Update of offline event selection and triggers for collectivity analysis in PHP

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Reminder of how our 2-particle correlation function is defined.

2-particle azimuthal correlations

$$c_n\{2\} = \langle \cos\left(n(\varphi_1 - \varphi_2)\right)\rangle$$

harmonic

Azimuthal angle particle 1

Azimuthal angle particle 2

N_{rec} is the number of reconstructed tracks passing the below criteria:

- ZTT track type
- >= 1 MVD hit
- DCAxy < 2 cm, DCAz < 2 cm
- 0.1 < pT < 5.0 GeV
- -1.5 < eta < 2

Offline event selection

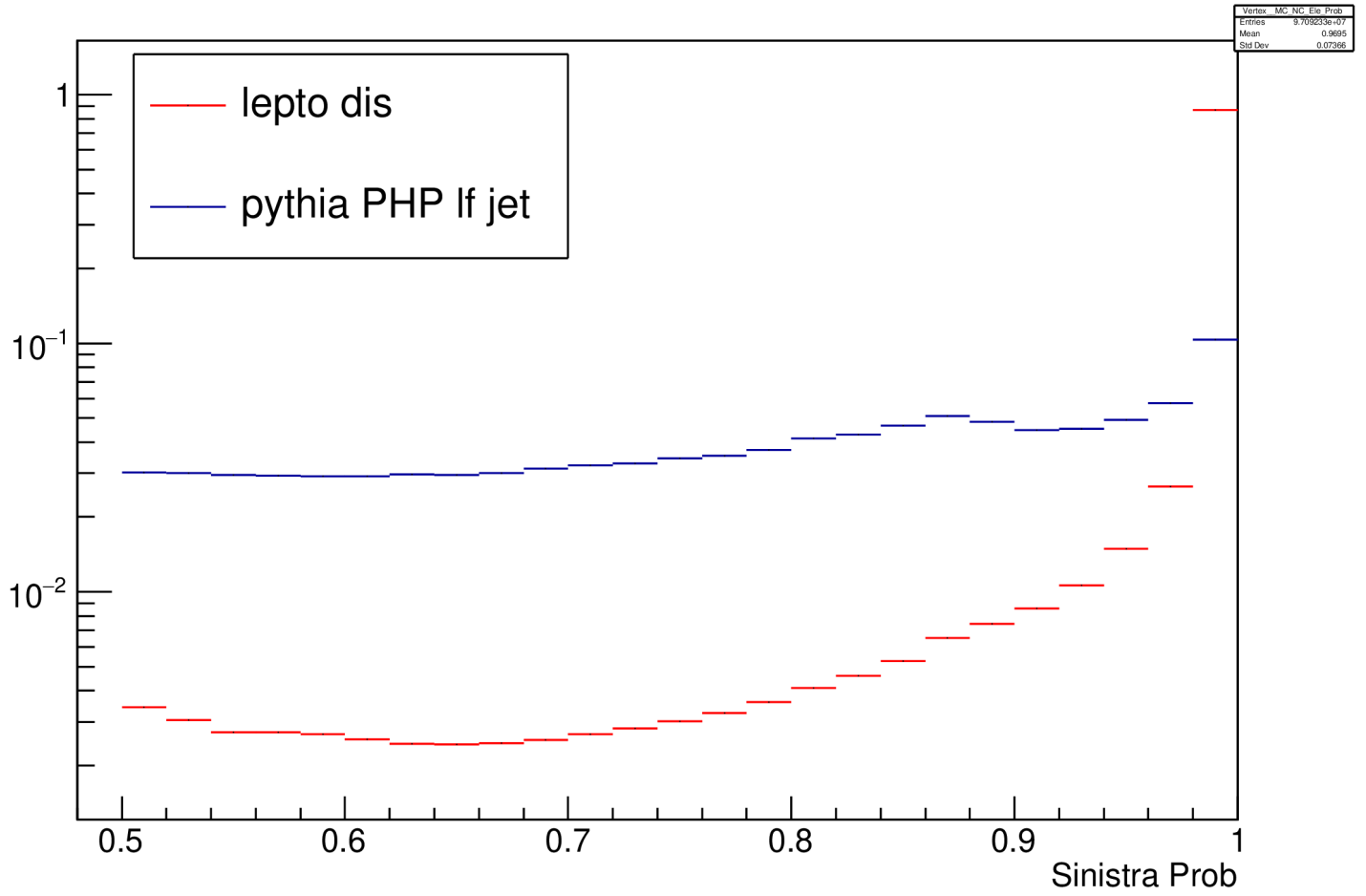
PHP

- Primary Vertex QA (same cuts as in DIS paper)
- Sinistra probability < 0.95
- Electron energy < 20 GeV
- E – Pz < 65 GeV

DIS

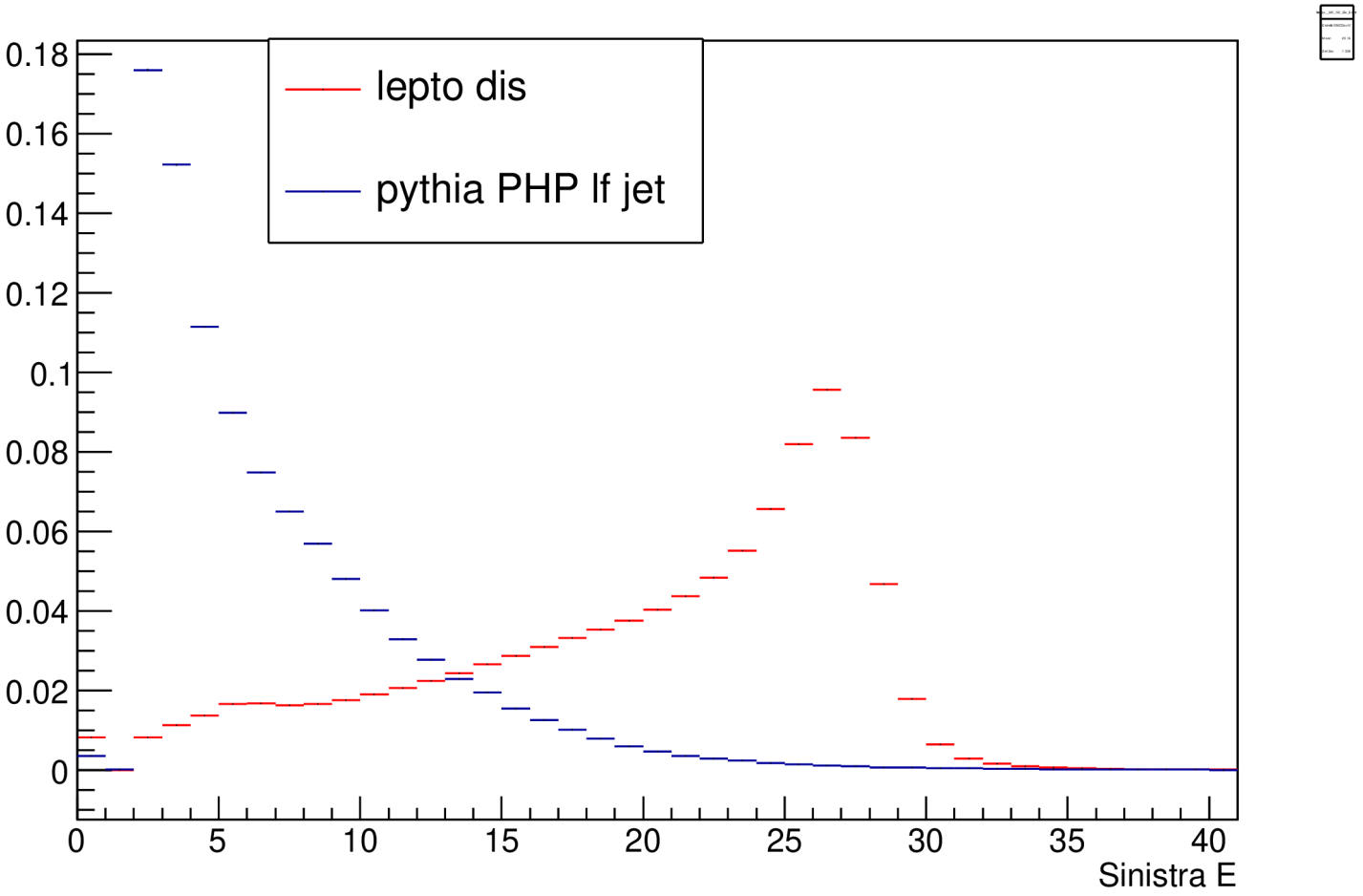
- Primary Vertex QA
- Sinistra radial position on entering RCAL cuts
- Sinistra theta > 1 radian
- $Q^2 > 5\ GeV^2$
- Sinistra probability > 0.9
- Electron energy > 10 GeV
- 47 < E – Pz < 69 GeV

MC sinistra probability distributions



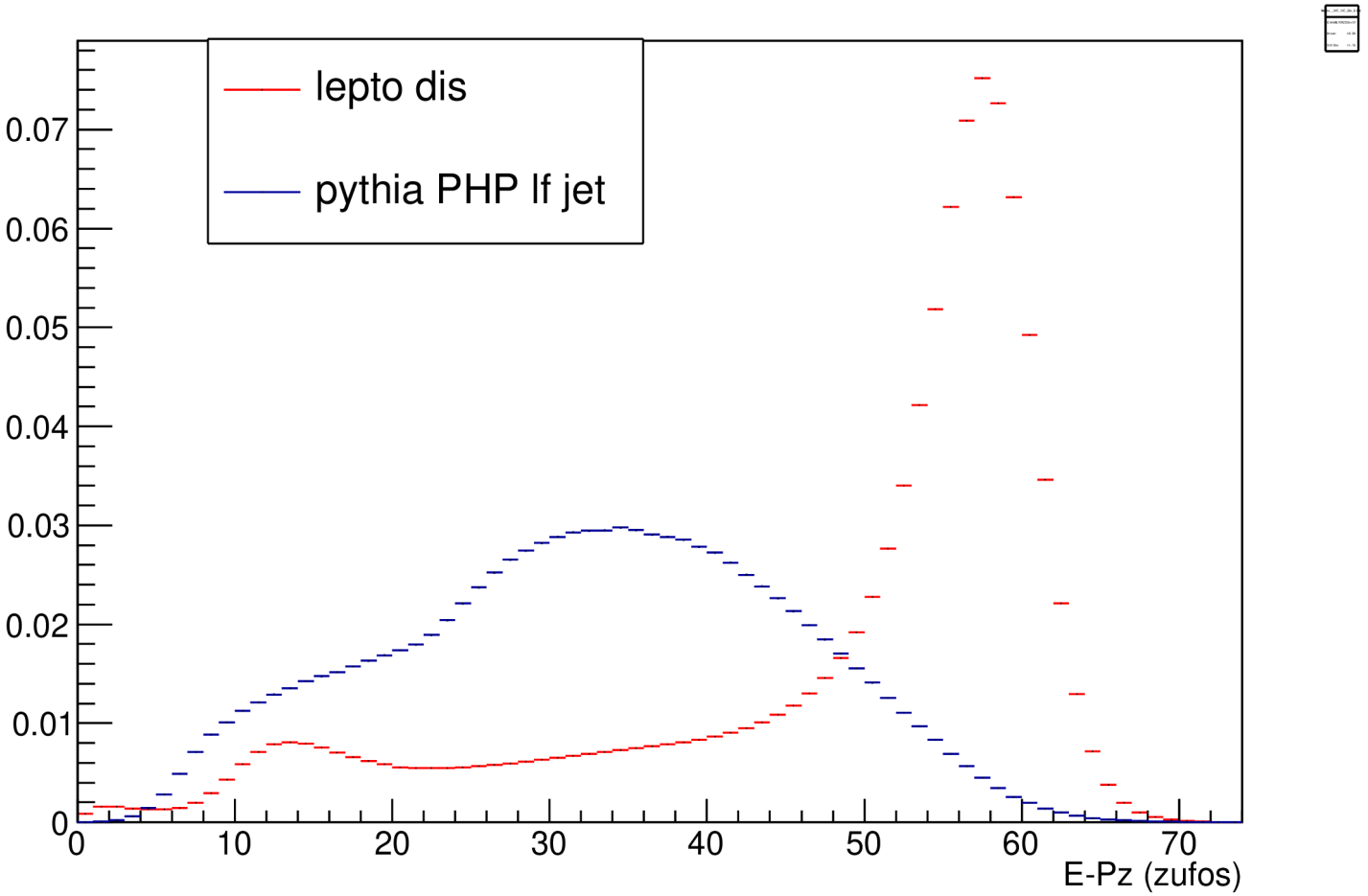
90% of DIS events are above Prob = 0.95

MC sinistra energy distributions



60% of DIS events are above E = 20

MC sinistra E - Pz distributions

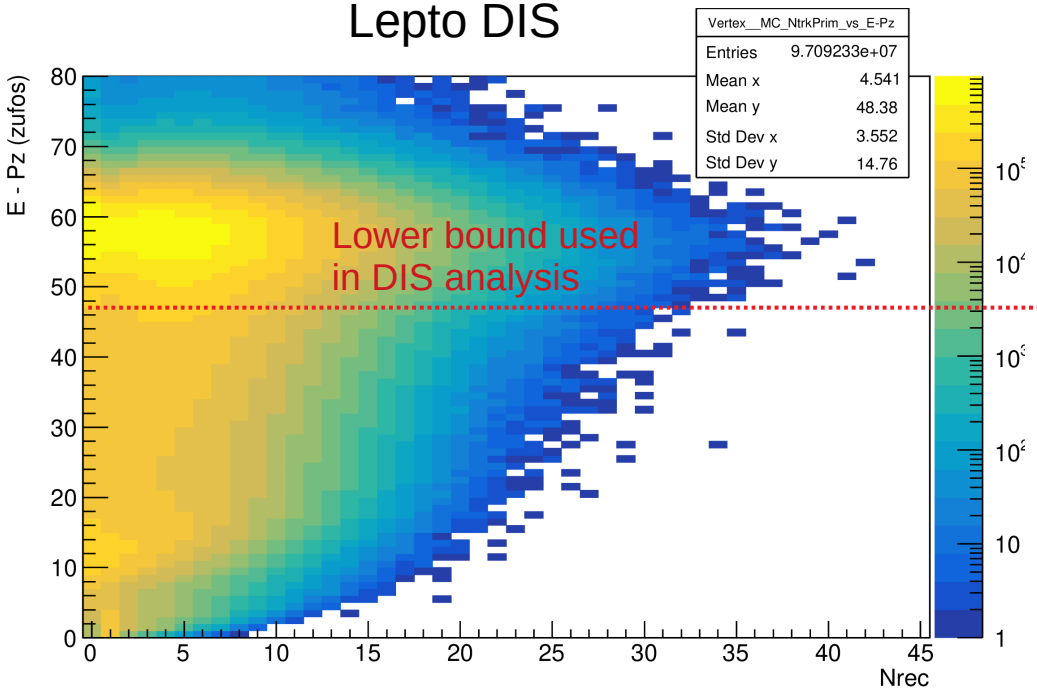


1% of DIS events are above E-Pz = 65

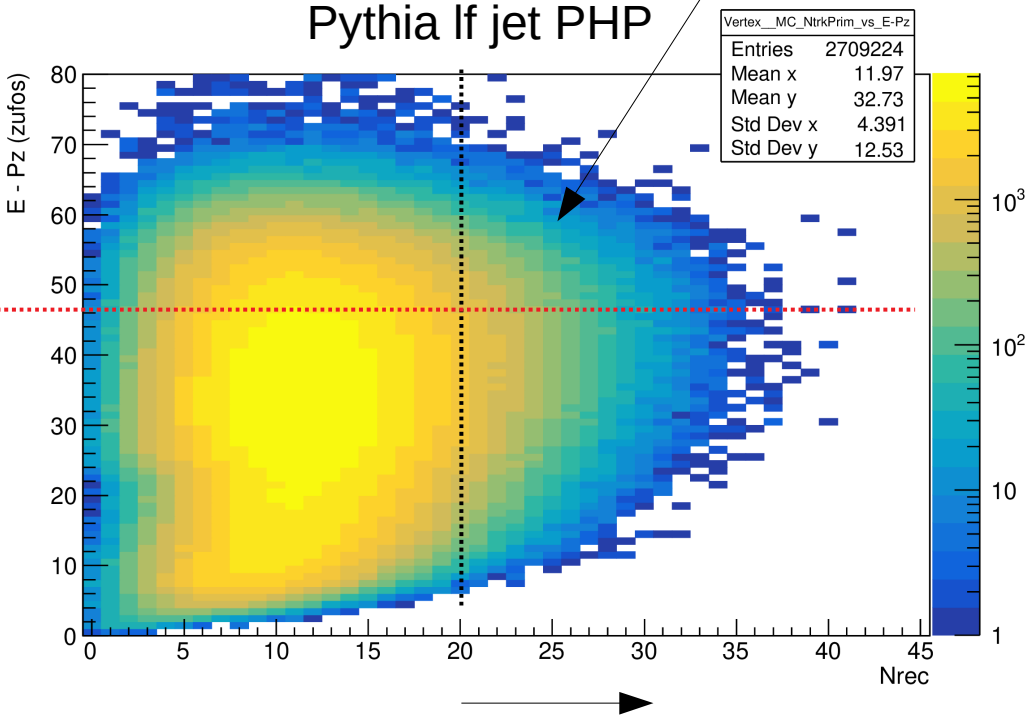
MC E – Pz vs Nrec

Probably not a good idea to lose these events

Lepto DIS



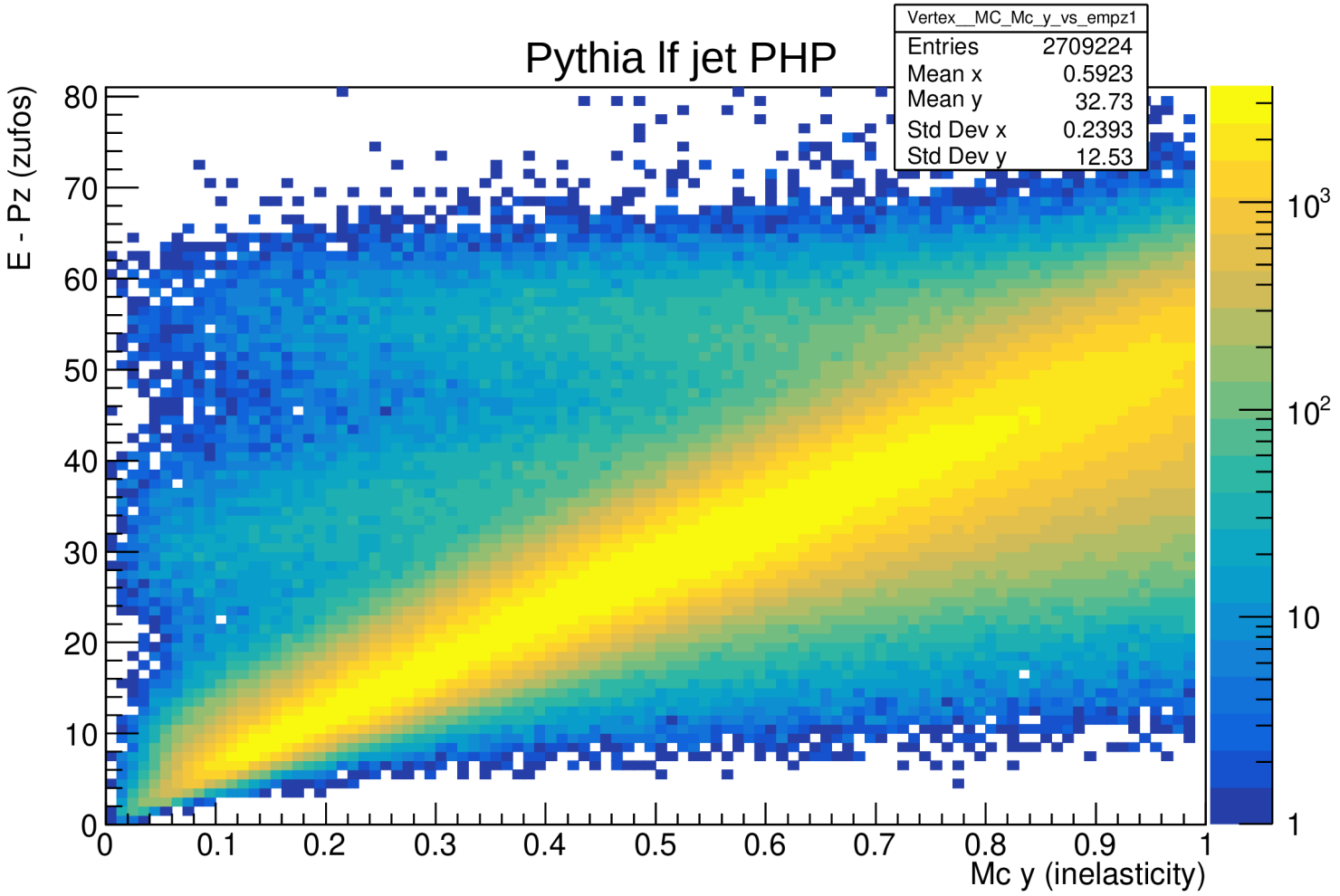
Pythia lf jet PHP



High Multiplicity

- E-Pz is positively correlated with multiplicity.
- PHP analyses in ZEUS often use an upper cut of around 45 GeV. The red line was the lower cut used in the DIS collectivity analysis.
- Since we are interested in high multiplicity, an E-Pz doesn't seem suitable.

MC E – Pz vs inelasticity



- High E-Pz events often correspond to highly inelastic events.
- These might be among the most interesting events because for y~1, the electron deposits most of its energy into the system.

$$y = \frac{p\,(k - k')}{p\,k}$$

k: beam lepton
k': scattered lepton
p: beam proton

Trigger studies

In the previous presentation, the TLT biases were estimated in MC PHP.

From that study, we found a few TLT candidates which biased the generator level correlation functions the least, namely HFL 28.

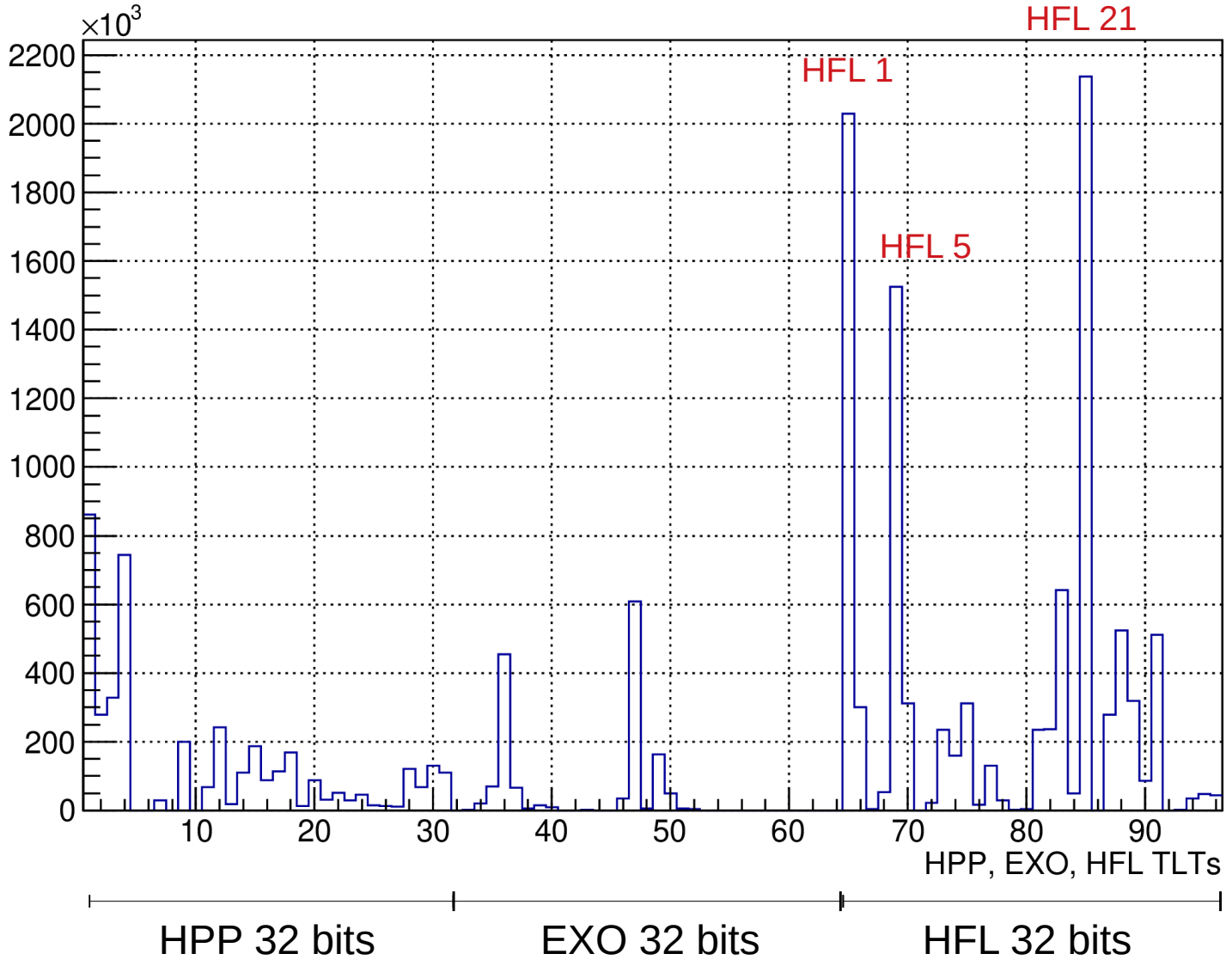
Complementary to that study, we will estimate the bias induced by HFL TLTs on a well-understood real-data sample: DIS.

To do that we will compare $c_n\{2\}$ in events selected with the well-understood DIS triggers to that obtained with certain HFL TLTs. Offline DIS event selection will be applied to both.

Efficiency corrections are not applied in this presentation.

TLTs which fired when HFL 28 did not fire

ZEUS data
06e-07p



- Nrec > 20 (high multiplicity events)
- HFL 1, HFL 5, & HFL 21 are the next most populated triggers to consider after HFL 28.

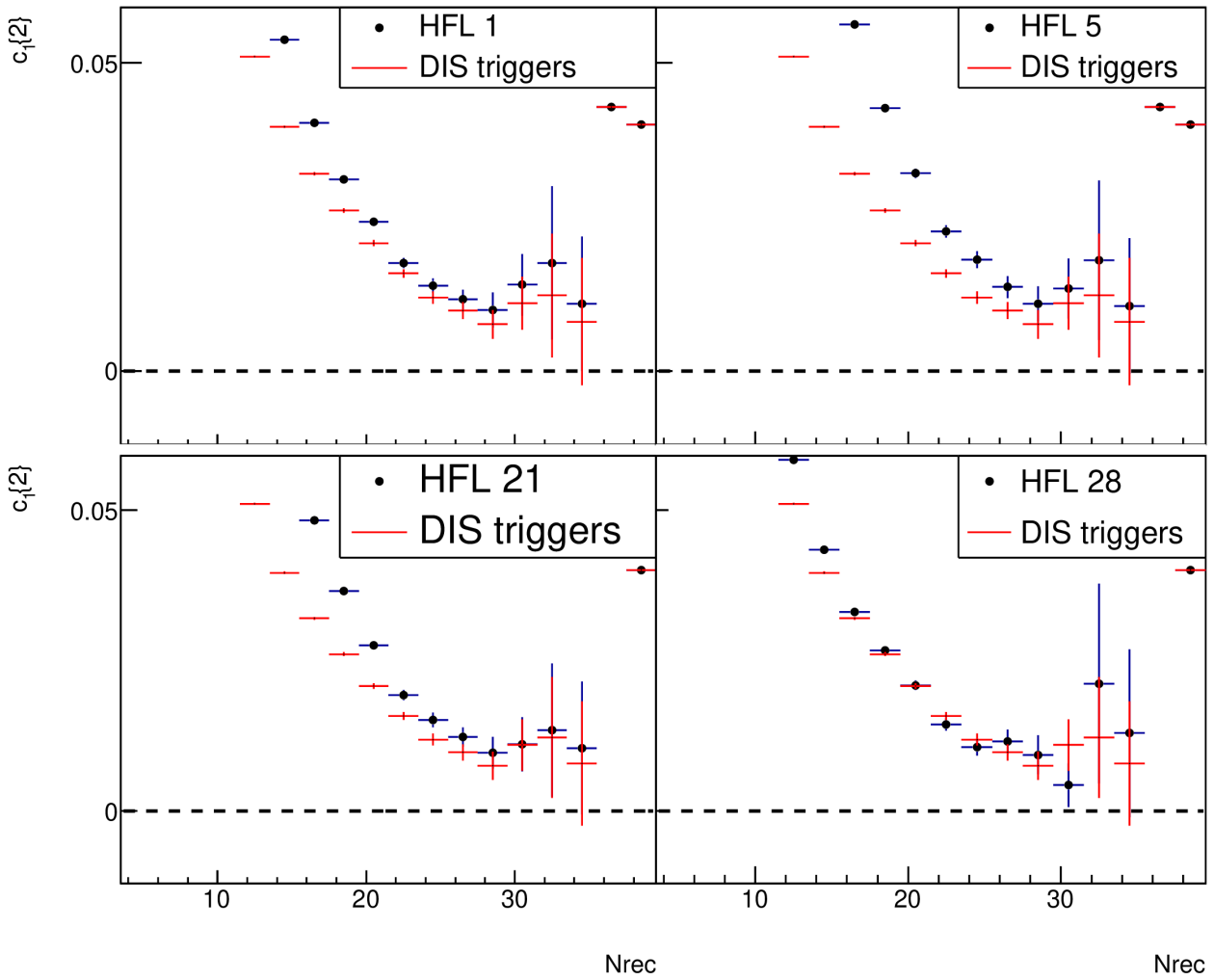
Reminder of HFL TLT descriptions

HFL TLT web page

TLT	Short description	Long description
HFL 1	Charmed hadrons in PHP	Or of all HFM triggers with hard cuts: pT thresholds and invariant mass thresholds of decay daughters.
HFL 2	Charmed hadrons in DIS	DIS electron Or of all HFM triggers with loose cuts:
HFL 5	inclusive dijets (similar to old HPP 14)	Two jets ET>4.5, eta<2.5 (EUCELL) Pz/E < 0.95 and E-Pz<100
HFL 6	jets in DIS	Two Jets ET>3.5, eta<2.5 (EUCELL) Pz/E < 1.0 and E-Pz<100
HFL 9	electron in PHP	Number of tracks > 2, Island Energy < 1000 Momentum track > 0 , pt of the track > 1.4 GeV , 0.6 < track theta < 2.55 , DCA < 30. EMC Island energy Fraction eEMCIsland/EIsland < 0.8
HFL 18	D* gold selection	See web pages for longer description.
HFL 19	D0/D0-bar mixing	See web pages for longer description.
HFL 21	MESON + jets	Two Jets ET>3.5, eta<2.5 (EUCELL) Pz/E < 1.0 and E-Pz<100 .or. of any of the 6 D meson low Pt cut channels
HFL 24	jet(s) + electron	See web pages for longer description
HFL 25	jet(s) + muon	See web pages for longer description
HFL 27	MVD inclusive trigger Only active since May 30th 2006 (~40% of HERA II integrated lumi)	All SLT PHP, DIS and MUON slots MVD vertex within -30 cm < z(vtx) < 30 cm at least 4 tracks fitted to the primary vertex Et > 8 GeV (excluding the 1st two inner rings around the beam pipe) At least three tracks with pt > 0.75, 0.6, 0.45 GeV Impact parameter significance cut for the 3rd highest significance track. The impact parameter significance is evaluated with respect to the primary event vertex.
HFL 28	MVD inclusive trigger using beam spot Only active since May 30th 2006	Same cuts as for HFL 27, but the impact parameter significance is evaluated with respect to the beam spot.

$c_1\{2\}$

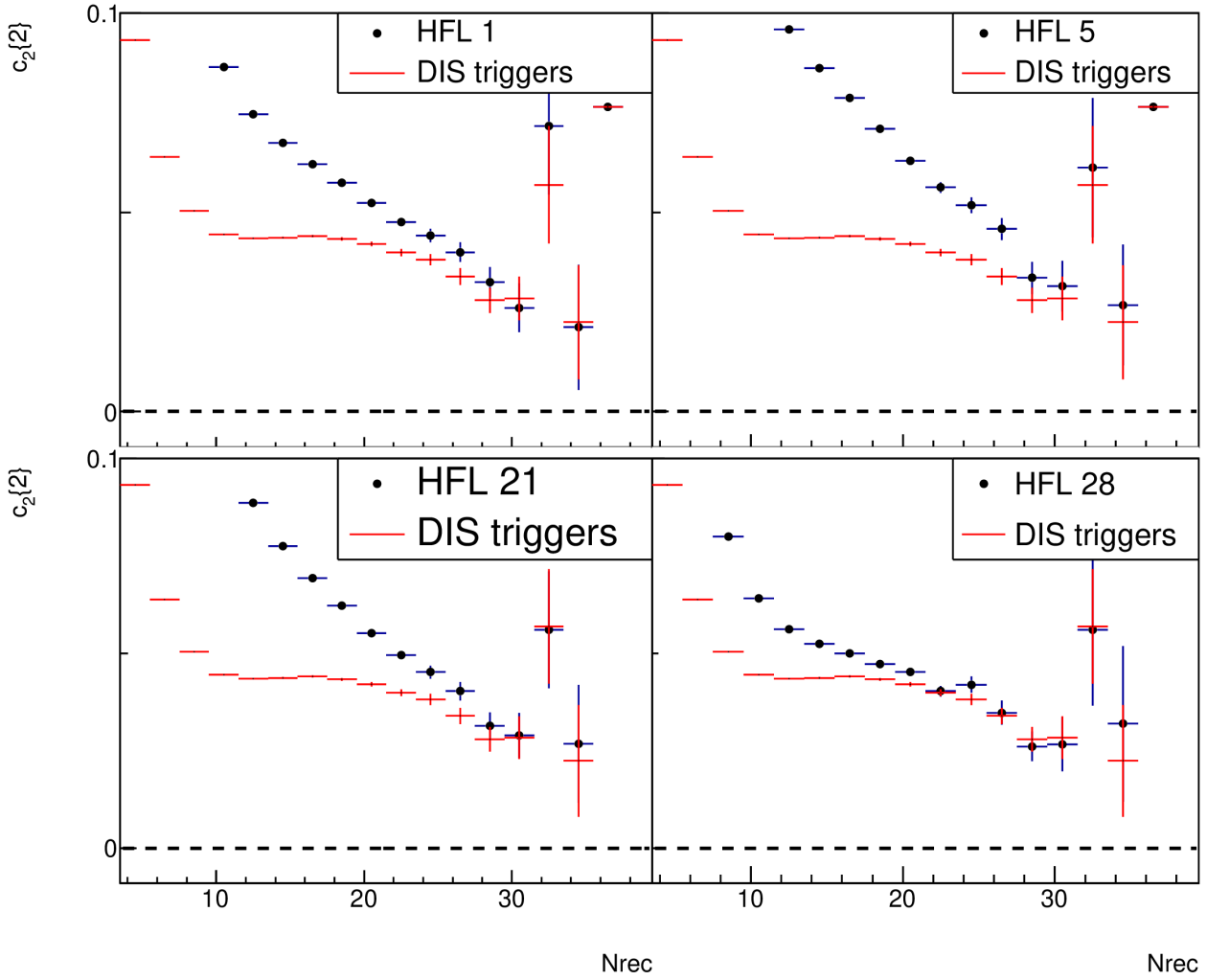
ZEUS data
06e-07p



- Bias is judged by how much the red lines (DIS results) differ from the black points.
- Offline DIS event selection applied to all.
- HFL 28 shows the least bias. Above Nrec ~ 20, it mostly coincides with DIS
- These 4 HFL triggers are all significantly biased at low Nrec.

$c_2\{2\}$

ZEUS data
06e-07p



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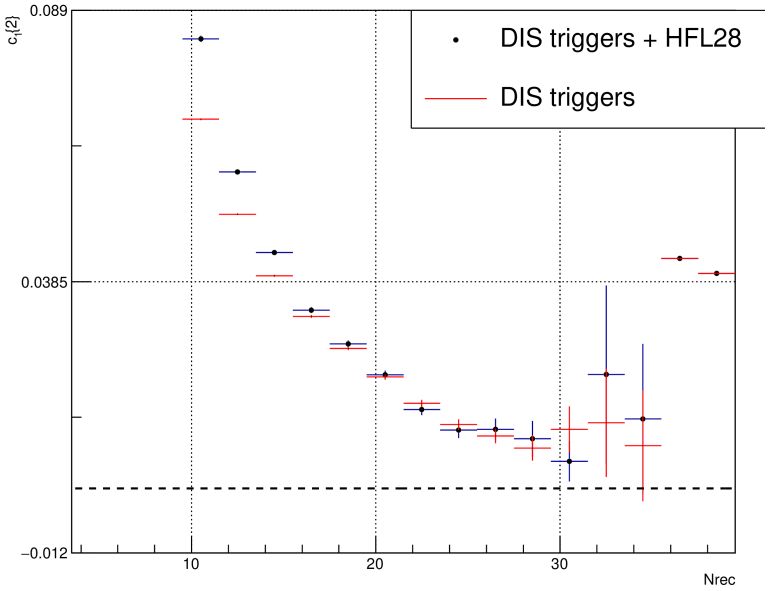
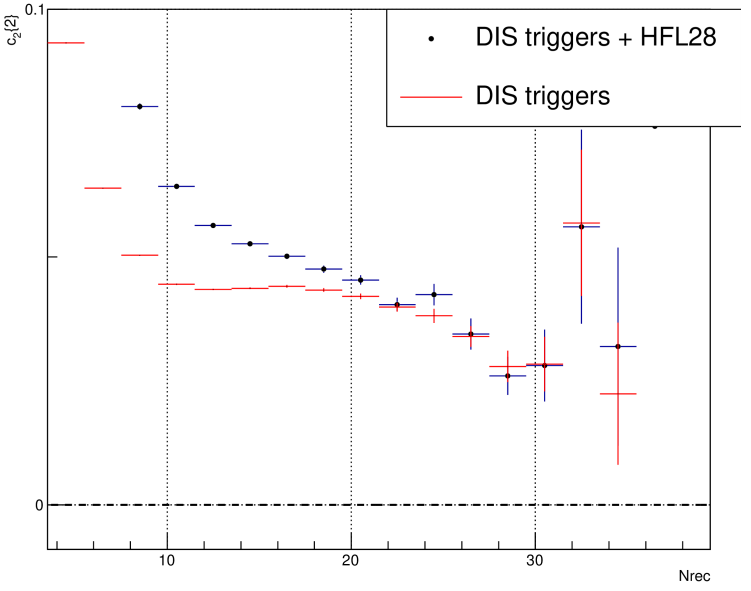
DIS offline + DIS triggers applied universally.
Black points have the additional HFL 28 constraint

ZEUS data
06e-07p

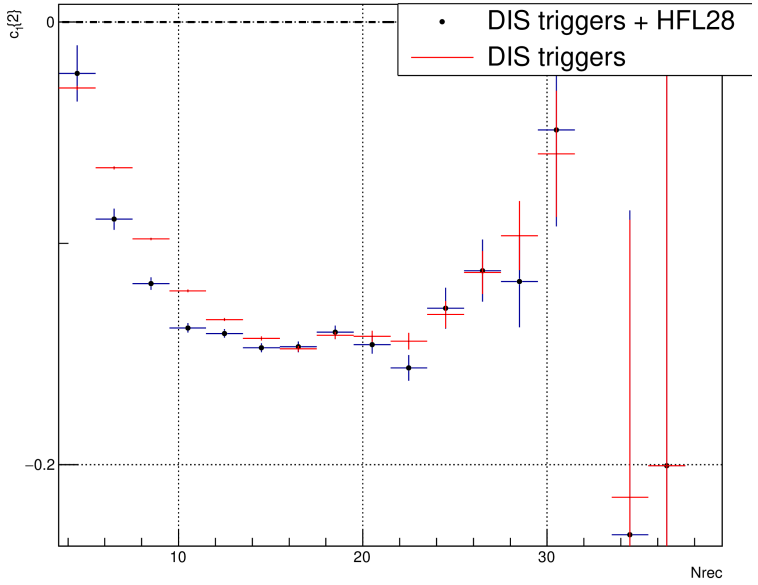
$c_1\{2\}$



$c_2\{2\}$



$c_1\{2\}$, $p_T>0.5$, $\Delta\eta>2$



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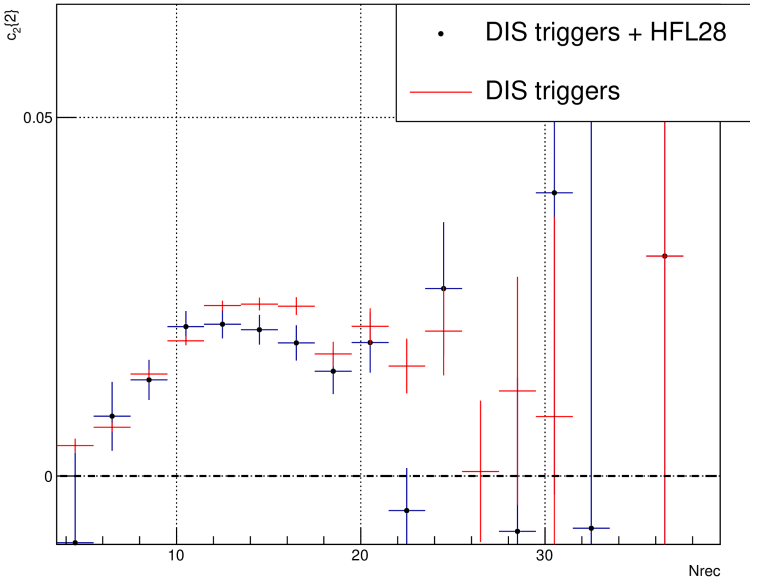

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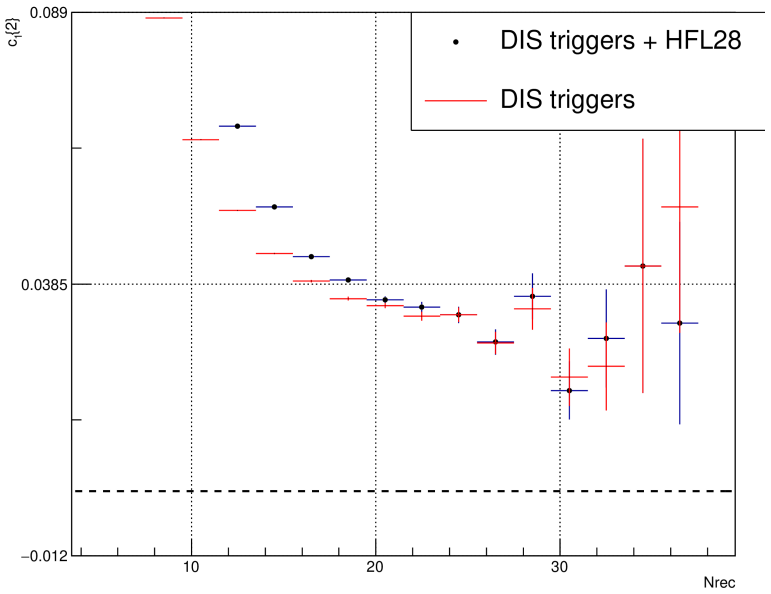
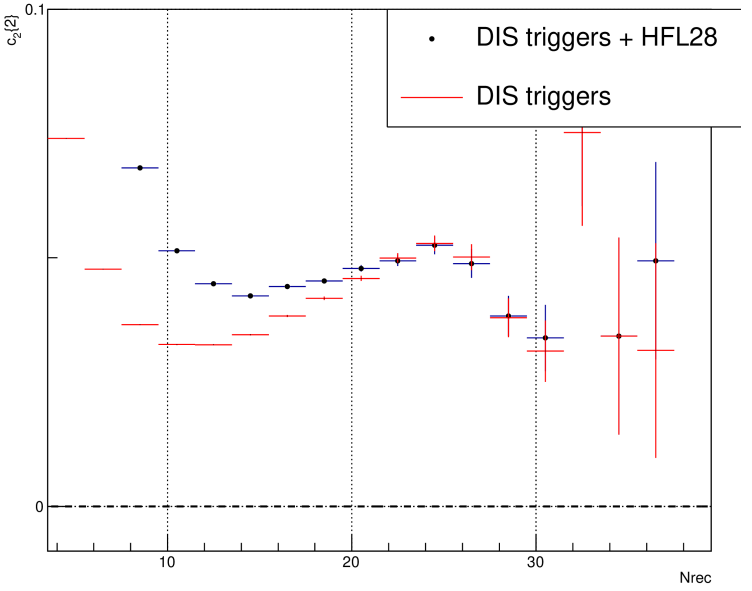
LEPTO DIS

$c_1\{2\}$



$c_2\{2\}$



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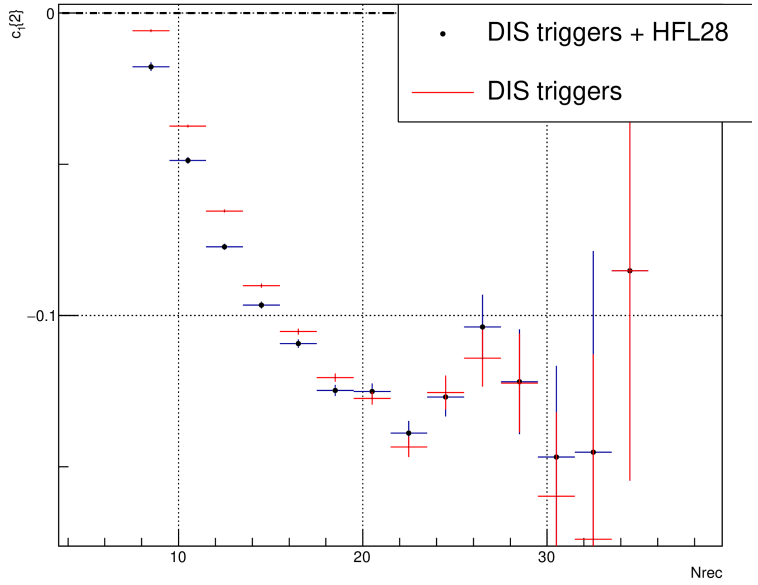

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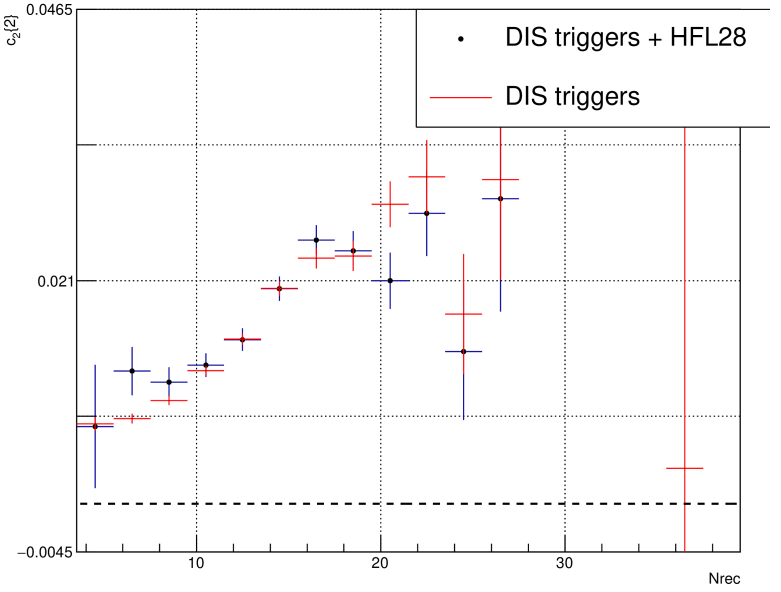


Summary

Offline event selection

- Requiring the sinistra electron probability < 95% removes 90% of the DIS background in this PHP study. Given that PHP has a 10x larger cross-section, the DIS contamination will be on the order of 1% with this cut alone.
- Since high E – Pz events correspond to high inelasticity and high Nch, perhaps we should not cut on this at all.

Triggers

- Among the HFL trigger which most often fire at high multiplicity, HFL 28 adds the least bias to the DIS measured correlation functions. The bias is quite small for Nrec >~ 20.
- Given that it also showed the least bias in the PHP MC studies from the last presentation, it appears that HFL 28 is effectively a high multiplicity trigger, which is what we want.

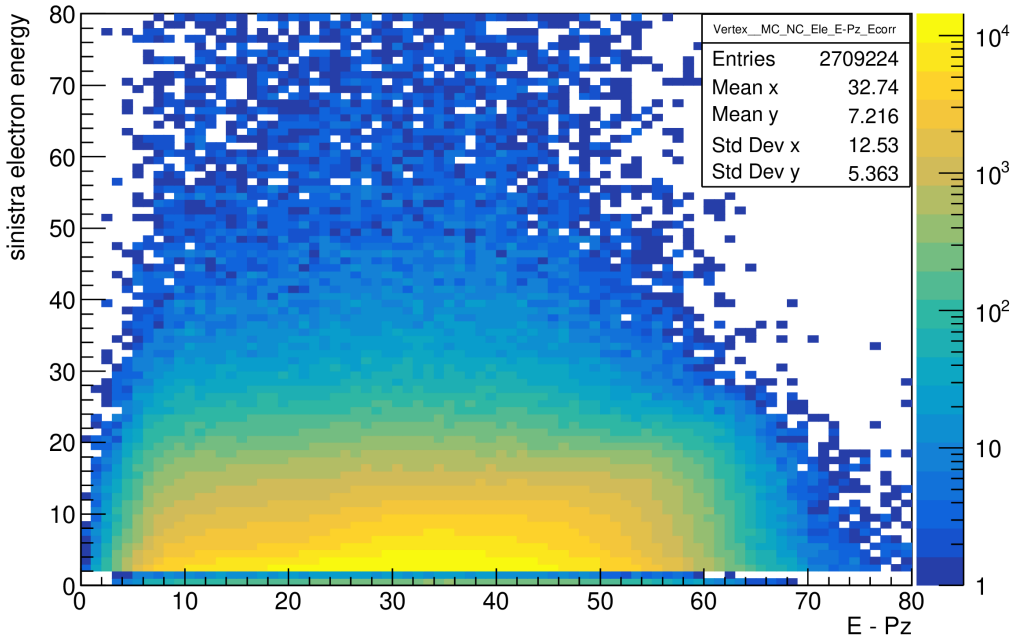
Planned next steps

- Proceed with HFL 28 for this analysis in PHP.
- Retain analyses with HFL 1, 5, & 21 in separate histograms for the upcoming systematic studies.
- Investigate efficiency corrections and MC closure test.

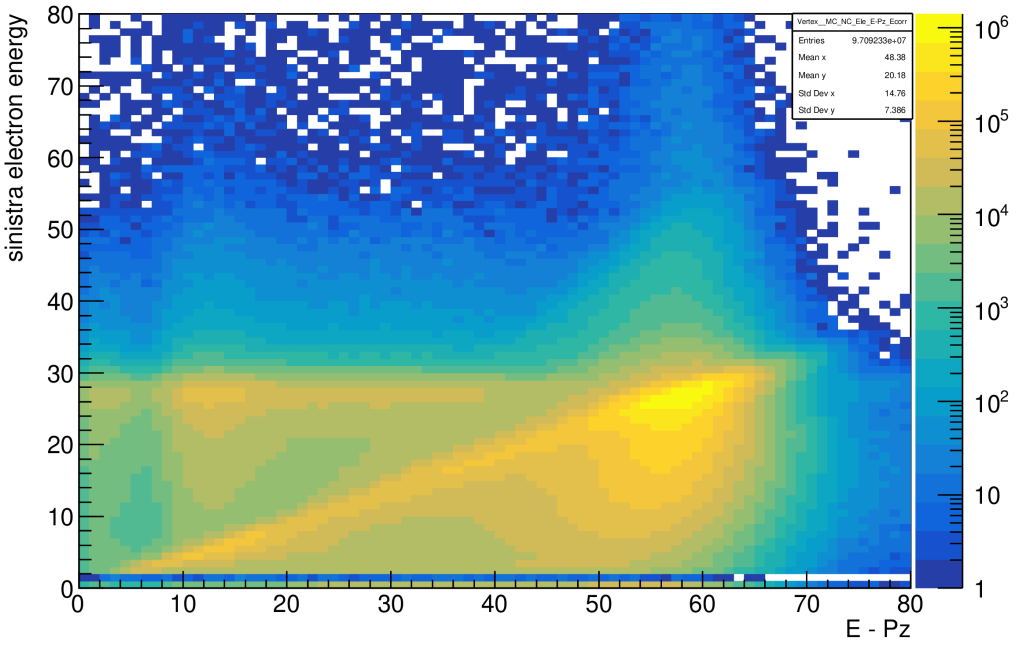
Extra

E vs E - Pz

Pythia PHP lf jet

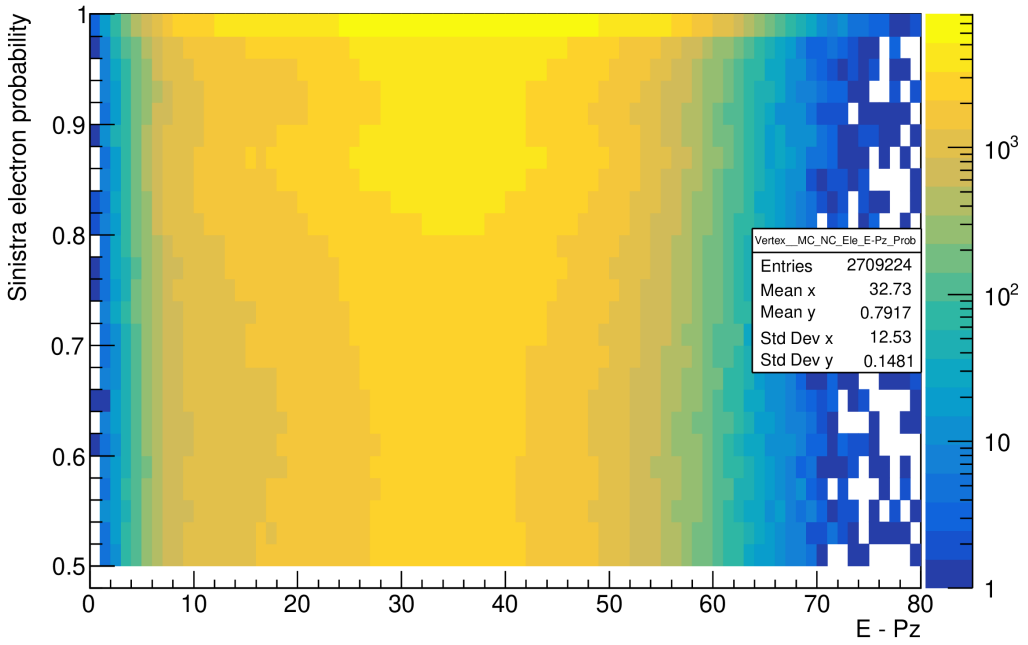


Lepto DIS



electron probability vs E - Pz

Pythia PHP lf jet



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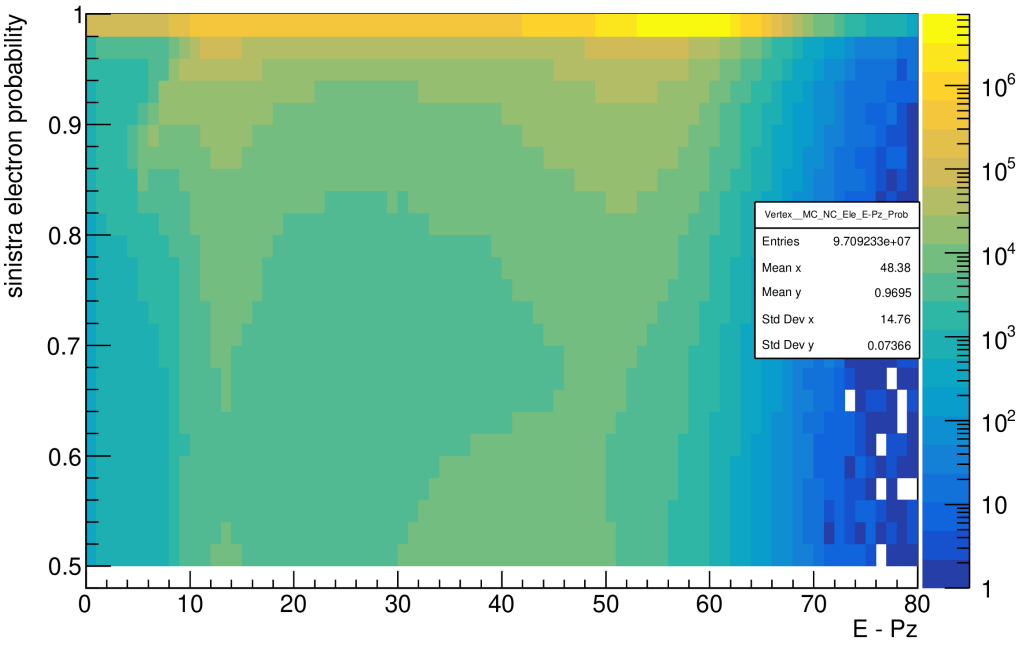
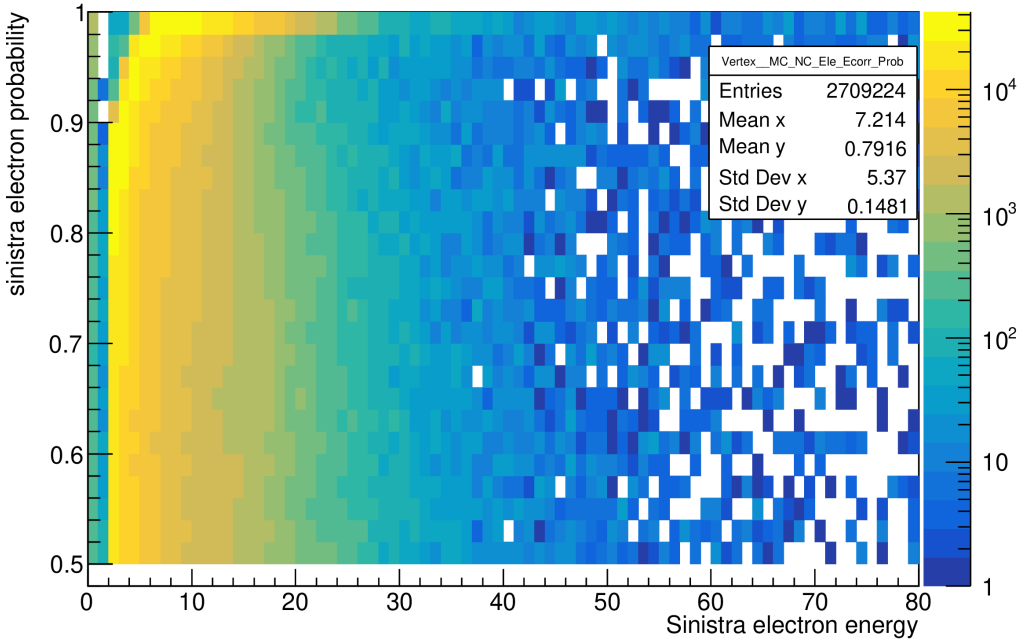


electron probability vs E

Pythia PHP lf jet



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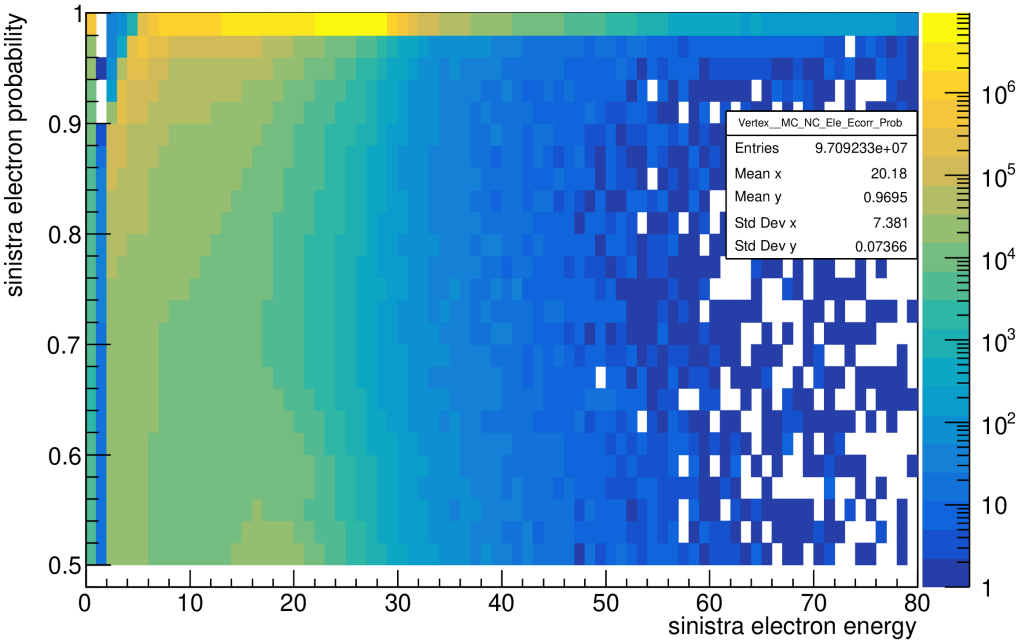
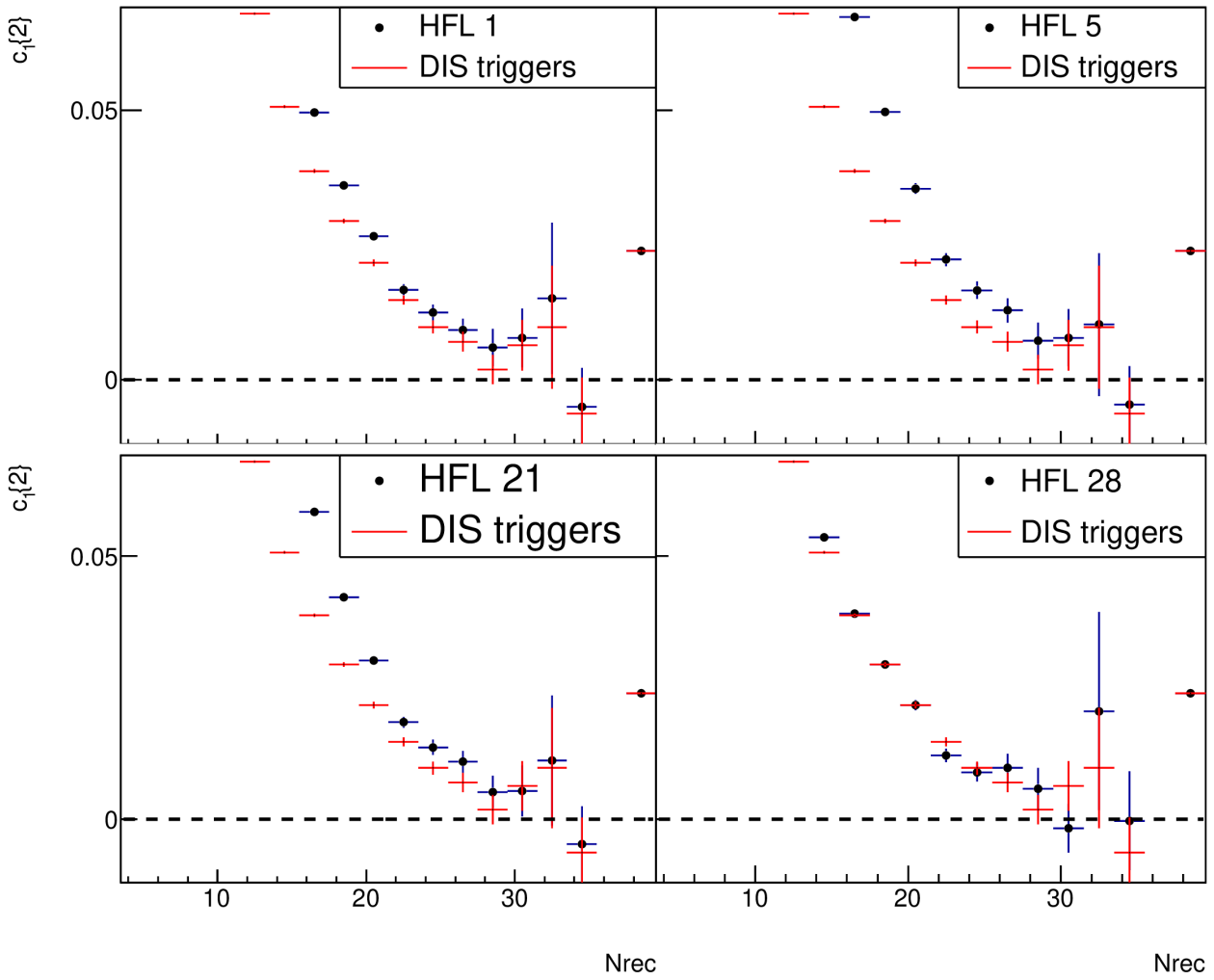


$c_1\{2\}$, $p_T > 0.5$

ZEUS data
06e-07p



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$c_2\{2\}$, $p_T > 0.5$

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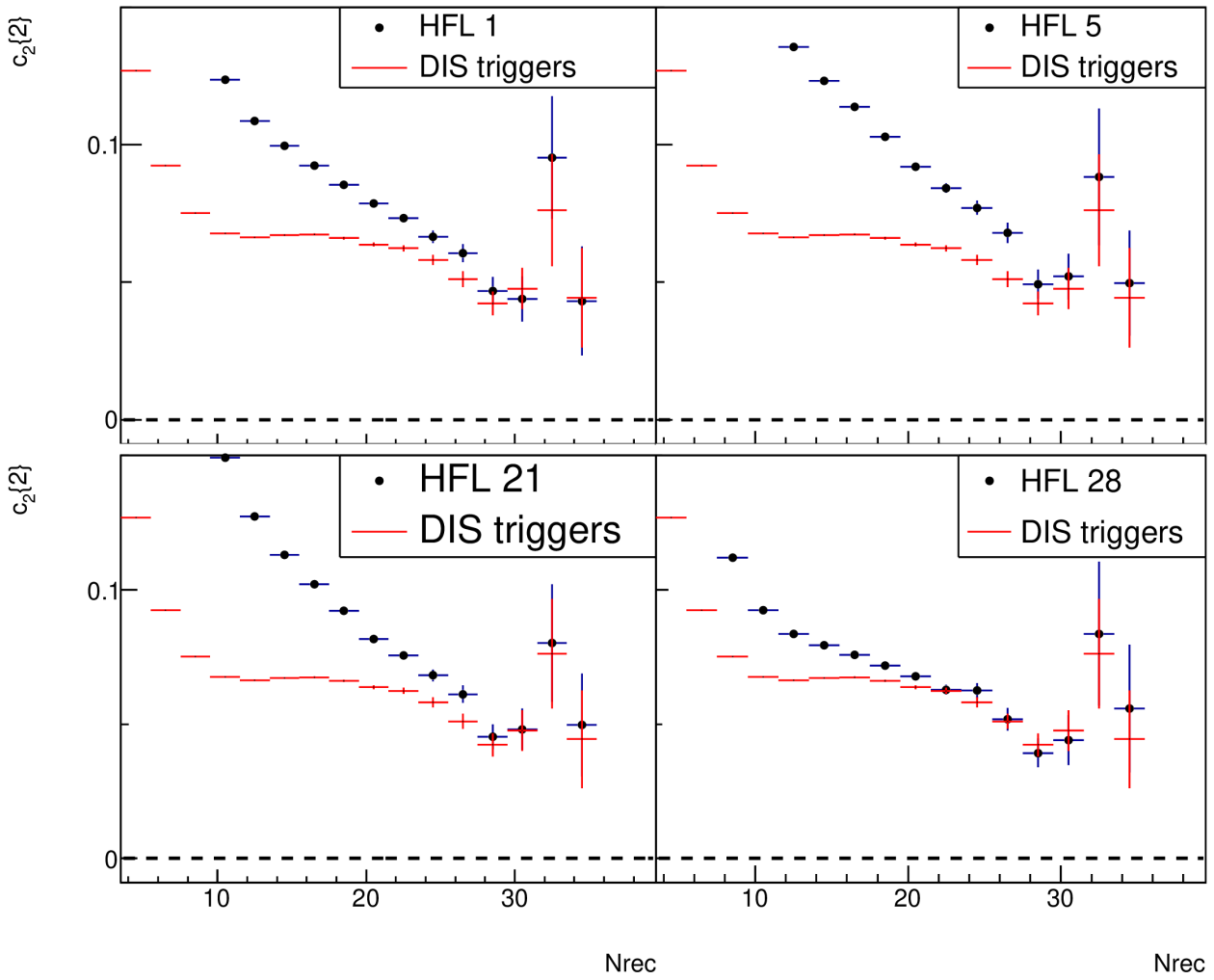
06e-07p



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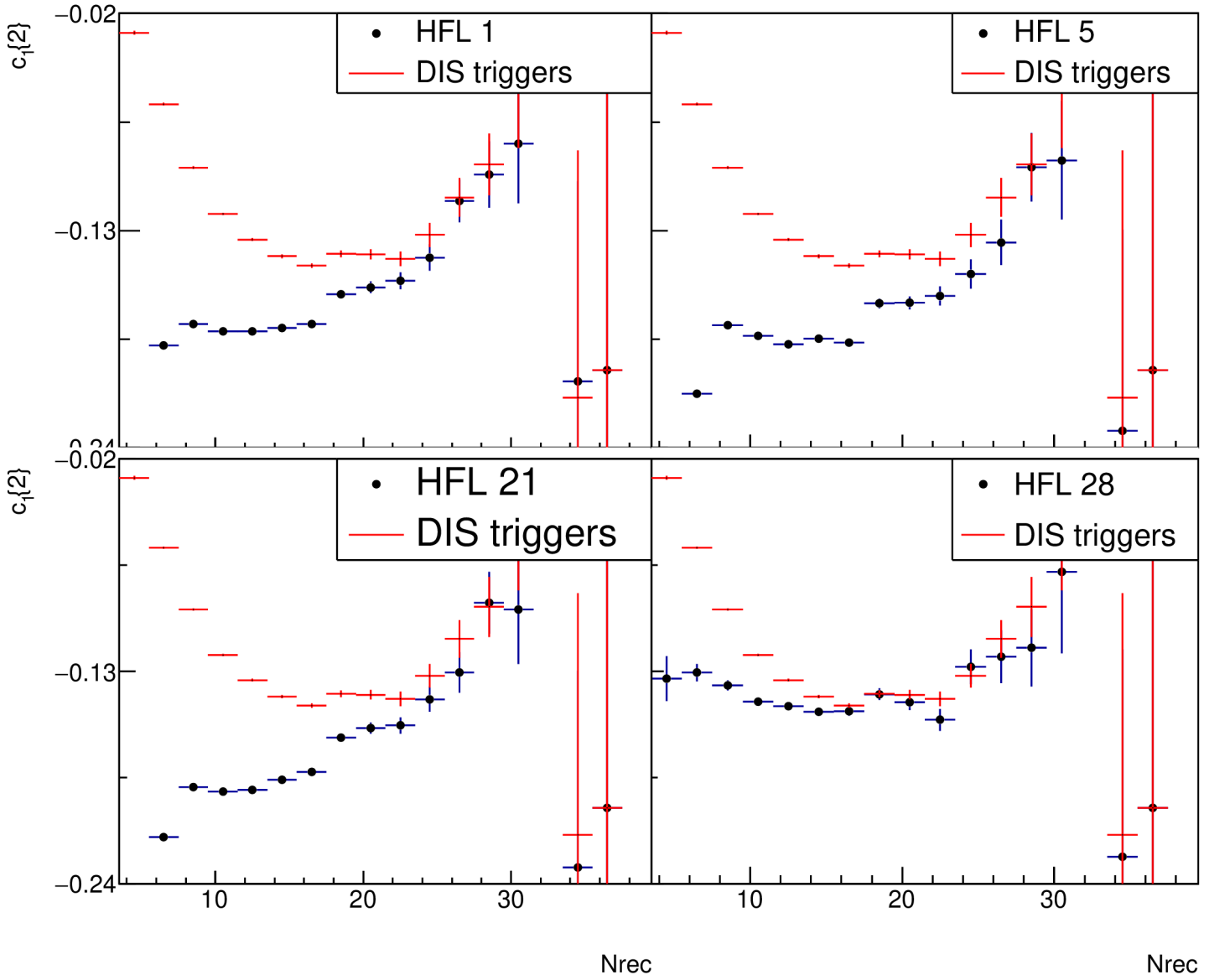

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ZEUS data
06e-07p