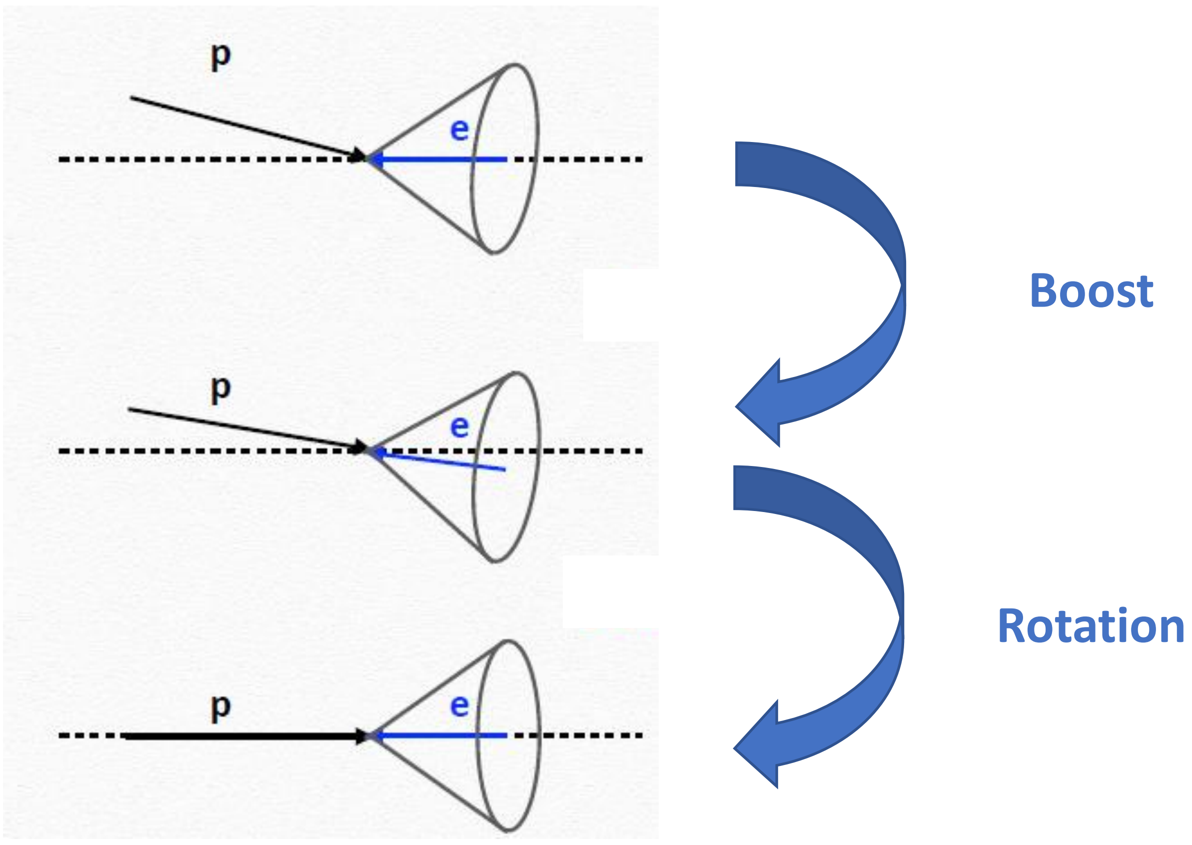
Calculations of crossing angle effects on kinematics

Barak Schmookler

with help from Wenqing Fan (LBNL)

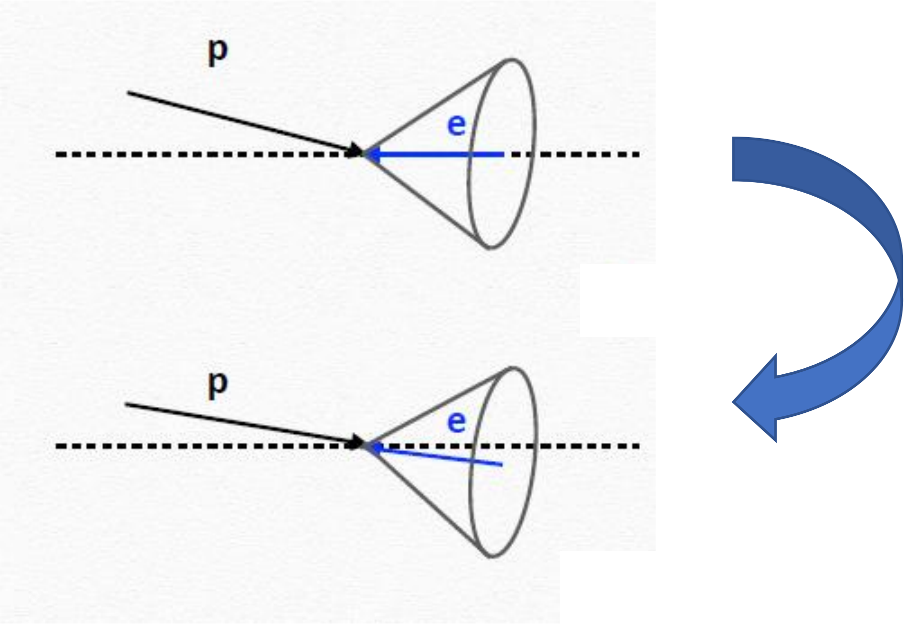
'After-burner' setup



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

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

Boost calculation



Boost

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

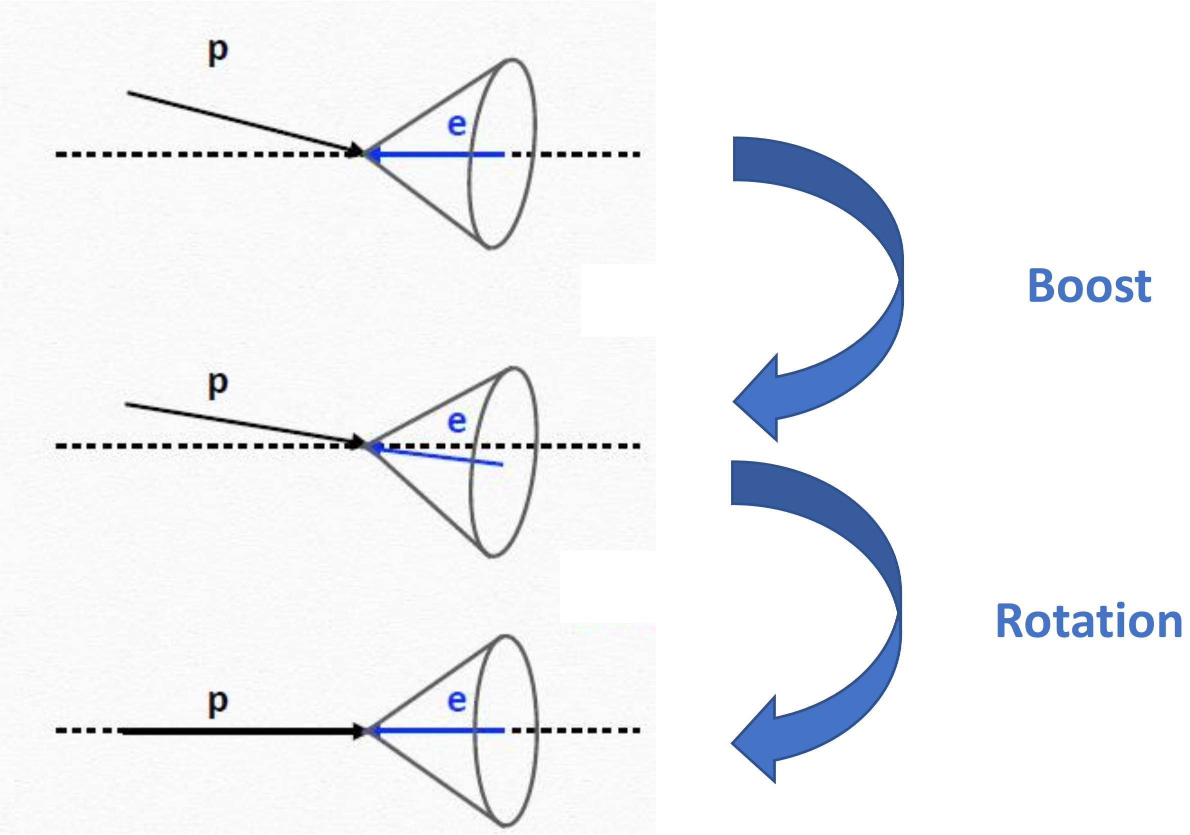
$$e_i = E_e(0, 0, -1, 1)$$

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

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

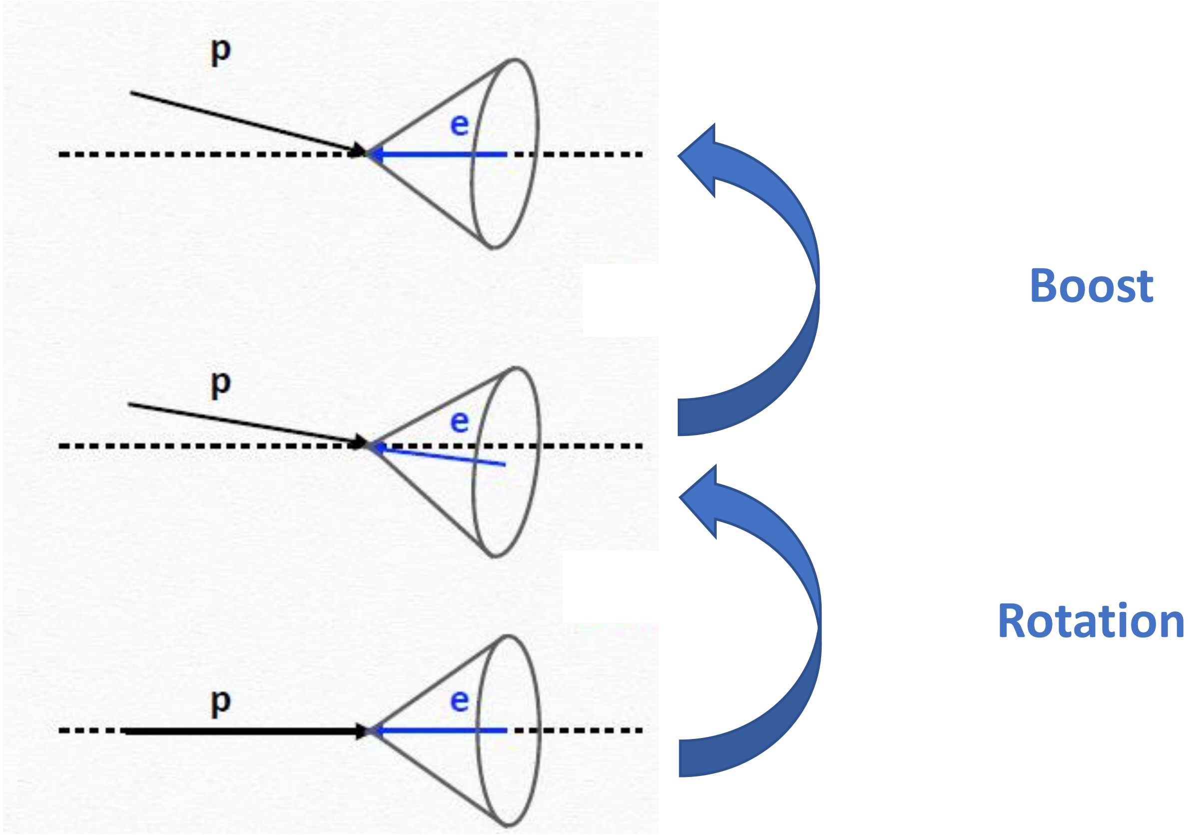


$$p_i = E_p(\sin\theta, 0, \cos\theta, 1)$$

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

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



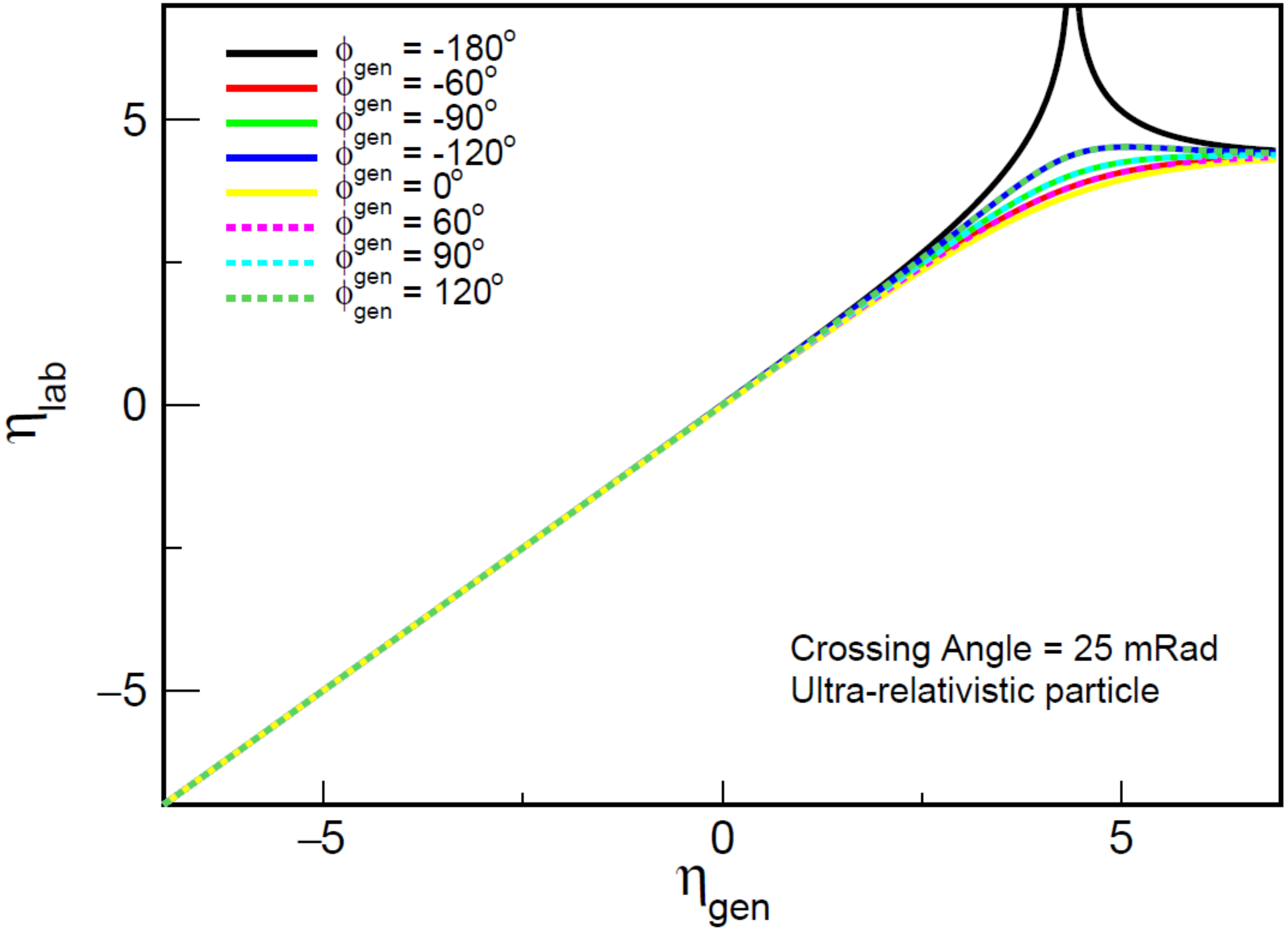
First-Order Matrix $L_{b+r}^{-1} = \begin{bmatrix} 1 & \theta/2 & 0 & 0 \\ \theta/2 & 1 & 0 & \theta/2 \\ 0 & 0 & 1 & 0 \\ 0 & -\theta/2 & 0 & 1 \end{bmatrix}$

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

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

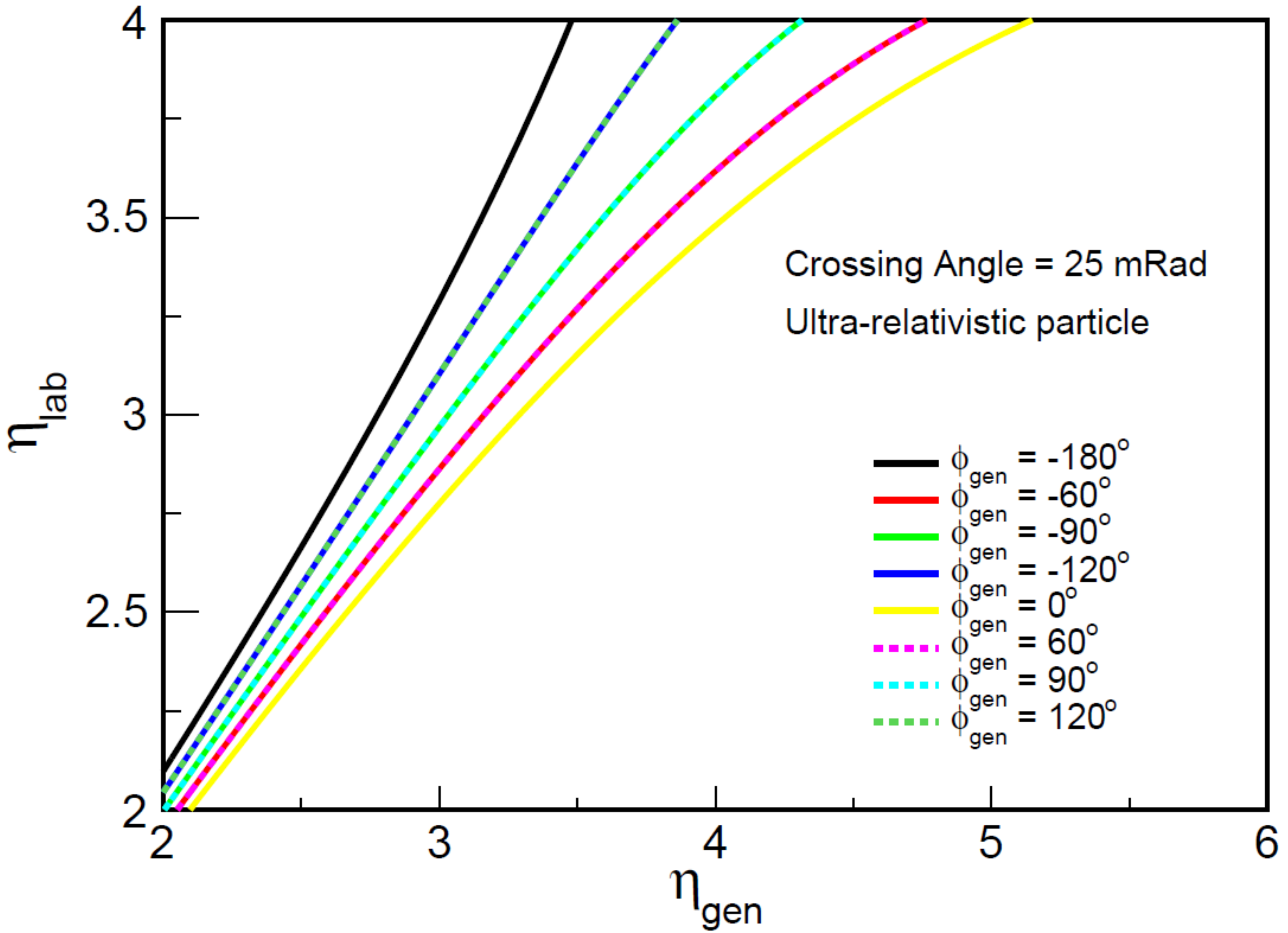
Lab vs. Colinear frame kinematics

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



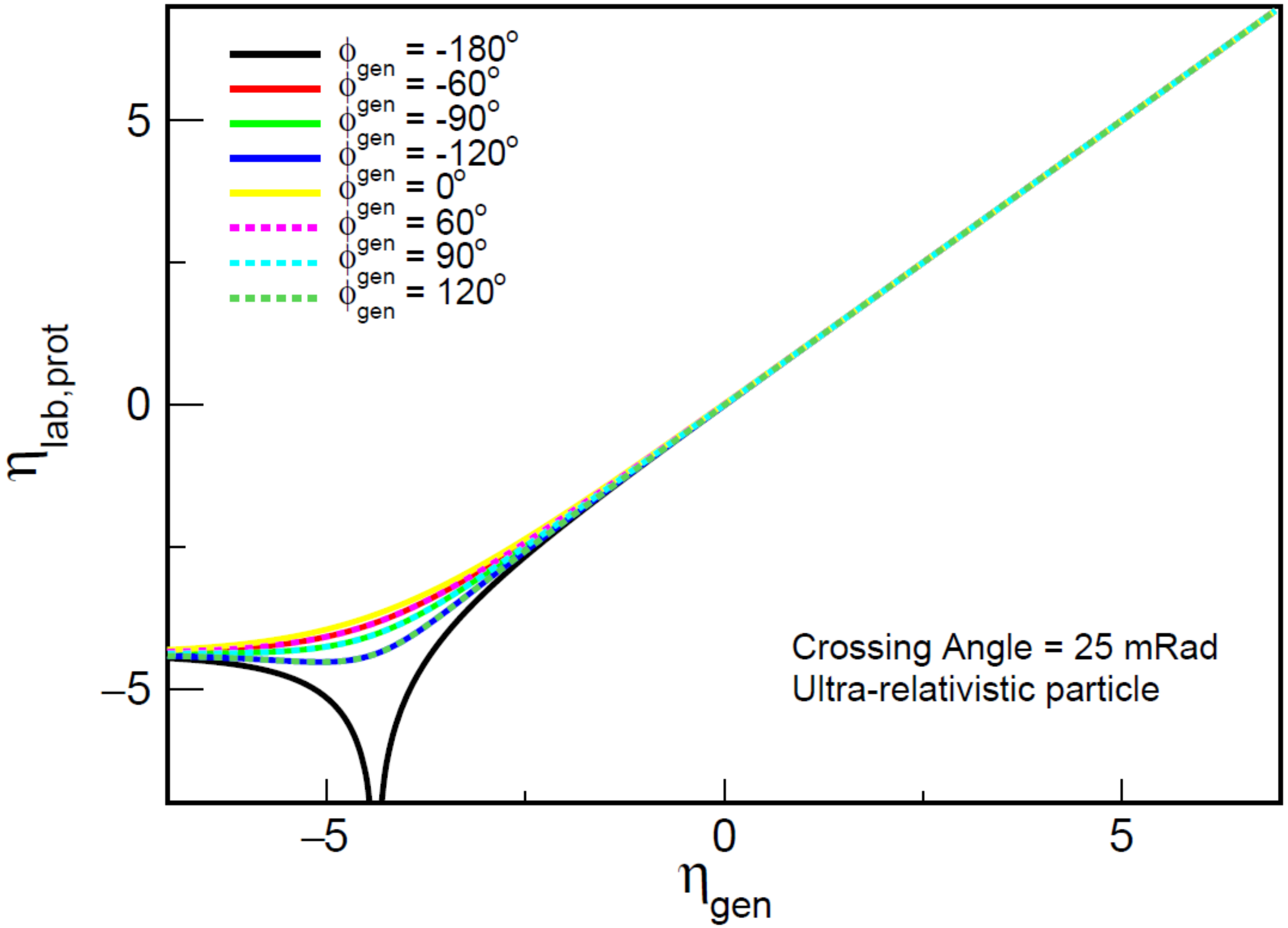
Lab vs. Colinear frame kinematics – zoomed in

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



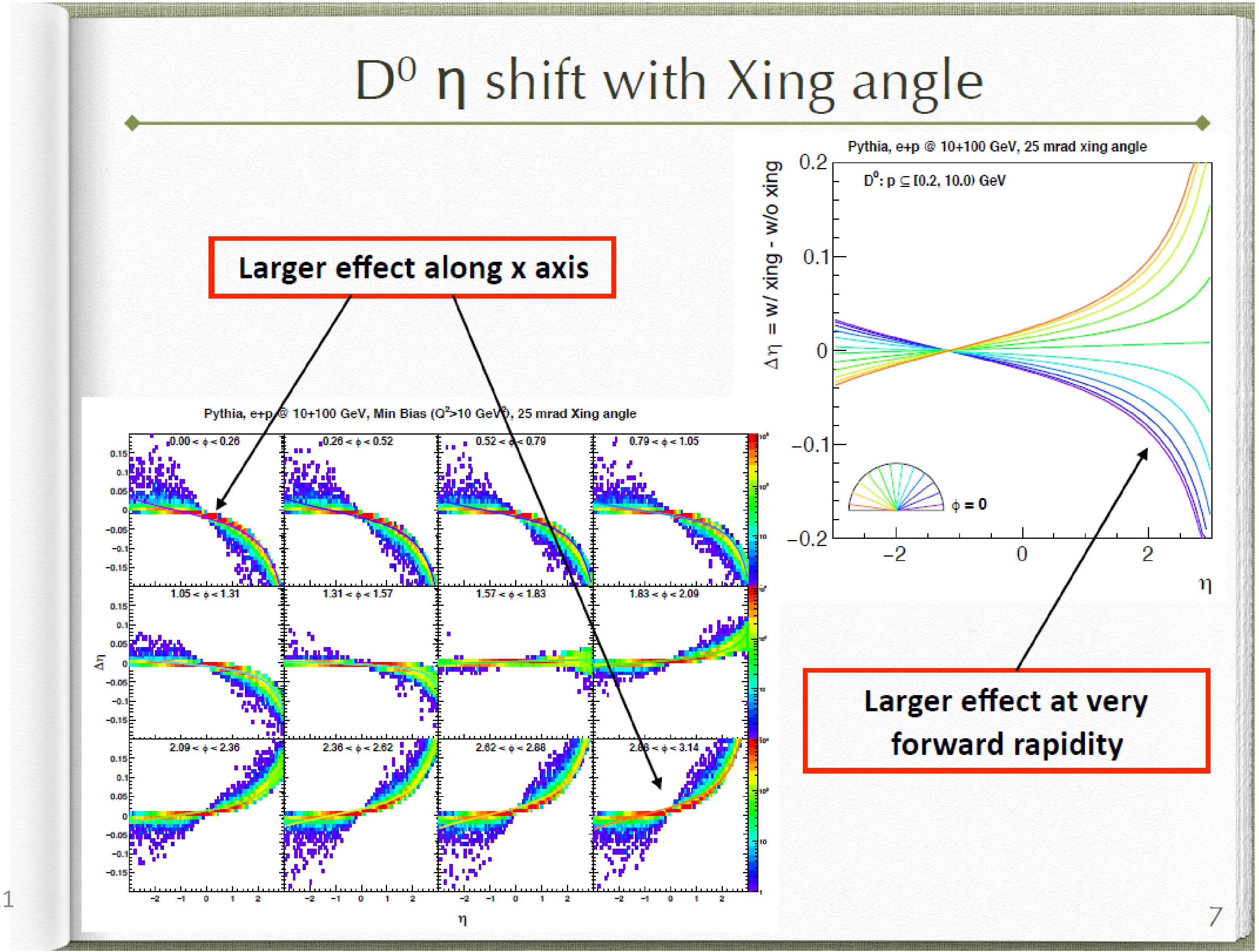
Acceptance cut of $\eta_{lab} < +4$ leads to a ϕ dependent acceptance in the colinear frame.

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



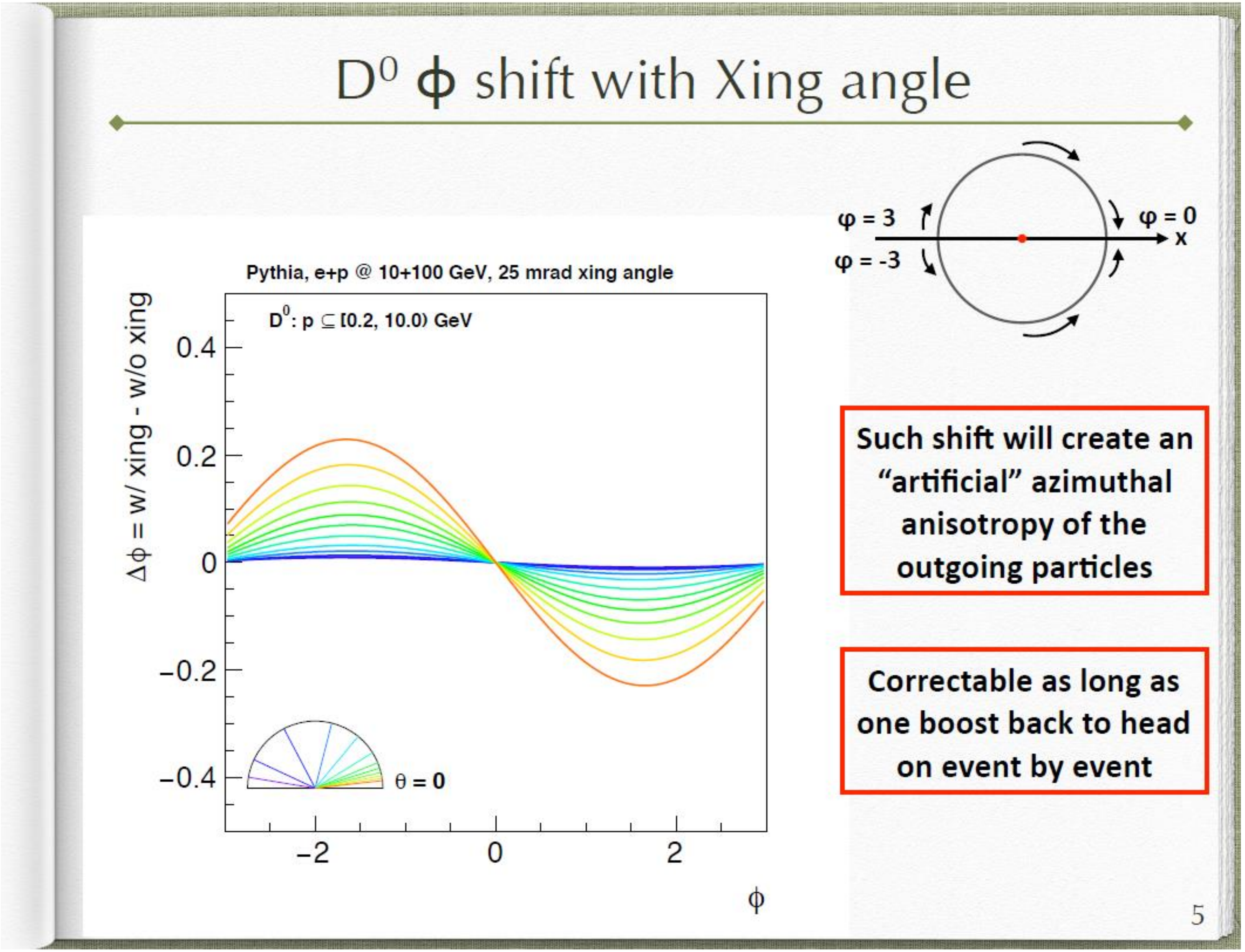
Acceptance cut of $\eta_{lab,prot}$ < +4 does **not** lead to a ϕ dependent acceptance in the colinear frame.

Fun4All after-burner studies



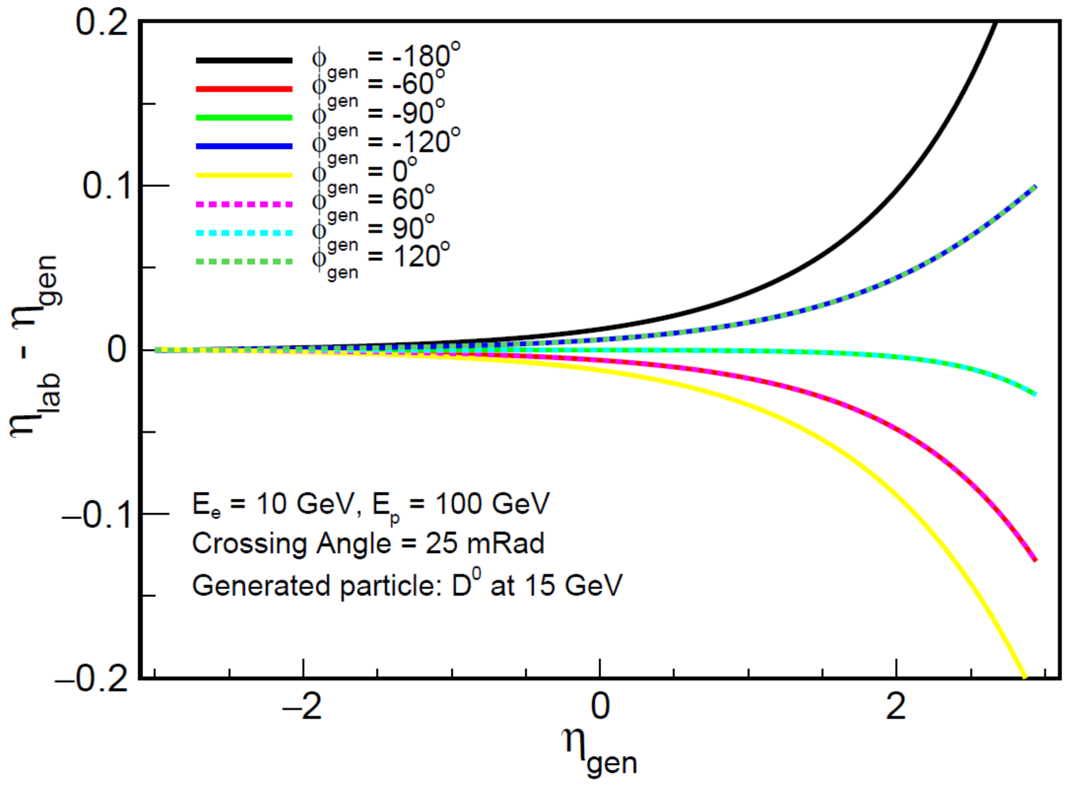
Slide from Wenqing Fan (LBNL)

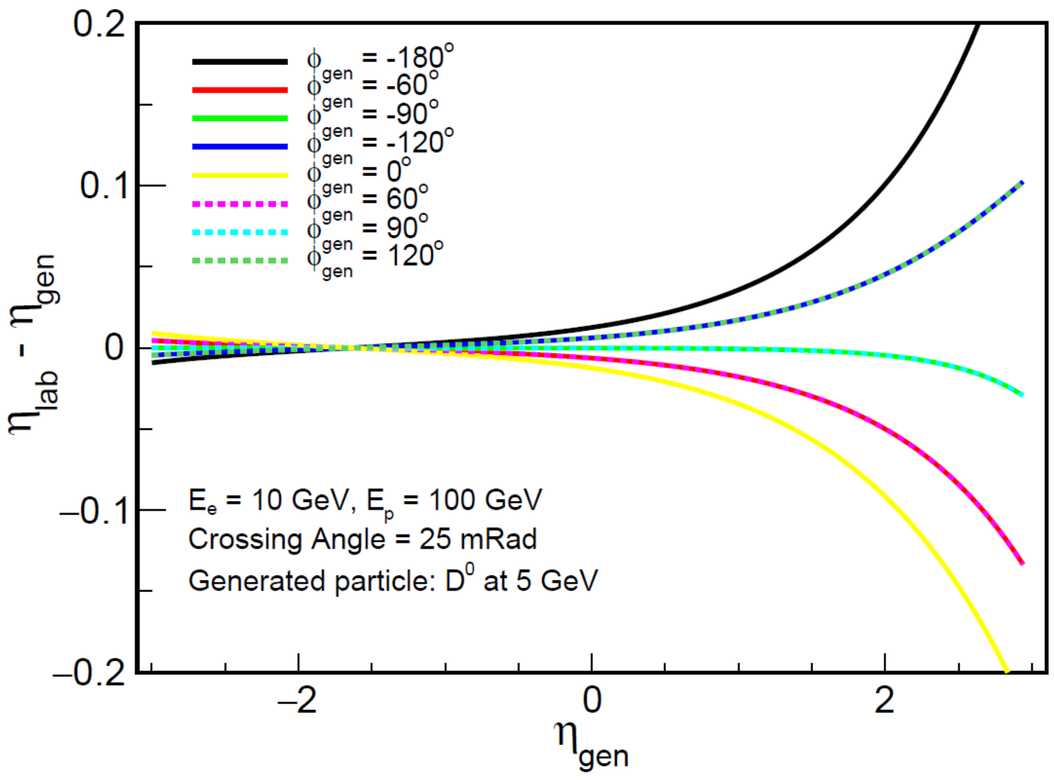
Fun4All after-burner studies



Slide from Wenqing Fan (LBNL)

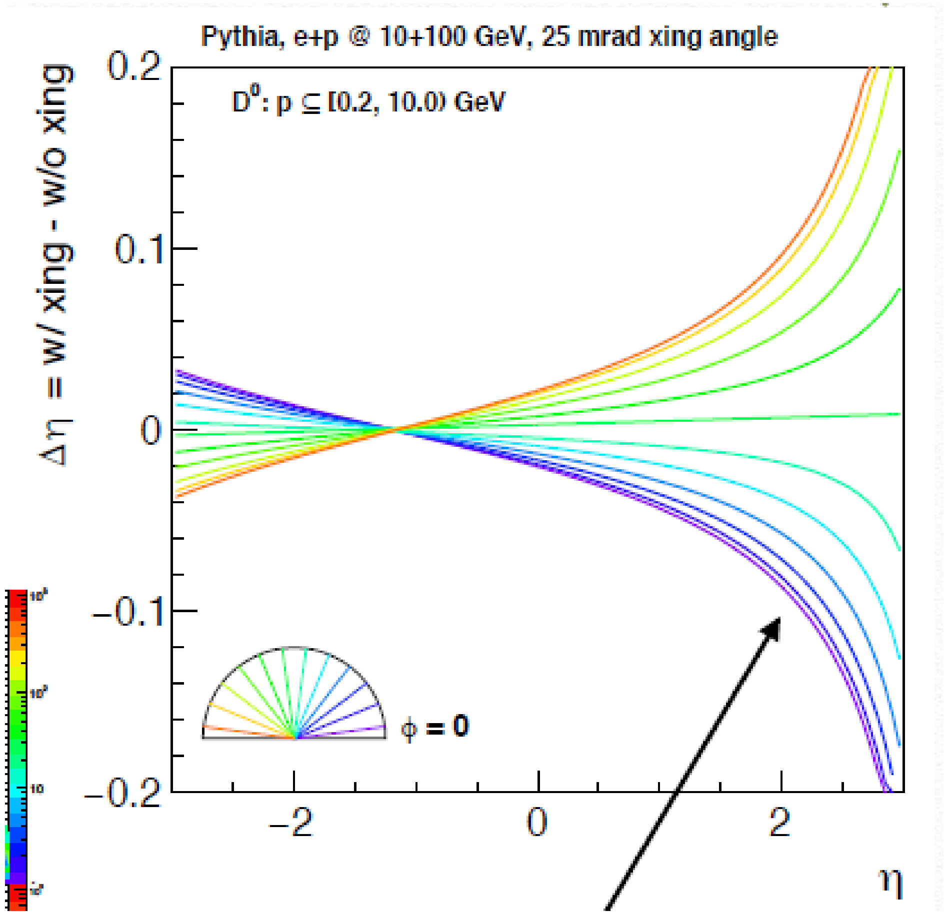
D^0 distribution depends on momentum – calculation



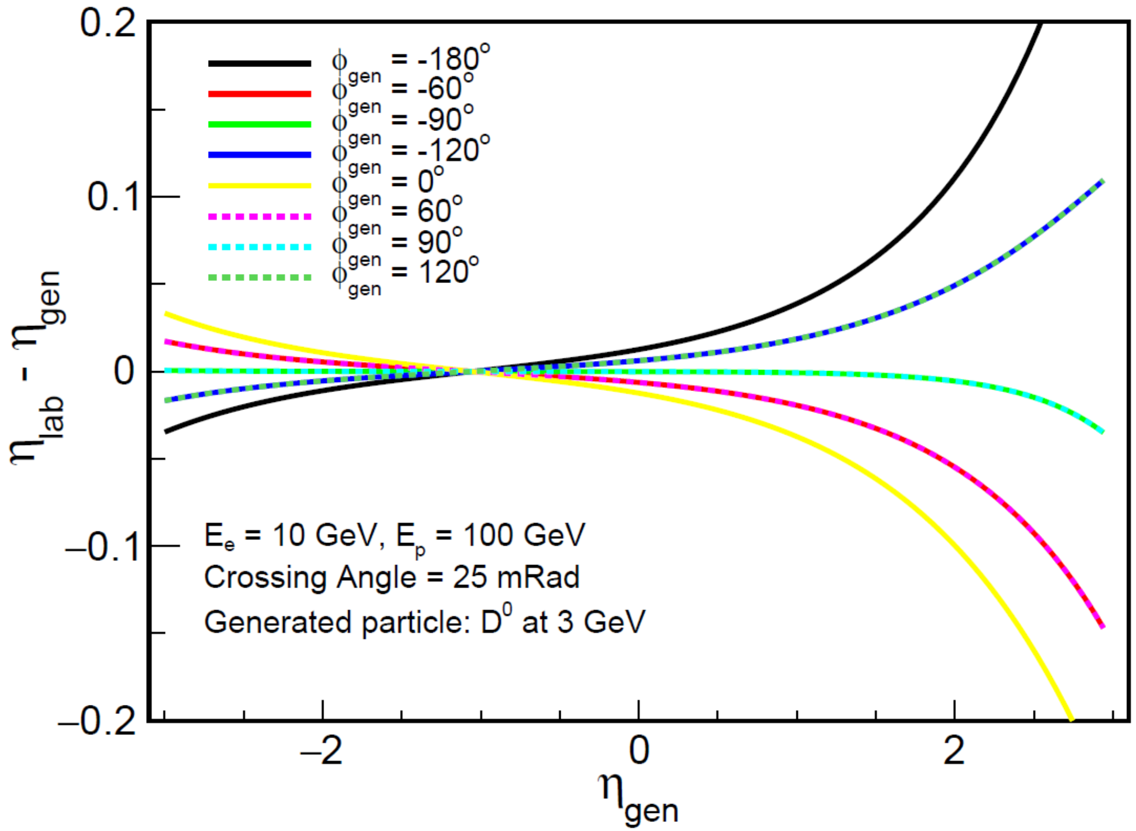


Comparison of *Fun4All* and calculation

Fun4All – average momentum ~ 3 GeV/c

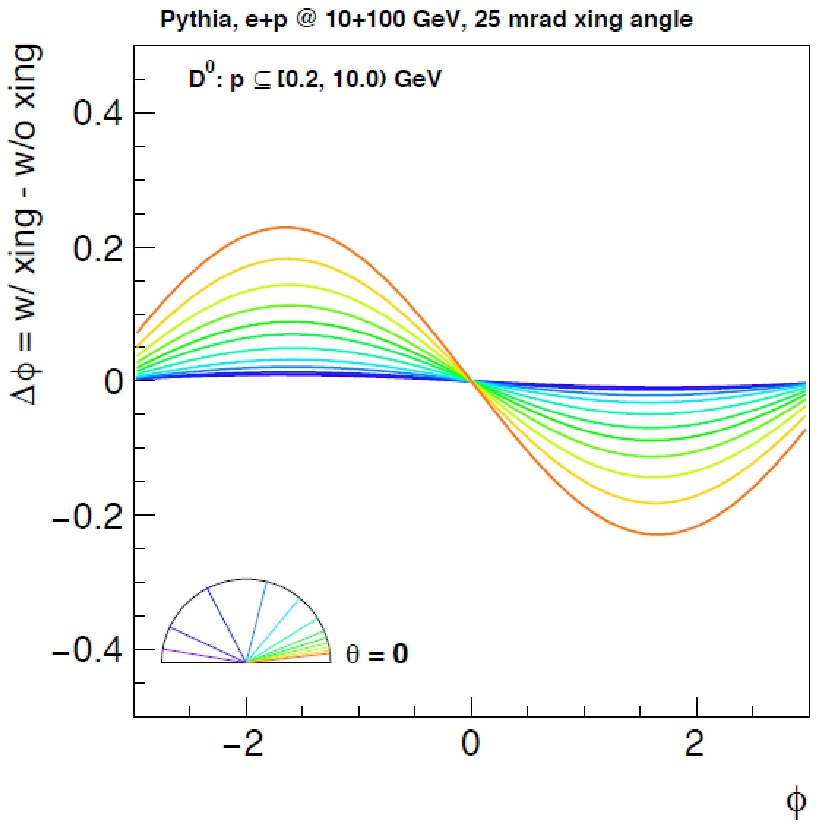


Calculation



Comparison of *Fun4All* and calculation

Fun4All – average momentum ~ 3 GeV/c



Calculation