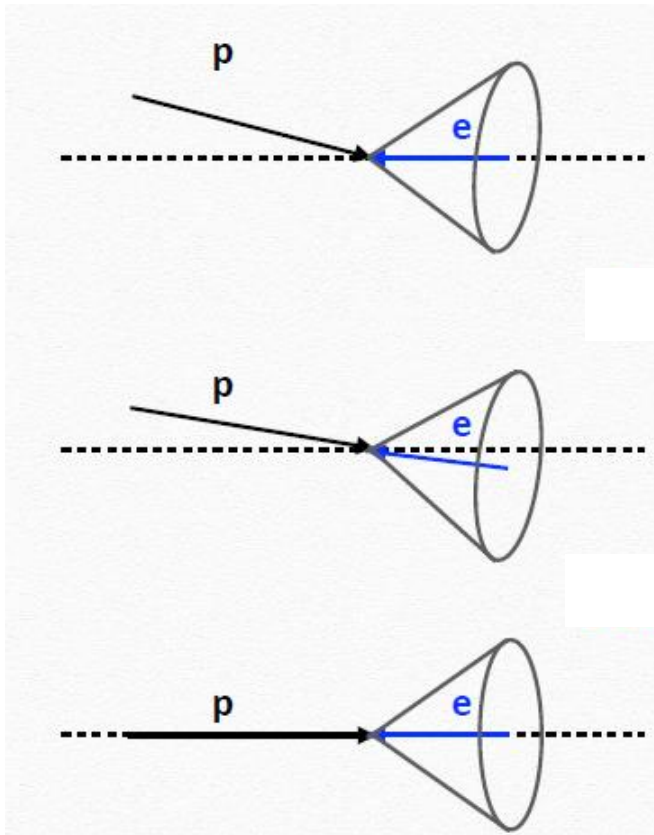


Calculations of crossing angle effects on kinematics

Barak Schmookler

with help from Wenqing Fan (LBNL)

'After-burner' setup



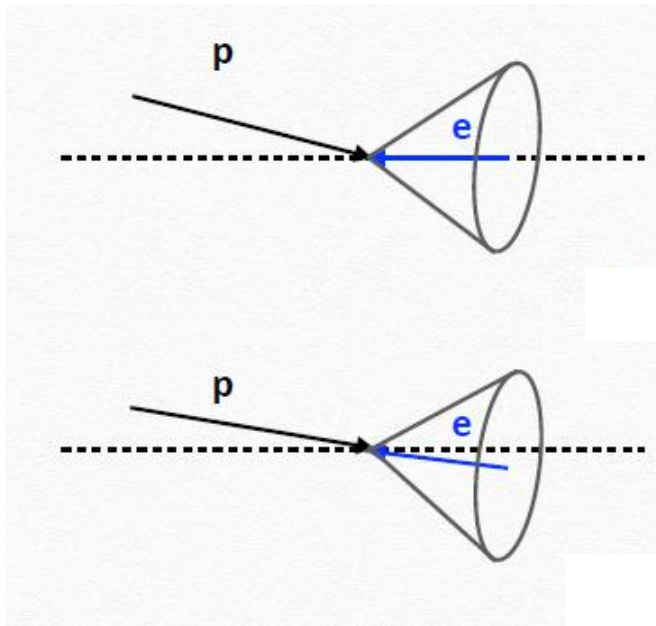
Boost

Rotation

$$p_i = E_p(\sin \theta, 0, \cos \theta, 1)$$

$$e_i = E_e(0, 0, -1, 1)$$

Boost calculation



Boost

$$p_i = E_p(\sin \theta, 0, \cos \theta, 1)$$

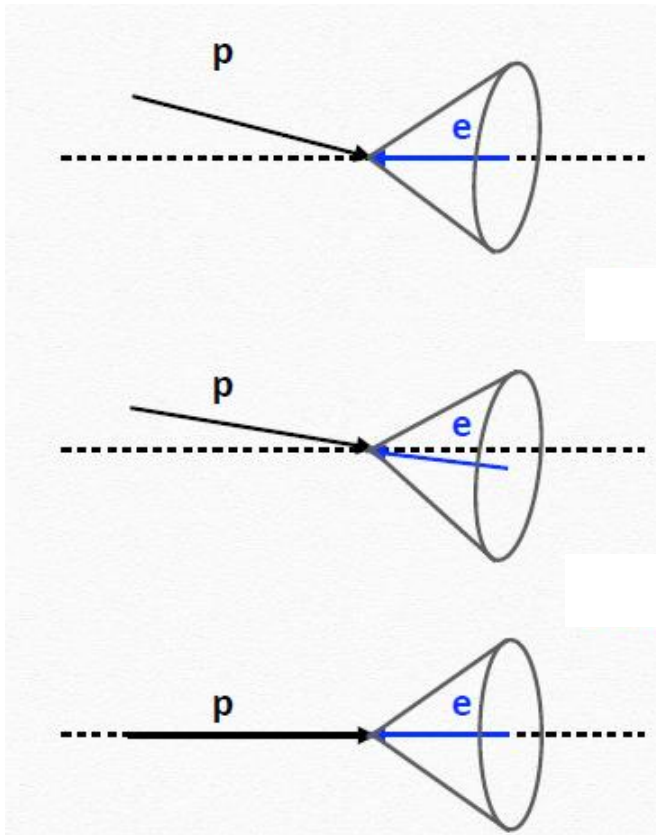
$$e_i = E_e(0, 0, -1, 1)$$

$$b = \left(\frac{\sin \theta}{2}, 0, \frac{\cos \theta - 1}{2} \right) \approx (\theta/2, 0, -\theta^2/4)$$

First-Order Matrix

$$L_b = \begin{bmatrix} 1 & -\theta/2 & 0 & 0 \\ -\theta/2 & 1 & 0 & 0 \\ 0 & 0 & 1 & 0 \\ 0 & 0 & 0 & 1 \end{bmatrix}$$

Boost + Rotation calculation



Boost

Rotation

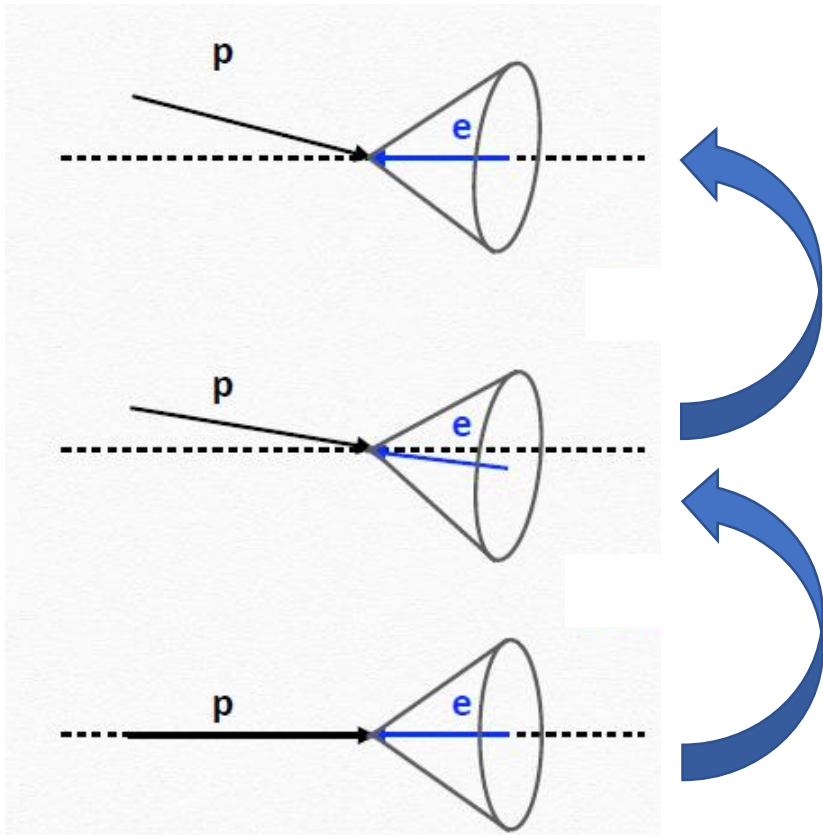
$$p_i = E_p(\sin \theta, 0, \cos \theta, 1)$$

$$e_i = E_e(0, 0, -1, 1)$$

First-Order Matrix

$$L_{b+r} = \begin{bmatrix} 1 & -\theta/2 & 0 & 0 \\ -\theta/2 & 1 & 0 & -\theta/2 \\ 0 & 0 & 1 & 0 \\ 0 & \theta/2 & 0 & 1 \end{bmatrix}$$

Inverse Boost + Rotation calculation



Boost

First-Order Matrix

$$L_{b+r}^{-1} = \begin{bmatrix} 1 & \theta/2 & 0 & 0 \\ \theta/2 & 1 & 0 & \theta/2 \\ 0 & 0 & 1 & 0 \\ 0 & -\theta/2 & 0 & 1 \end{bmatrix}$$

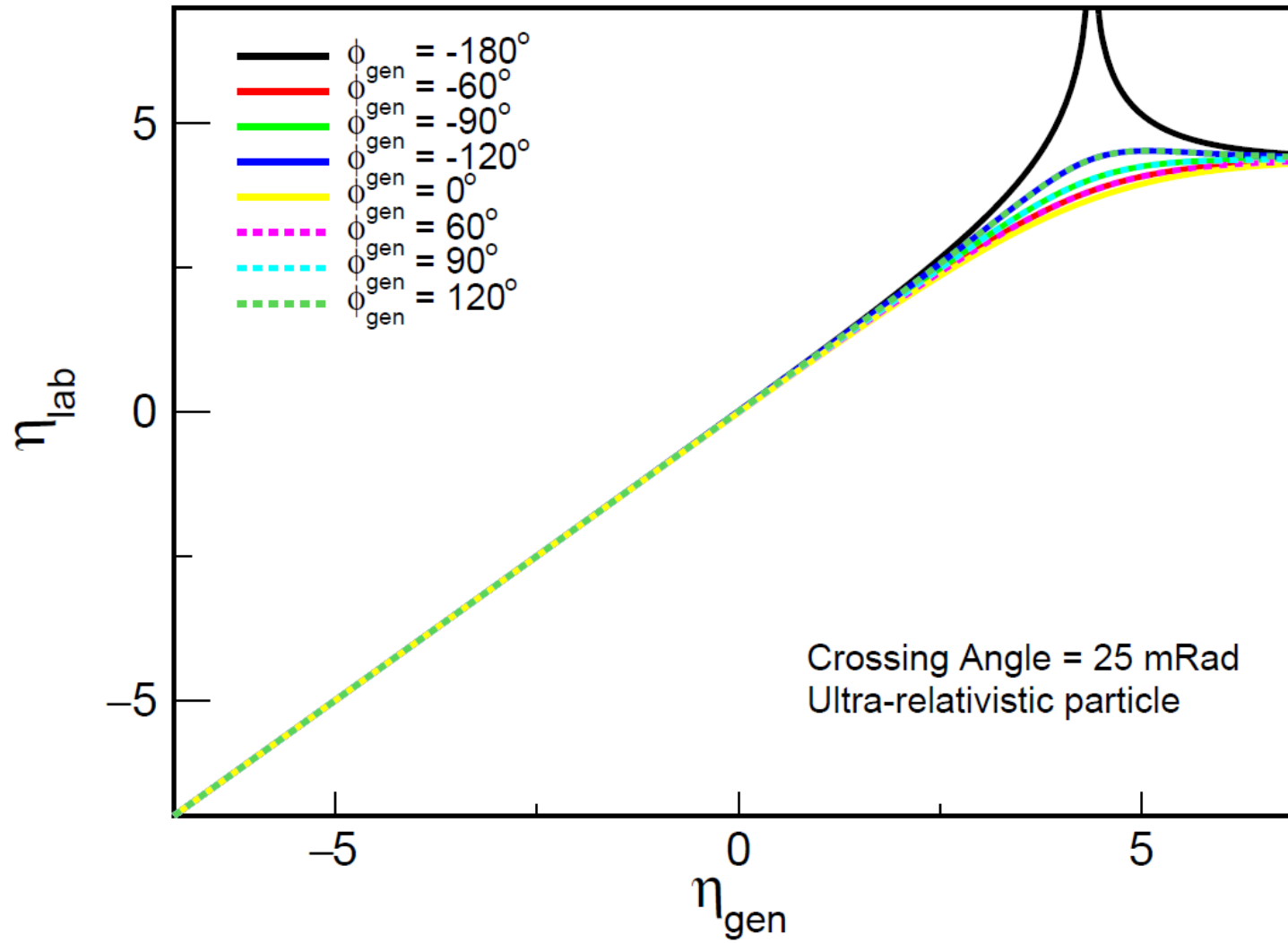
Rotation

$$\begin{bmatrix} E \\ p_x \\ p_y \\ p_z \end{bmatrix}_{lab} = L_{b+r}^{-1} \begin{bmatrix} E \\ p_x \\ p_y \\ p_z \end{bmatrix}_{colinear}$$

Can directly calculate 4-vector in lab frame for any particle in colinear frame. For ultra-relativistic particles (mass \sim 0), the only relevant variables are η and ϕ .

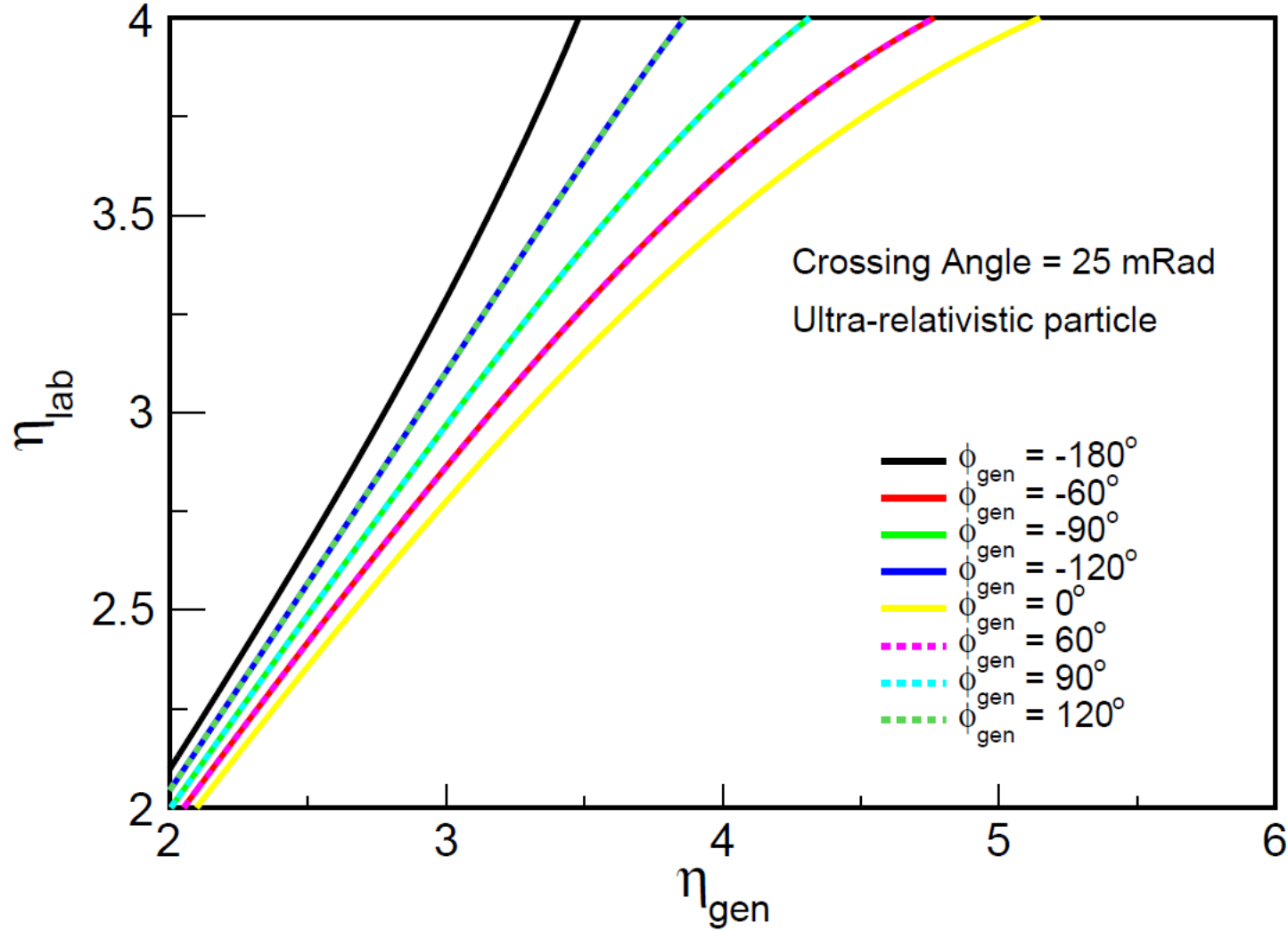
Lab vs. Colinear frame kinematics

η_{lab} is calculated with respect to +z (anti-parallel) to incoming electron beam.



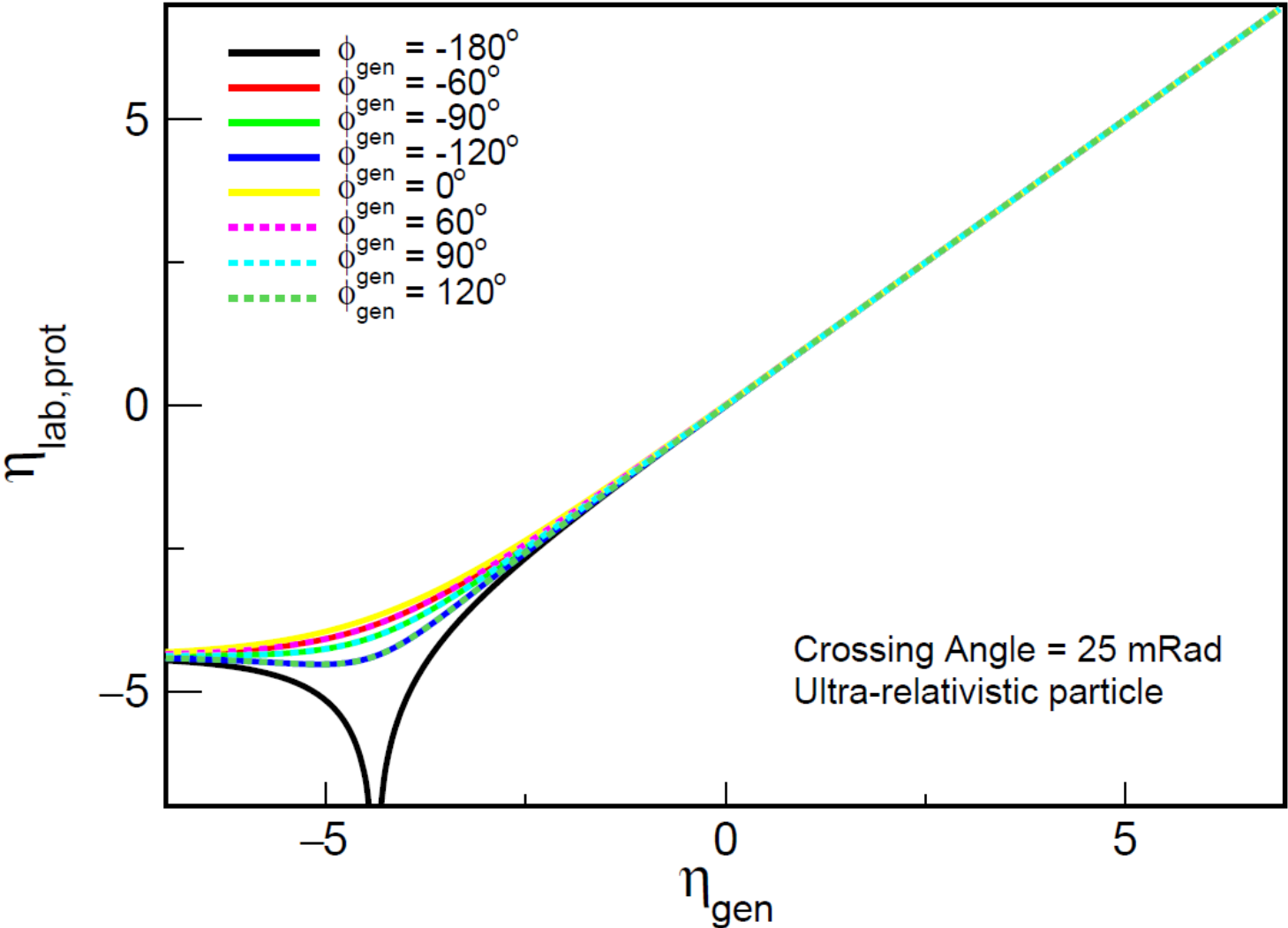
Lab vs. Colinear frame kinematics – zoomed in

η_{lab} is calculated with respect to +z (anti-parallel) to incoming electron beam.



Acceptance cut of $\eta_{\text{lab}} < +4$ leads to a ϕ dependent acceptance in the colinear frame.

What if we calculate η_{lab} with respect to incoming proton beam?

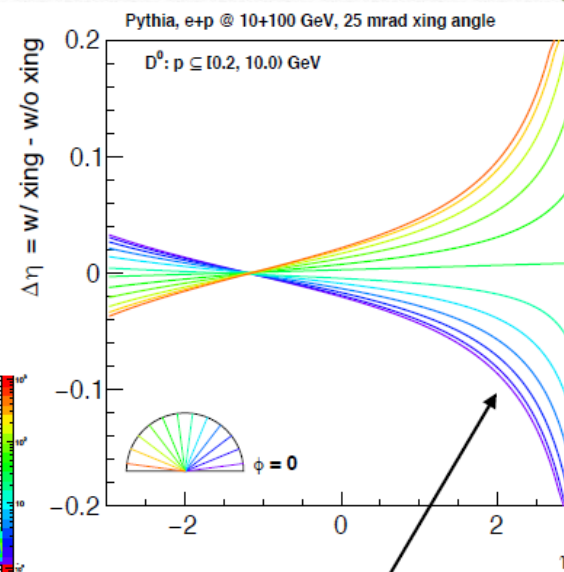
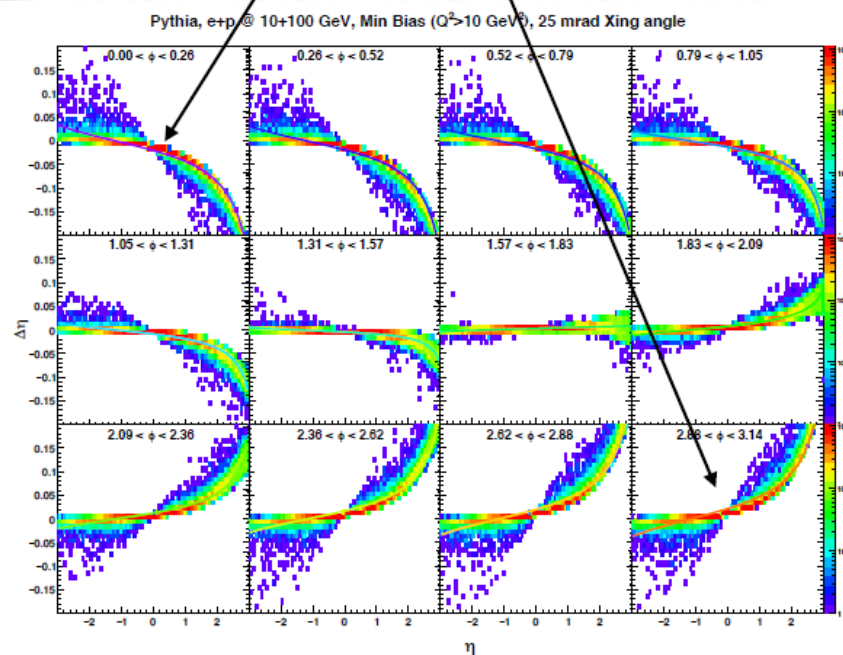


Acceptance cut of $\eta_{lab,prot} < +4$ does **not** lead to a ϕ dependent acceptance in the colinear frame.

Fun4All after-burner studies

D^0 η shift with Xing angle

Larger effect along x axis

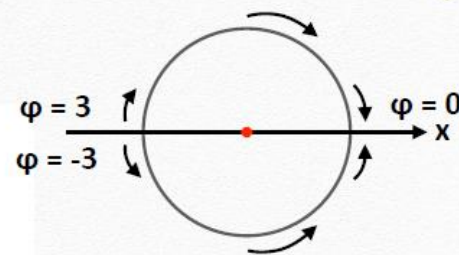
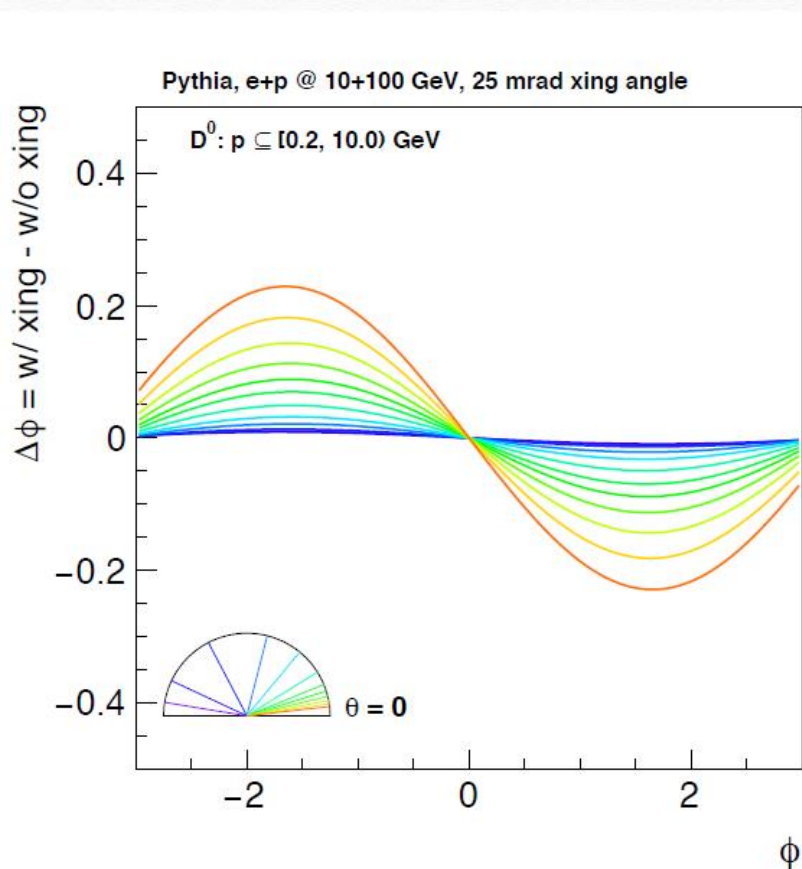


Larger effect at very forward rapidity

Slide from Wenqing Fan (LBNL)

Fun4All after-burner studies

D^0 ϕ shift with Xing angle

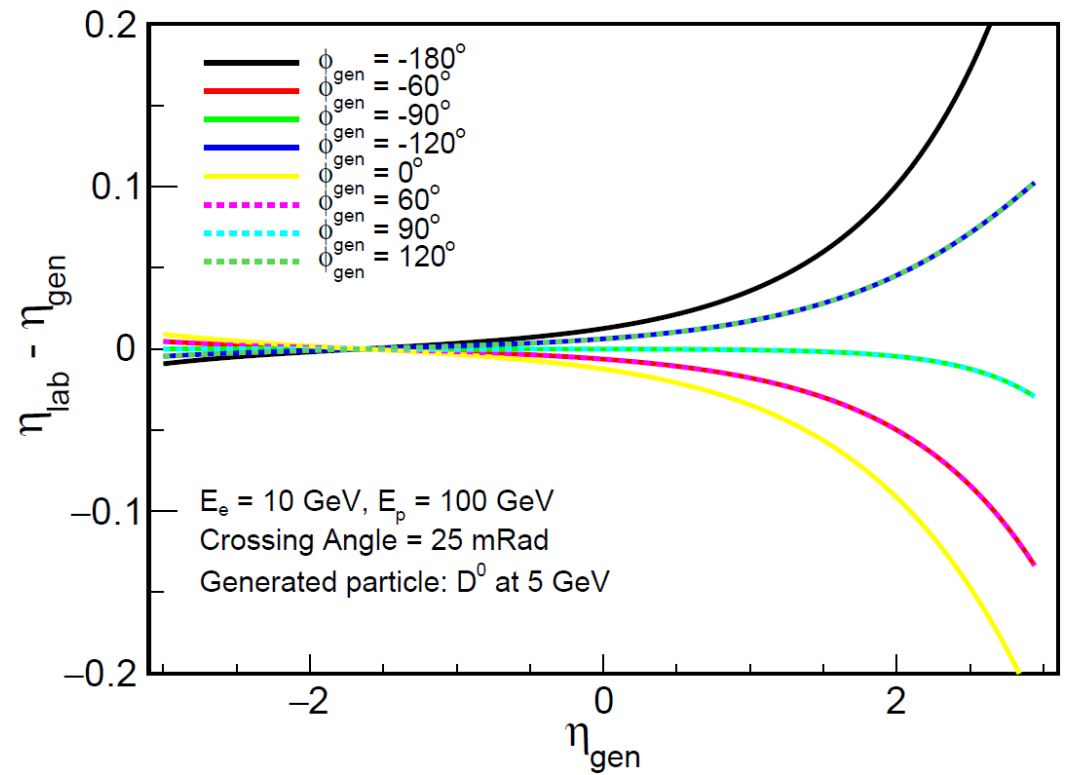
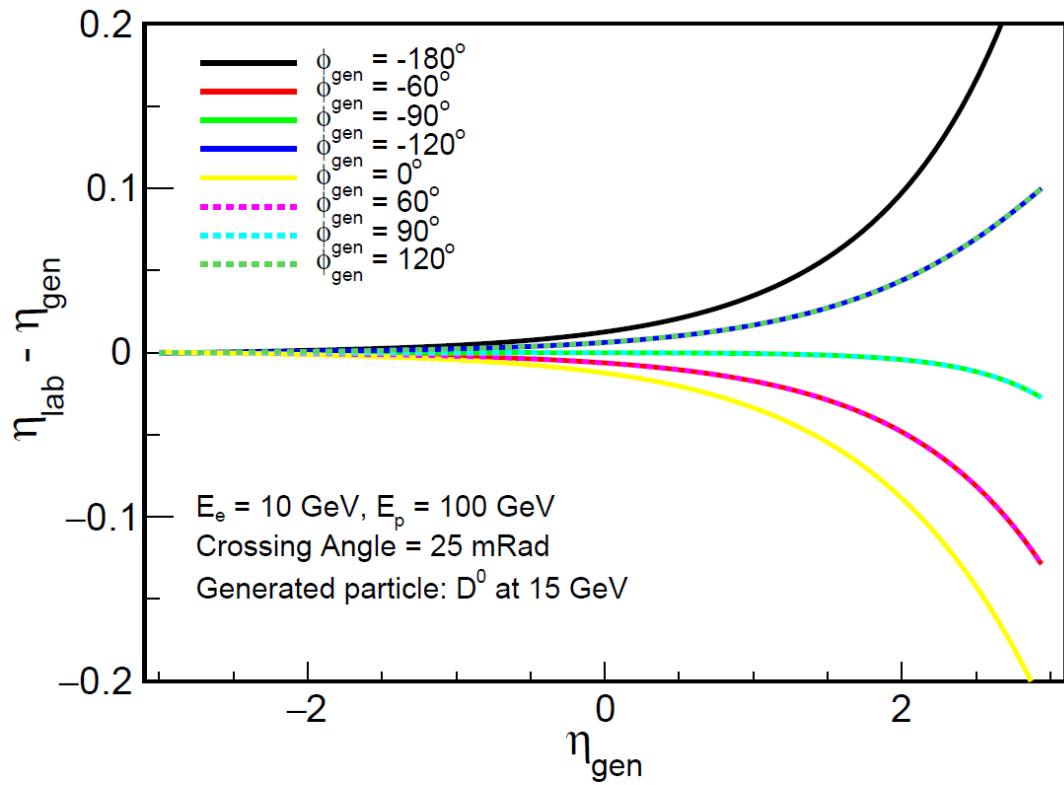


Such shift will create an
“artificial” azimuthal
anisotropy of the
outgoing particles

Correctable as long as
one boost back to head
on event by event

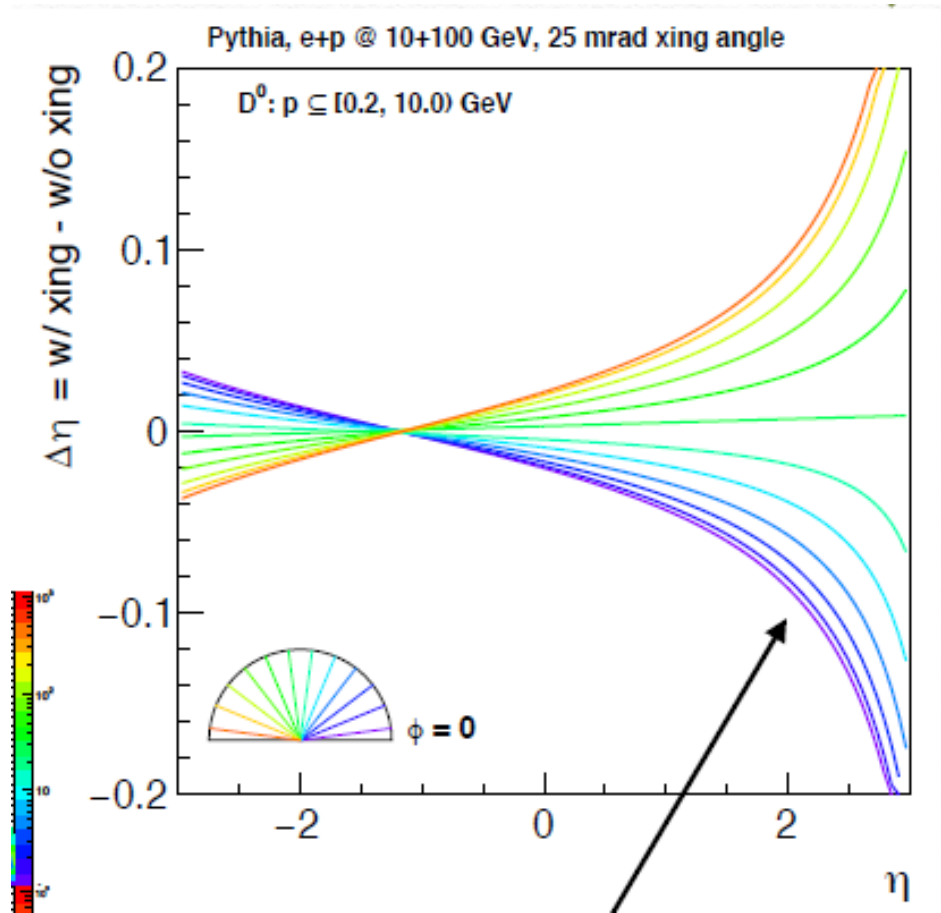
Slide from Wenqing Fan (LBNL)

D⁰ distribution depends on momentum – calculation

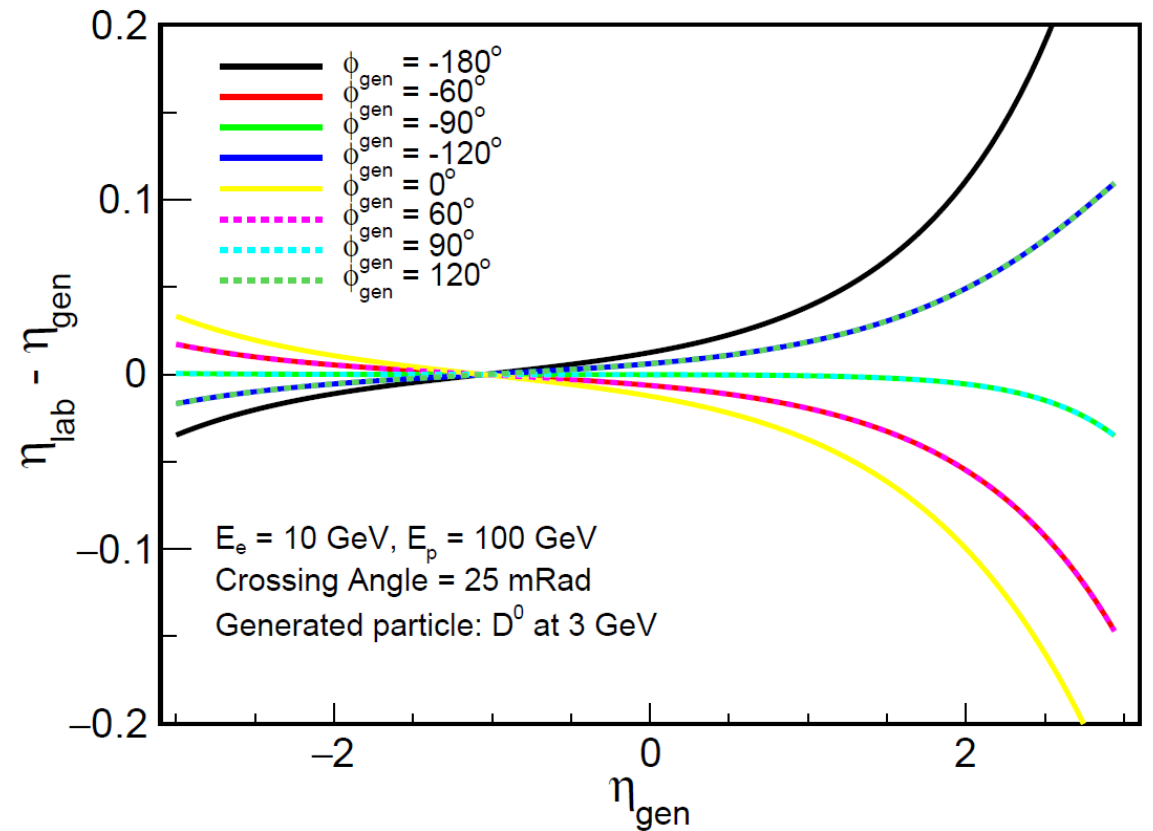


Comparison of *Fun4All* and calculation

Fun4All – average momentum ~ 3 GeV/c

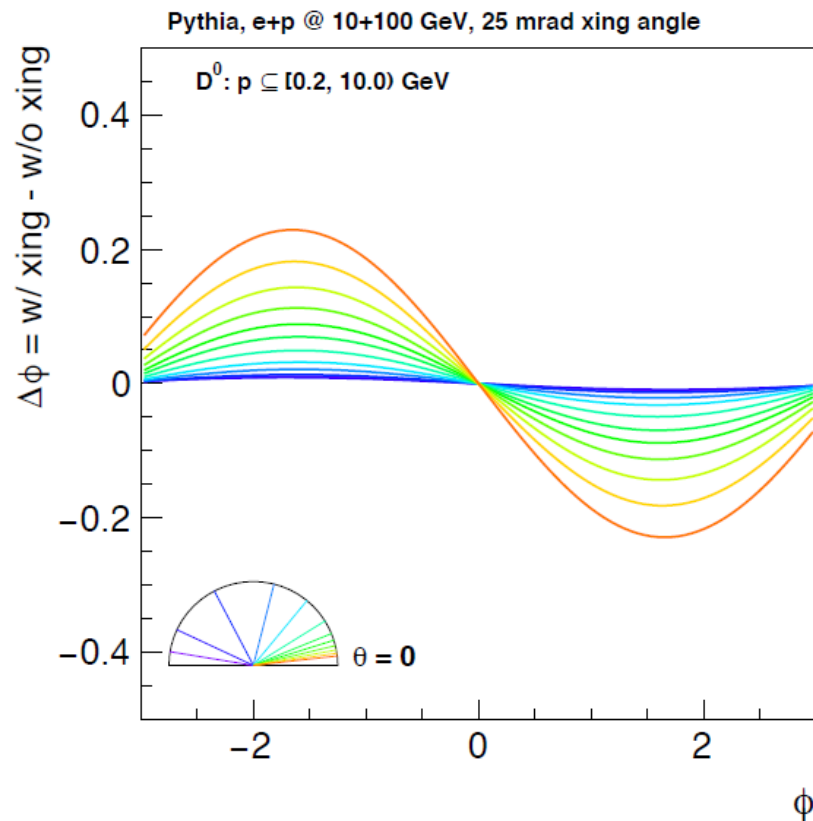


Calculation



Comparison of *Fun4All* and calculation

Fun4All – average momentum ~ 3 GeV/c



Calculation

