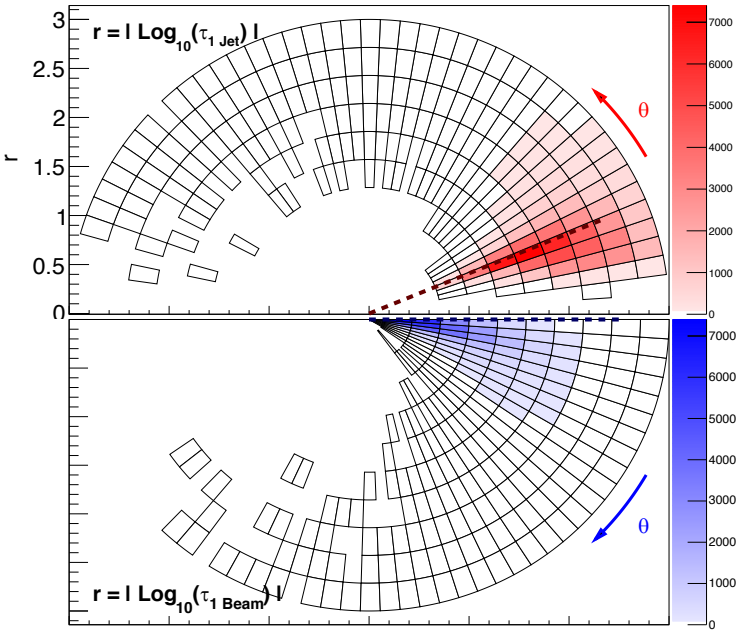
PID requirement for 1-jettiness type measurements: Extended eta coverage in forward region

E_p =275 GeV, E_e= 18 GeV

Event topology for τ_{1b}
at (x, Q^2) = (0.19, 371)



- 1-jettiness is a global event shape observable and wide η coverage is critical.
- At mid-to-large x and mid-to-high Q^2 region, jets are created in forward direction.
- In this region,
  - Q^2 resolution meets minimum requirement of <1%. (Fig.1)
  - Theoretical uncertainties currently at the level of < 5% at NNLL (Fig.2) and expected to be further improved at N3LL.
  - However, limited eta coverage in PID as well as tracking detectors results in large systematic uncertainties of ~9.1%. (Fig.3)
- Extending current eta coverage from 3.5 to 4.0, for instance, can reduce **systematic uncertainties** attributed to survival rate by **a factor of ~2 (9.1→5.4)**.

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Figure 1

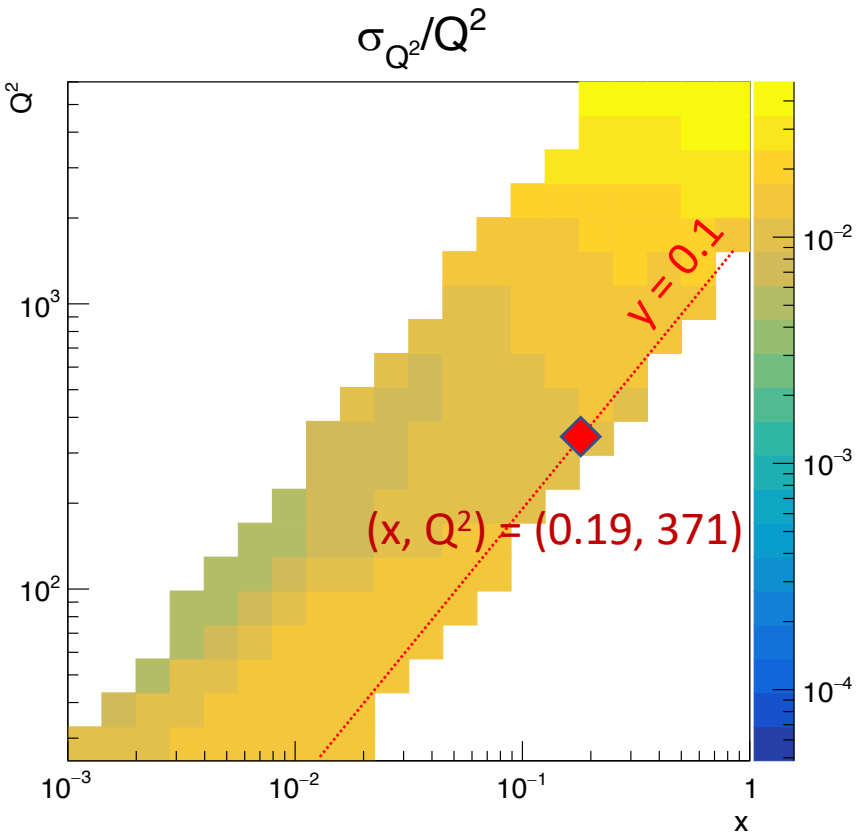

Figure 2

Current theoretical uncertainty
vs. HERA or EIC coverage:

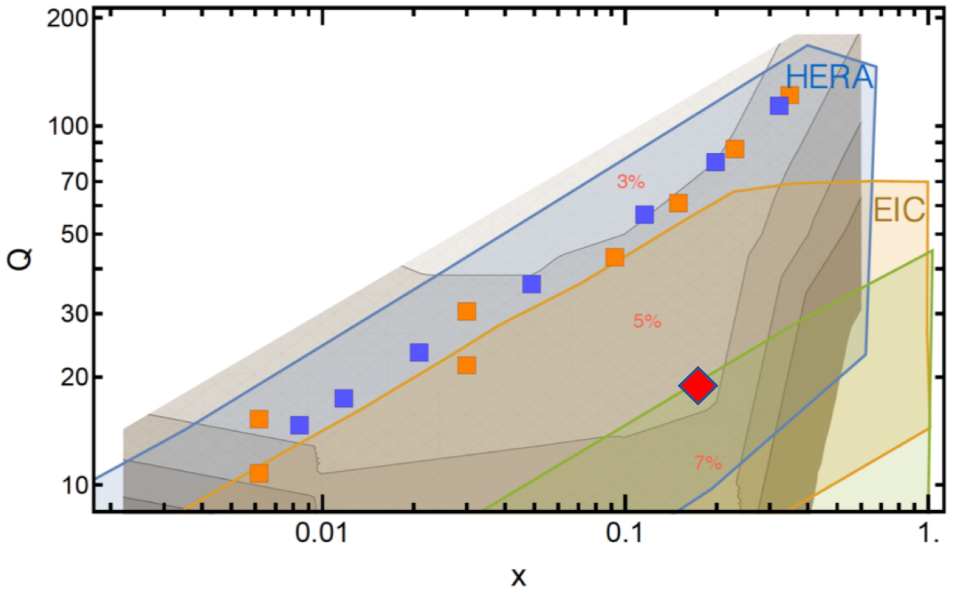

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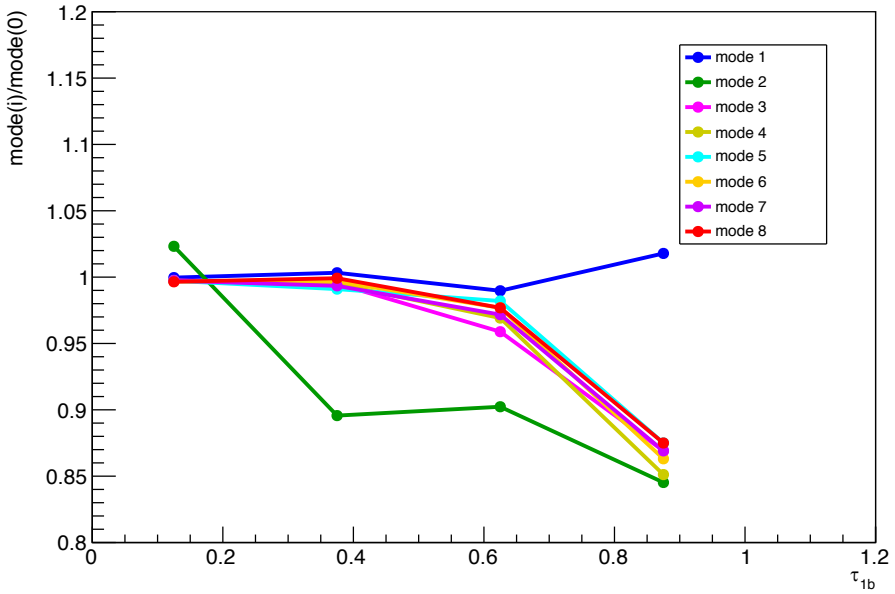
Figure 3



Mode 3 : Current PID matrix

Deterioration compared to true 4-momentum (mode 0) is driven by tracks out of acceptance (η >3.5) tracks, get closer to pion mass limit (mode 2).

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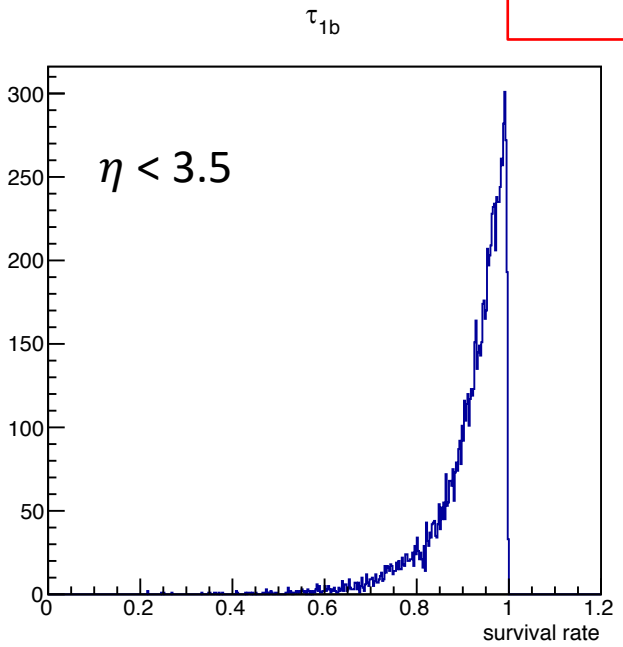
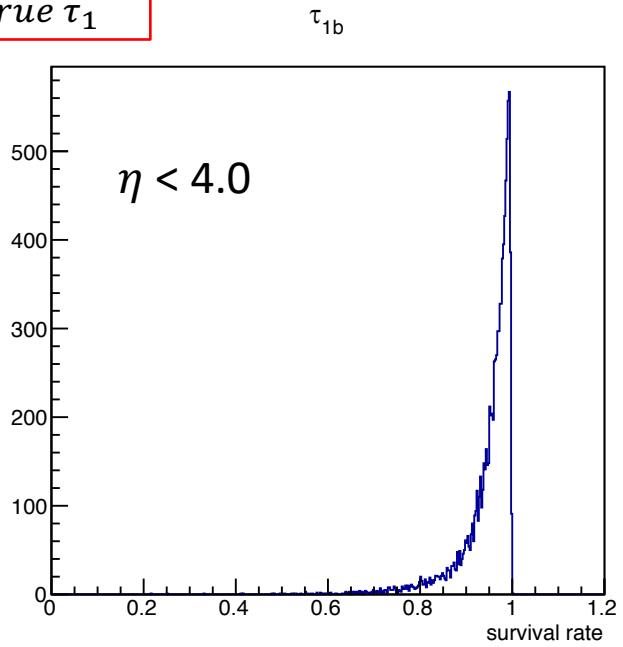
Figure 4

Survival rate = $\frac{reco\ \tau_1}{true\ \tau_1}$

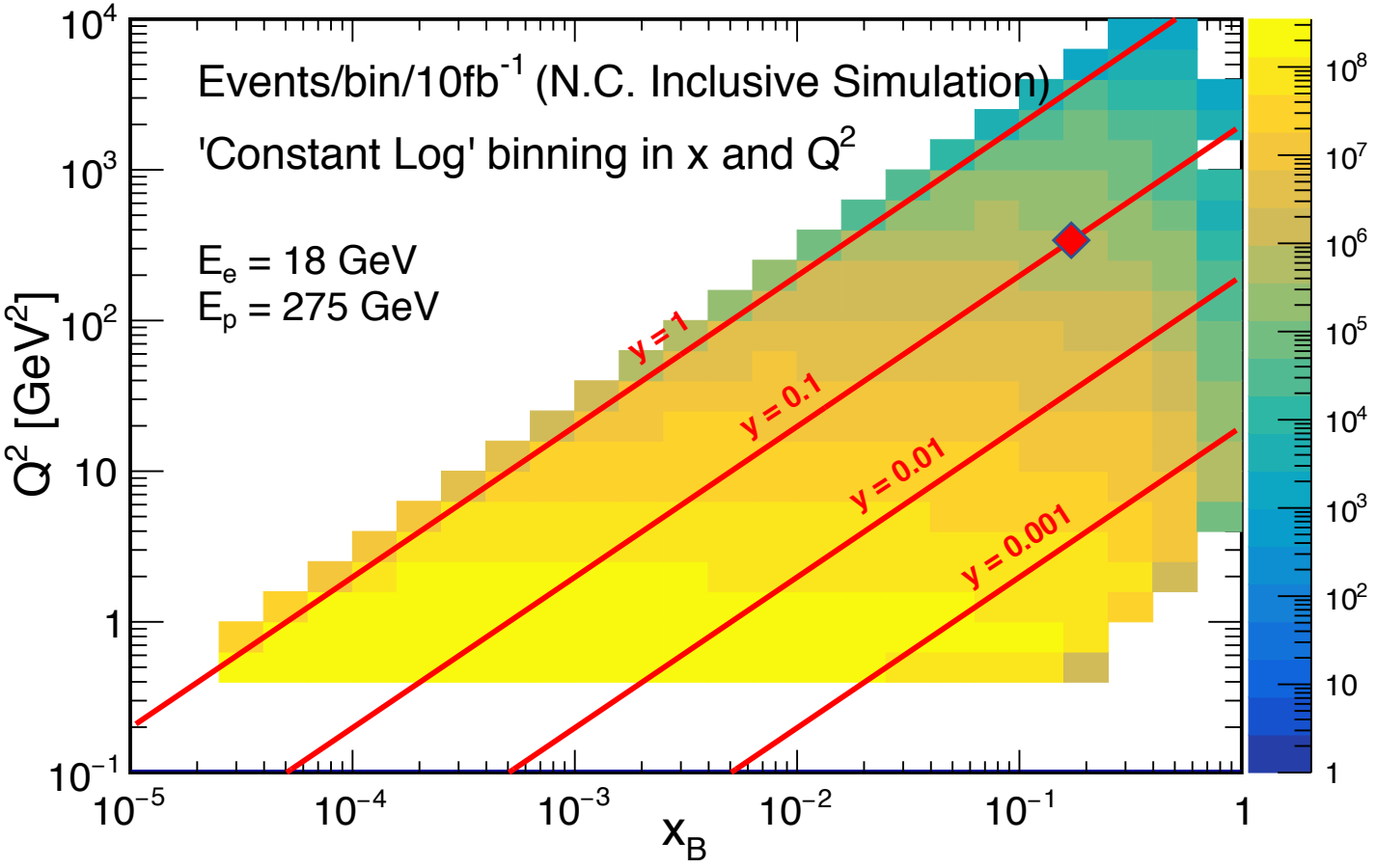


Sys. Uncertainty
9.1% at 68% CL



Sys. Uncertainty
5.4% at 68% CL

Extra


Events/bin/10fb^{-1} (N.C. Inclusive Simulation)
'Constant Log' binning in x and Q^2
E_e = 18 GeV
E_p = 275 GeV
y = 1
y = 0.1
y = 0.01
y = 0.001
Q^2 [GeV^2]
x_B
10^4
10^3
10^2
10
1
10^{-1}
10^{-5}
10^{-4}
10^{-3}
10^{-2}
10^{-1}
1
10^8
10^7
10^6
10^5
10^4
10^3
10^2
10
1