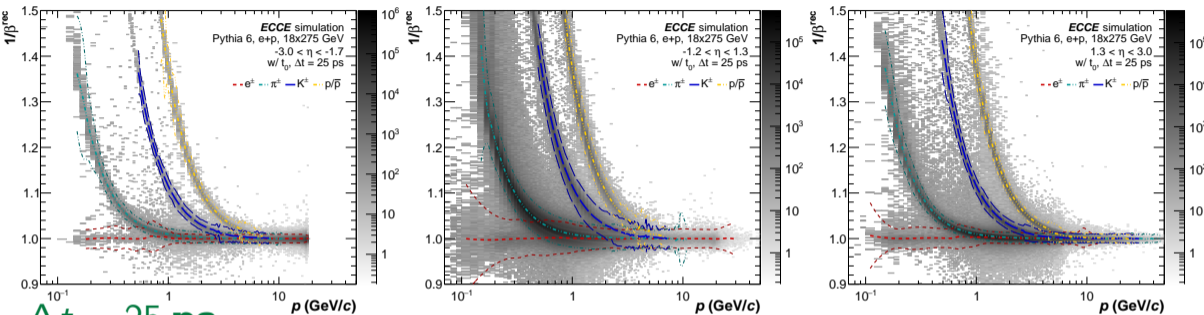
Geometry & Basic Assumptions



- Plate design for barrel
- Alternating sensor placement (top & bottom)
→ path length corrected in simulations
- Small rapidity gap still to be optimized
- Simulations with pixels of $500 \times 500 \mu\text{m}$, $\sigma_{xy} = 30 \mu\text{m}$
- Variations of time resolution:
 $\sigma_t = 25 \text{ ps}, 30 \text{ ps}, 35 \text{ ps}, 40 \text{ ps}, 40 \text{ ps}$

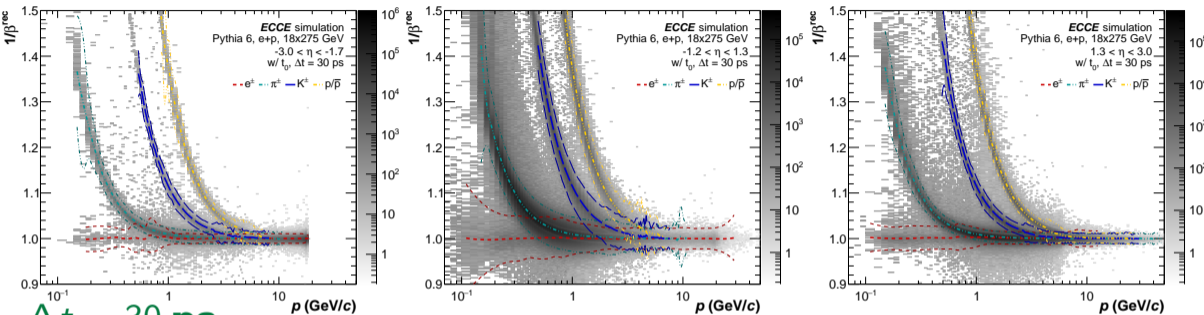


PID performance of TTL (1)



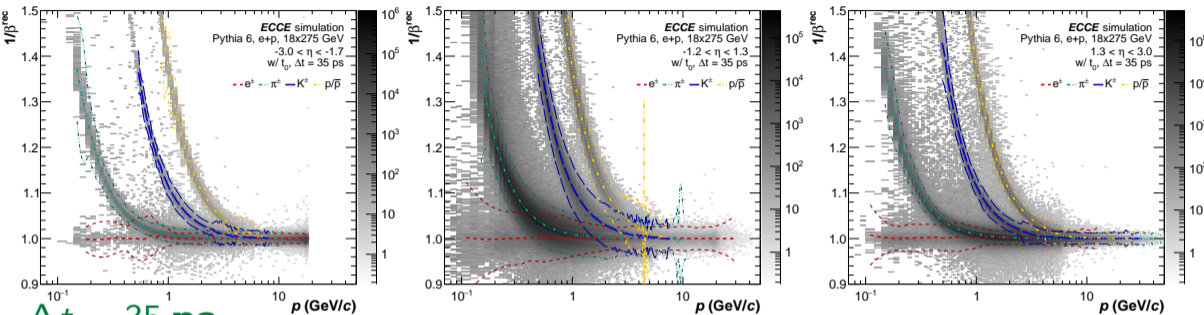
- Lines indicate center line & 3σ lines for different particle species
- Calculated t_0 enters for every event directly \rightarrow increases in Δt doesn't worsen $1/\beta$ resolution entirely linearly
- Optimized η coverage in particular towards electron end cap would improve scattered electron finding
 \rightarrow PID discrimination in barrel & forward direction

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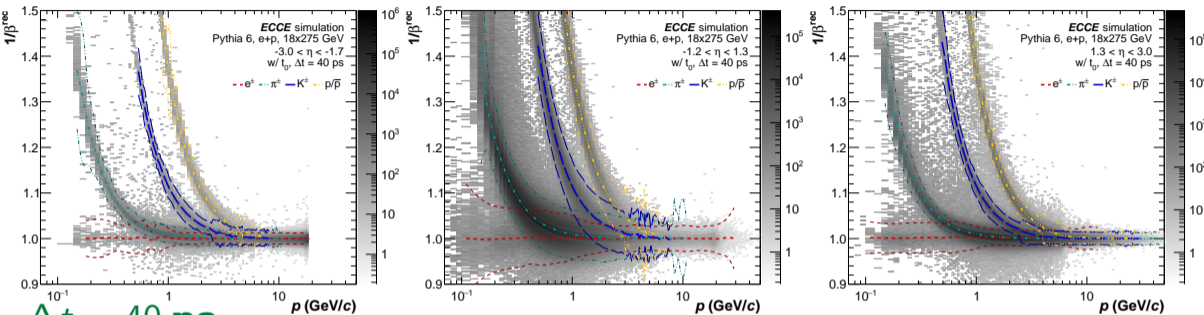
PID performance of TTL (1)



$\Delta t = 35$ ps

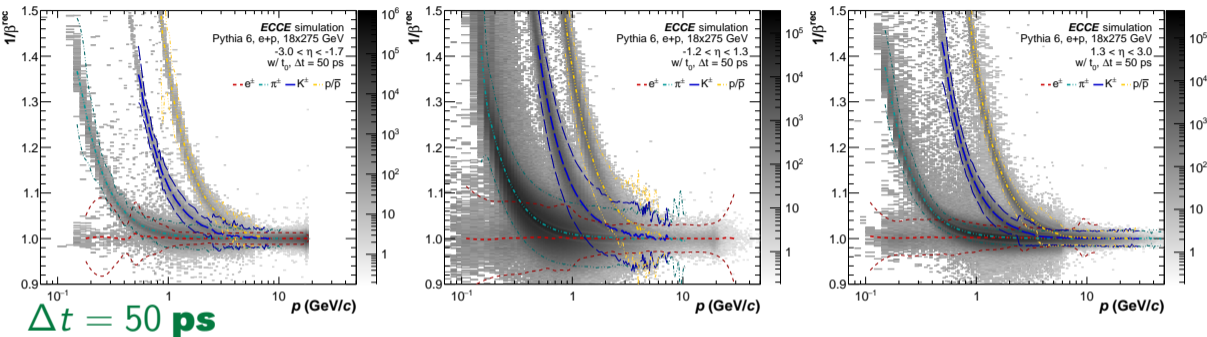
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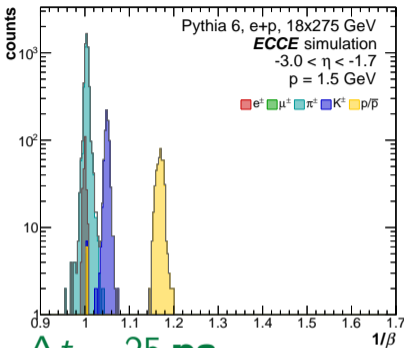
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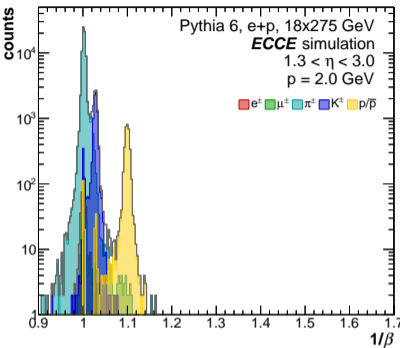
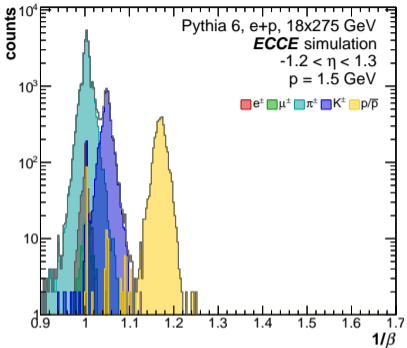


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PID performance of TTL (2)

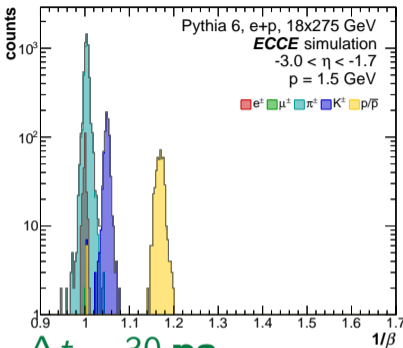


$\Delta t = 25 \text{ ps}$

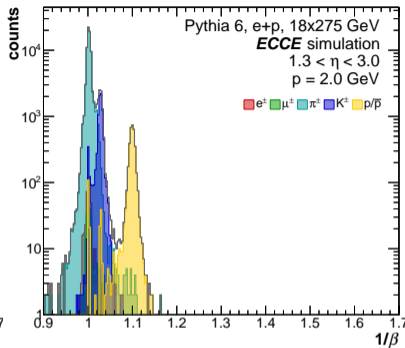
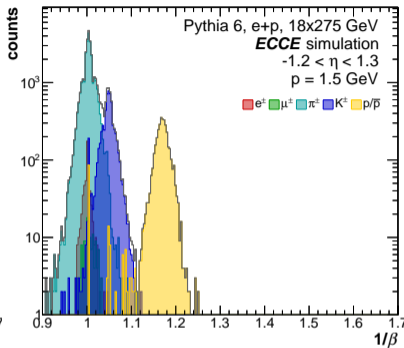


- Calculated t_0 enters for every event directly \rightarrow increases in Δt doesn't worsen $1/\beta$ resolution entirely linearly
- Full impact on PID with together with other detectors would need full extended likelihood evaluation (next step)

PID performance of TTL (2)

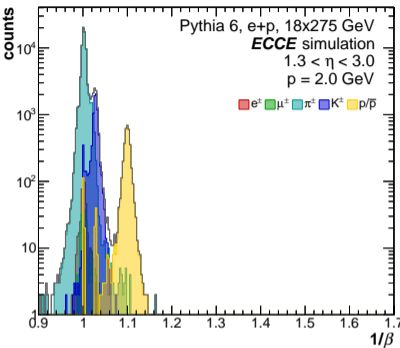
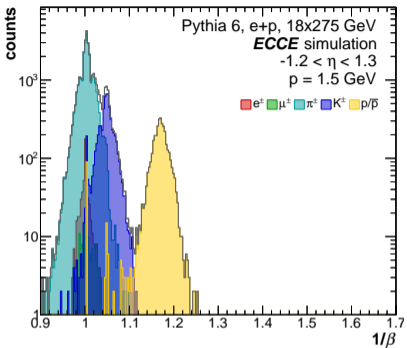
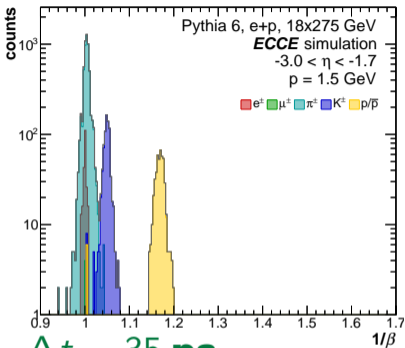


$\Delta t = 30 \text{ ps}$



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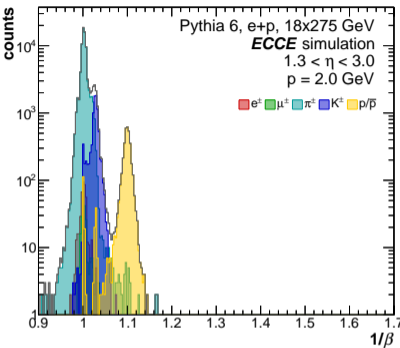
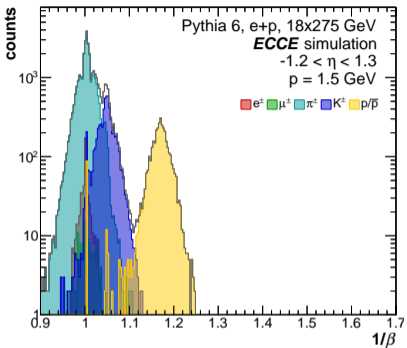
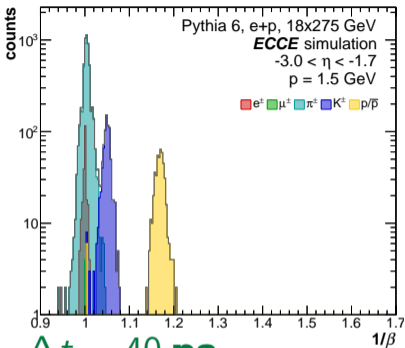
PID performance of TTL (2)



$\Delta t = 35 \text{ ps}$

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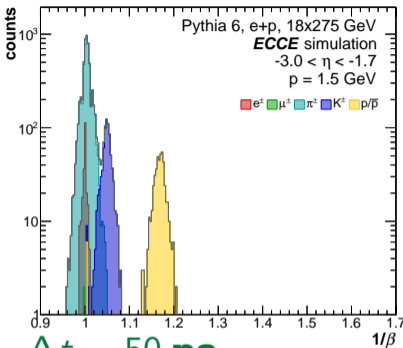
PID performance of TTL (2)



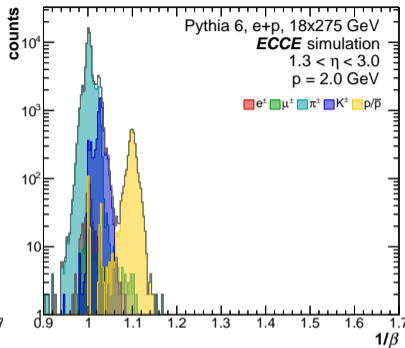
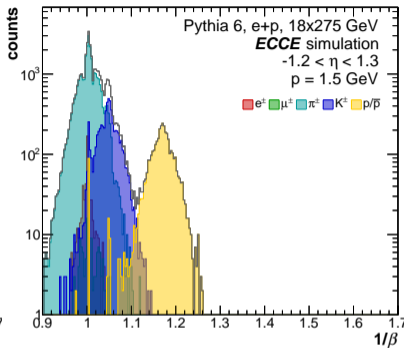
$\Delta t = 40 \text{ ps}$

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PID performance of TTL (2)



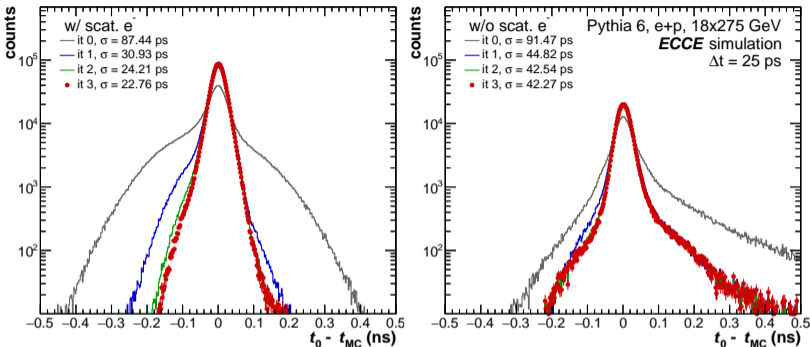
$\Delta t = 50 \text{ ps}$



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Effect on start time resolution

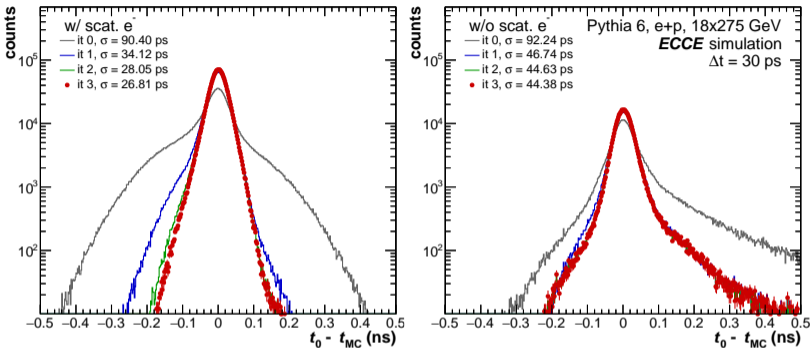
$\Delta t = 25$ ps



- Increased Δt resolution same fractional increase in t_0 resolution w/ scattered electron
- Increased Δt resolution less fractional impact on t_0 resolution w/o scattered electron
- Would need adaptation of cutoffs for t_0 determination

Effect on start time resolution

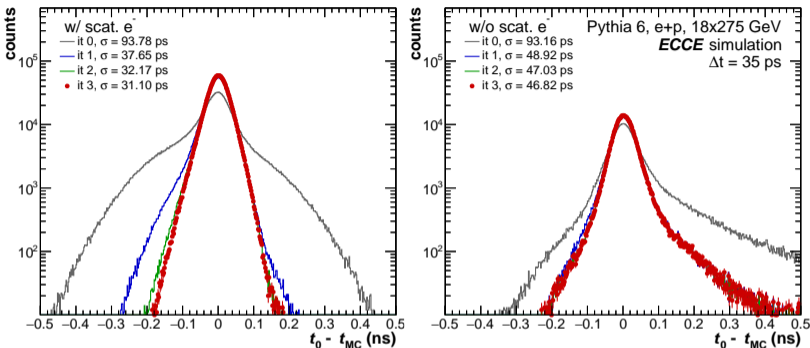
$\Delta t = 30$ ps



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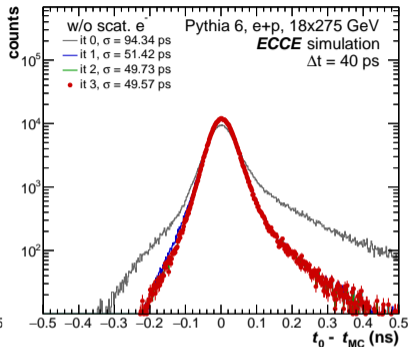
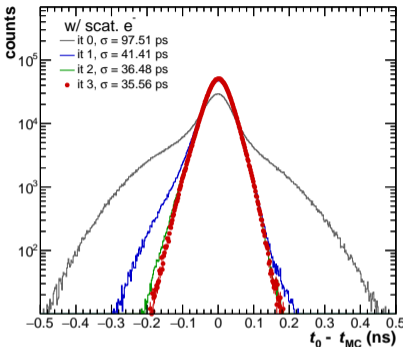
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Effect on start time resolution

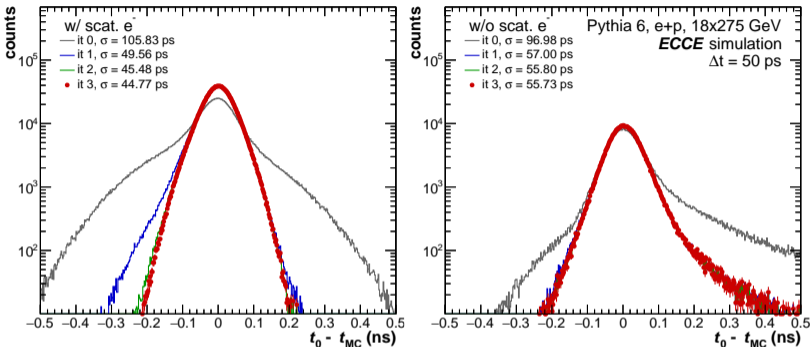
$\Delta t = 40$ ps



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