

TOF at central barrel

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Extrapolate TOF performance

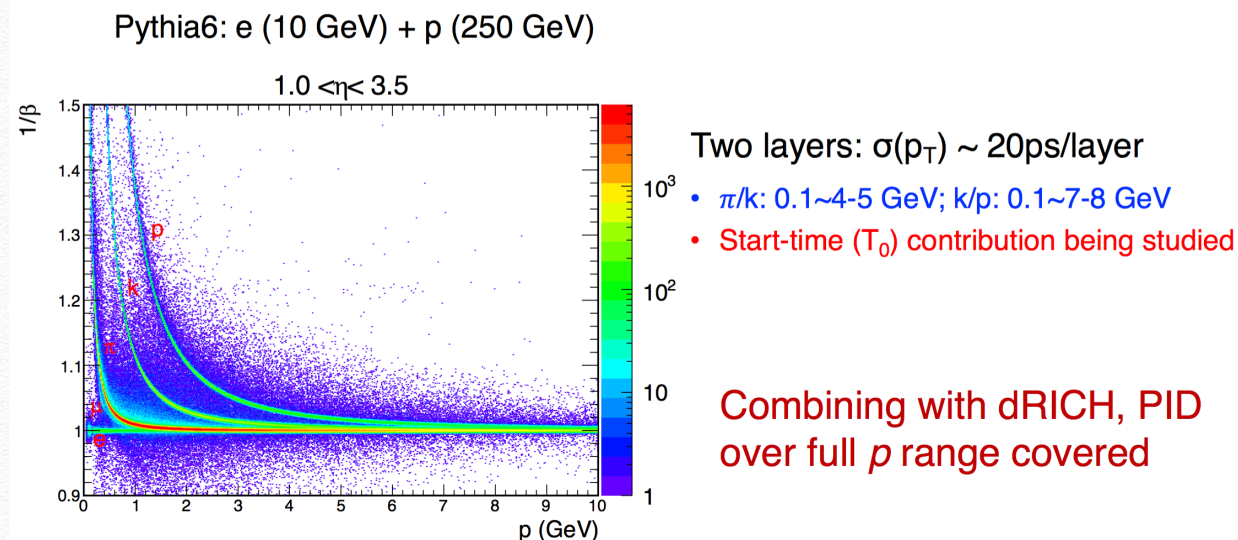
❖ Simple estimation

- ❖ 20 ps LGAD performance at 2.8m:

π/K 0.1~**4**

K/p 0.1~**7** GeV

PID performance $1/\beta$ vs. p



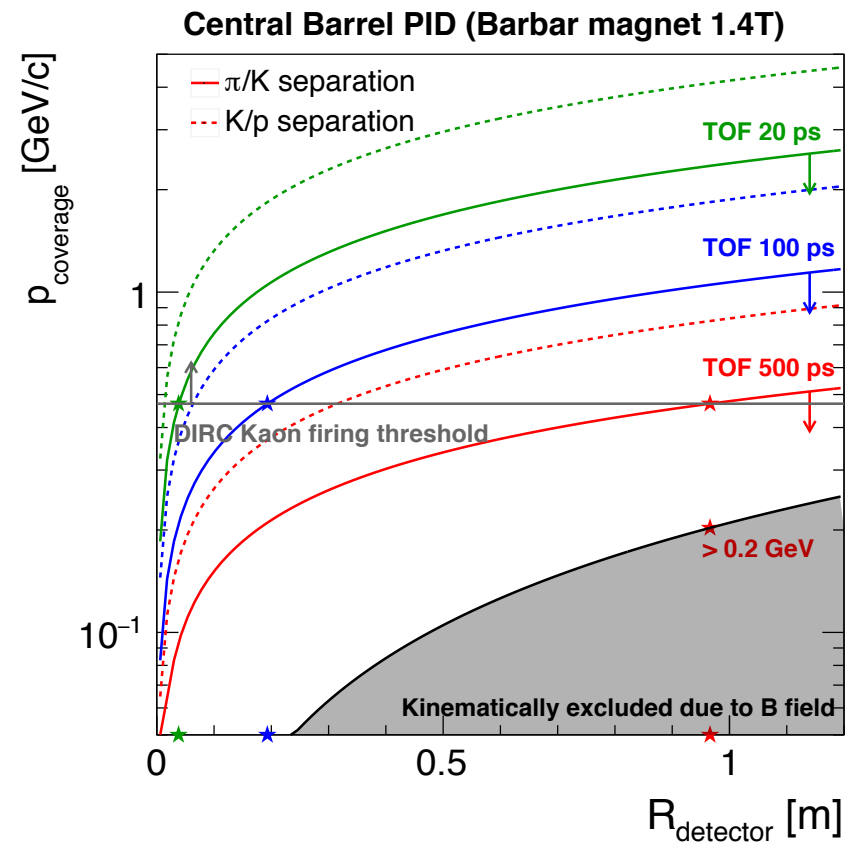
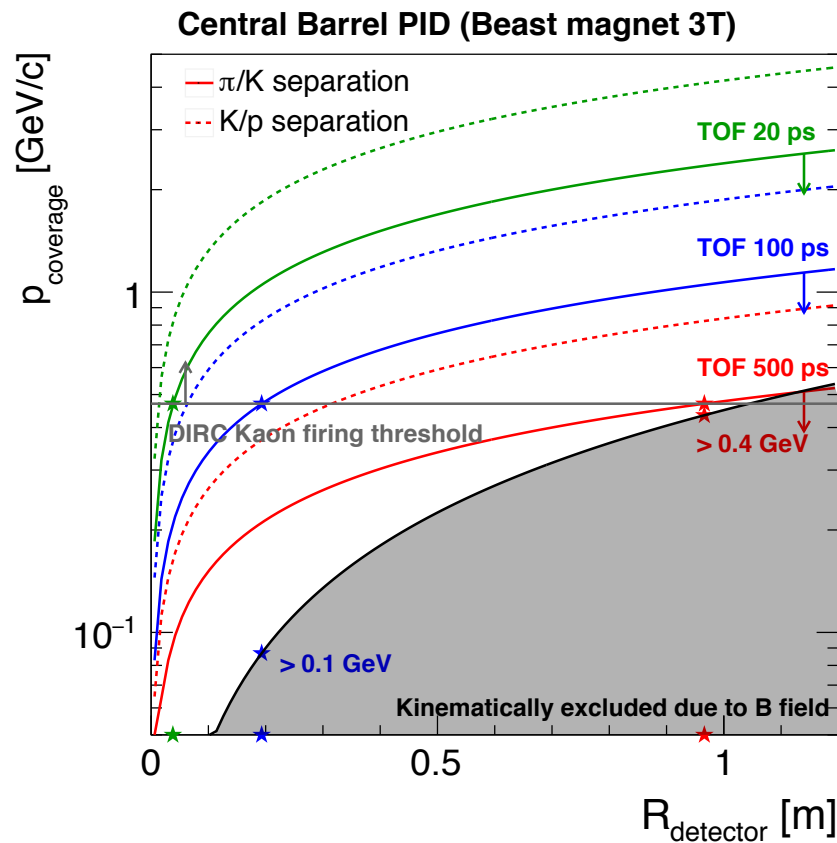
- ❖ Extrapolate TOF (radial position R , timing resolution Δt) high momentum reach $p_R, \Delta t$ at midrapidity

$$\begin{aligned}
 p_{L1}/p_{L2} &= \sqrt{L_2/L_1} \\
 p_{\Delta t1}/p_{\Delta t2} &= \sqrt{\Delta t_2/\Delta t_1}
 \end{aligned}
 \longrightarrow
 \begin{aligned}
 p_{R, \Delta t} &= p_{2.8m, 20ps} \cdot \sqrt{R/2.8} \cdot \\
 &\quad \sqrt{20ps/\Delta t}
 \end{aligned}$$

TOF at midrapidity?

- ❖ Estimated TOF performance (500 ps, 100 ps and 20 ps) as function of radial position
- ❖ One needs to be very careful with the low momentum cutoff due to the strong B field (especially 3T)

$$p_T [\text{GeV}/c] = 0.3 \cdot B [\text{T}] \cdot r/2 [\text{m}]$$



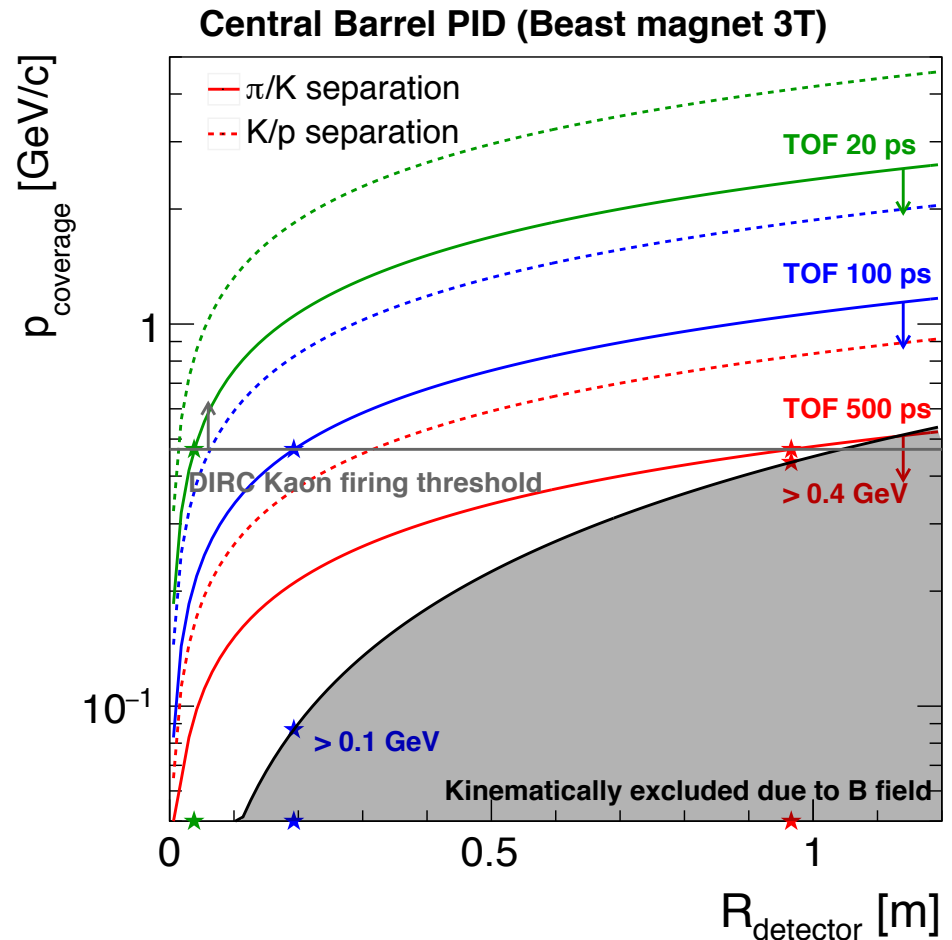
low p PID at midrapidity for 3T

NO PID (DIRC, TOF, dE/dx) detector
~1m can identify particles below 0.4
GeV in the mid-rapidity!

If one want to use dE/dx (cluster
counting) or TOF to cover low p, it
needs to sits at a smaller R (<30cm if
one want PID ~0.1 GeV)

~100ps TOF can cover the p range
below DIRC firing threshold if put
>20cm (STAR TOF seem to offer
similar resolution)

20ps LGAD can be put even closer
(<10 cm) to cover the p range below
DIRC firing threshold (put in between
MAPs layers?)



- The smaller the cheaper
- Additional material inside trackers additional M.S.

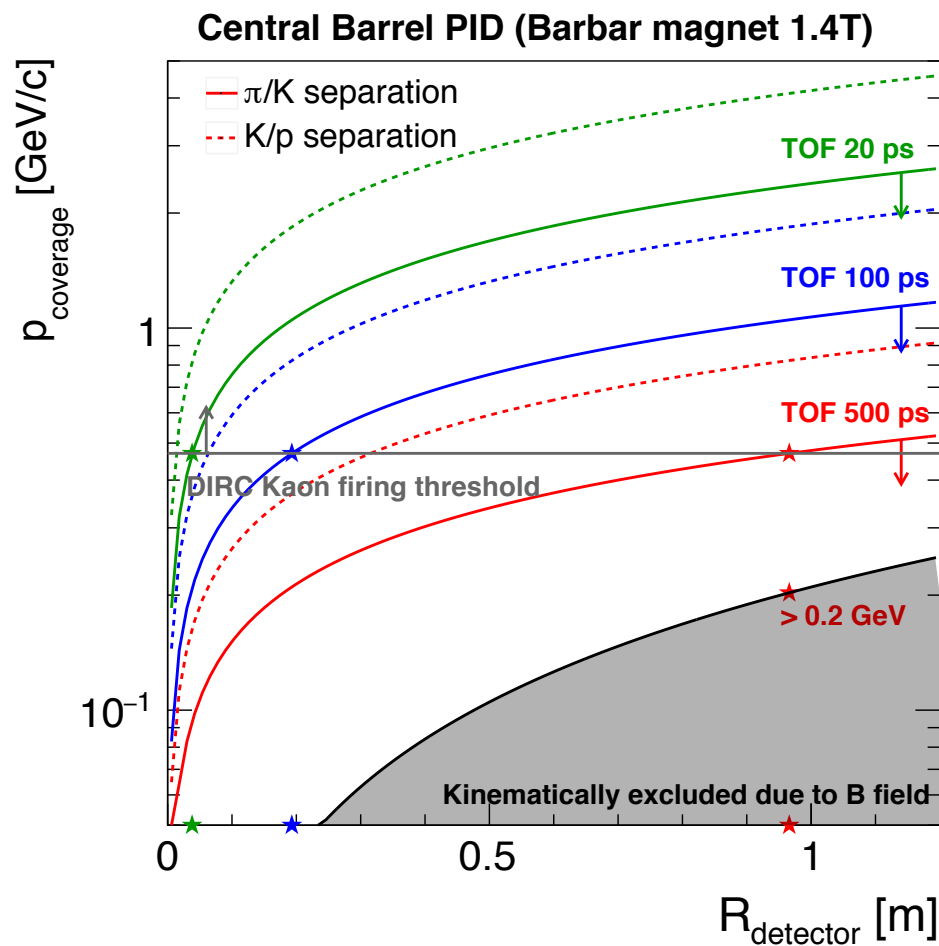
low p PID at midrapidity for 1.4T

Easier to perform low p PID (DIRC, TOF, dE/dx): can 0.2 GeV particles can reach detector ~1m

If one want to use dE/dx (cluster counting) or TOF to cover low p, it needs to sits at a moderate R (<50cm if one want PID ~0.1 GeV)

~100ps TOF sitting 20-50cm can cover 0.1 GeV to DIRC firing threshold

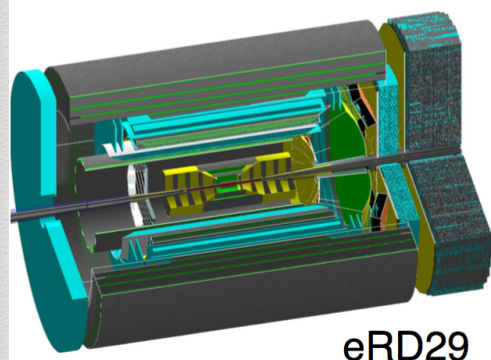
20ps LGAD 5-50cm can cover 0.1 GeV to DIRC firing threshold



Full-sim results from RICE group

Contributions you can bring to the PID activity towards the proposal in the next months.

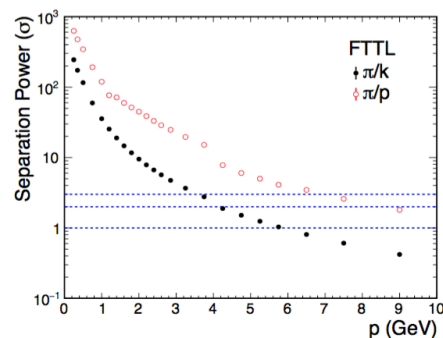
If pursuing PID with TOF, Rice group (and potentially others groups in the LGADs consortium) can contribute to implement the design, perform full simulations, assess impact on physics performance, cost estimate etc.



eRD29

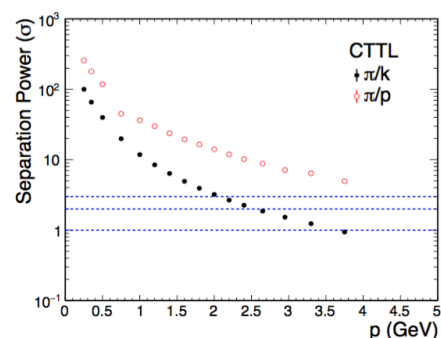
LGADs timing layers
in Fun4All (B=1.5T)

Forward:
2 layers at $z \sim 2.8$ m
(behind dRICH)



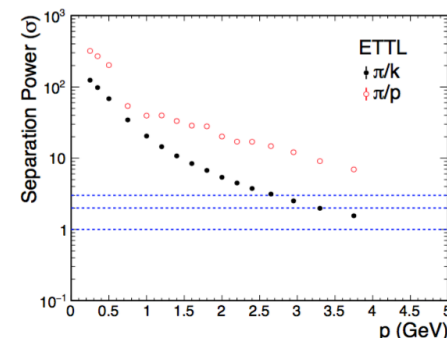
0.2-4 GeV

Central:
1 layer at $r \sim 0.9$ m



0.2-2.5 GeV

Backward:
2 layers at $z \sim -1.5$ m



0.2-3 GeV

All uncertainties (t_0 , t_f , L) included

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https://github.com/eic/fun4all_eicmacros/blob/master/common/G4_TTL_EIC.C

https://github.com/eic/fun4all_eicmacros/blob/master/detectors/Modular/Fun4All_G4_FullDetectorModular.C