



LOUISIANA STATE UNIVERSITY

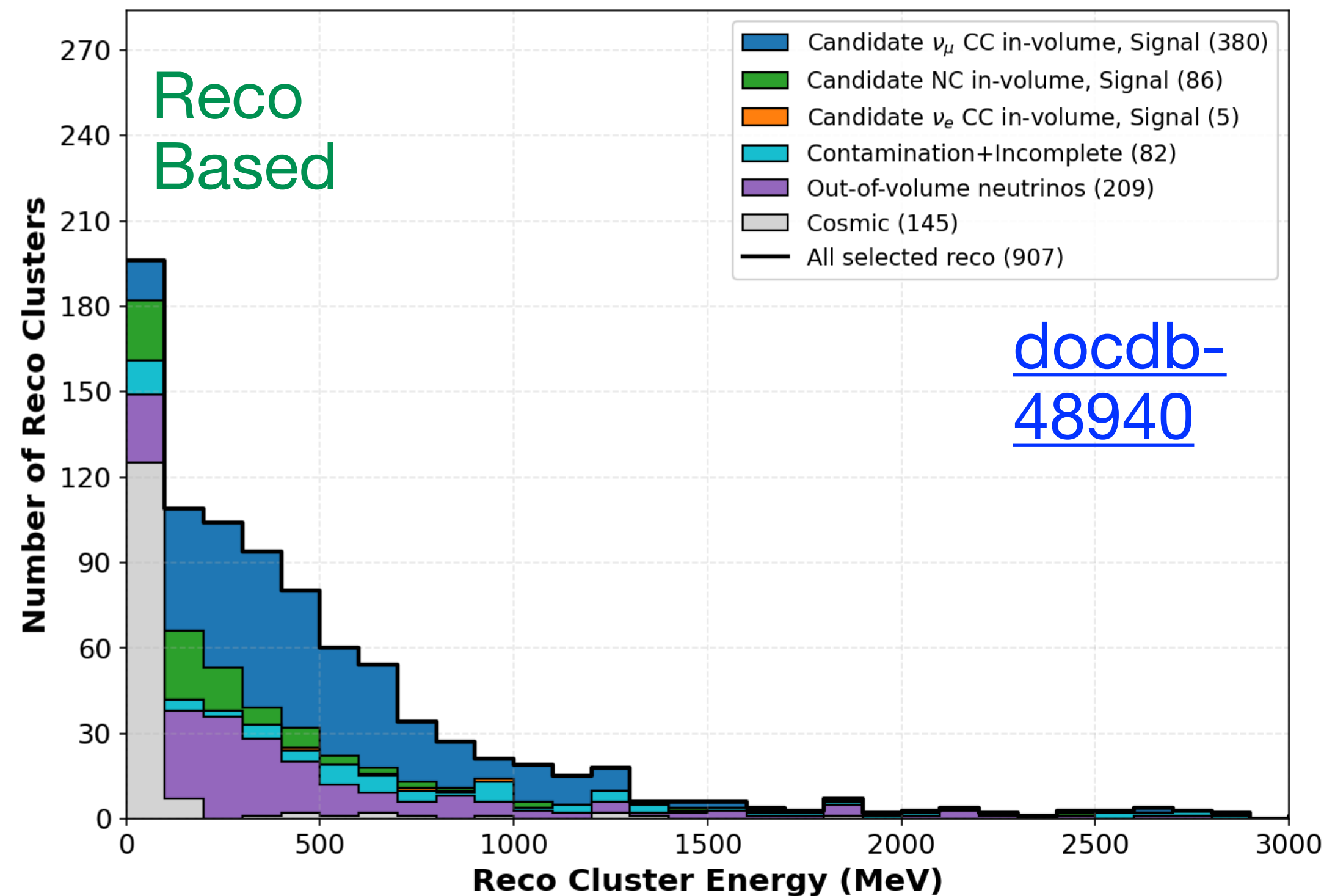


Status of Cosmic Tagger

SBND Wirecell Meeting

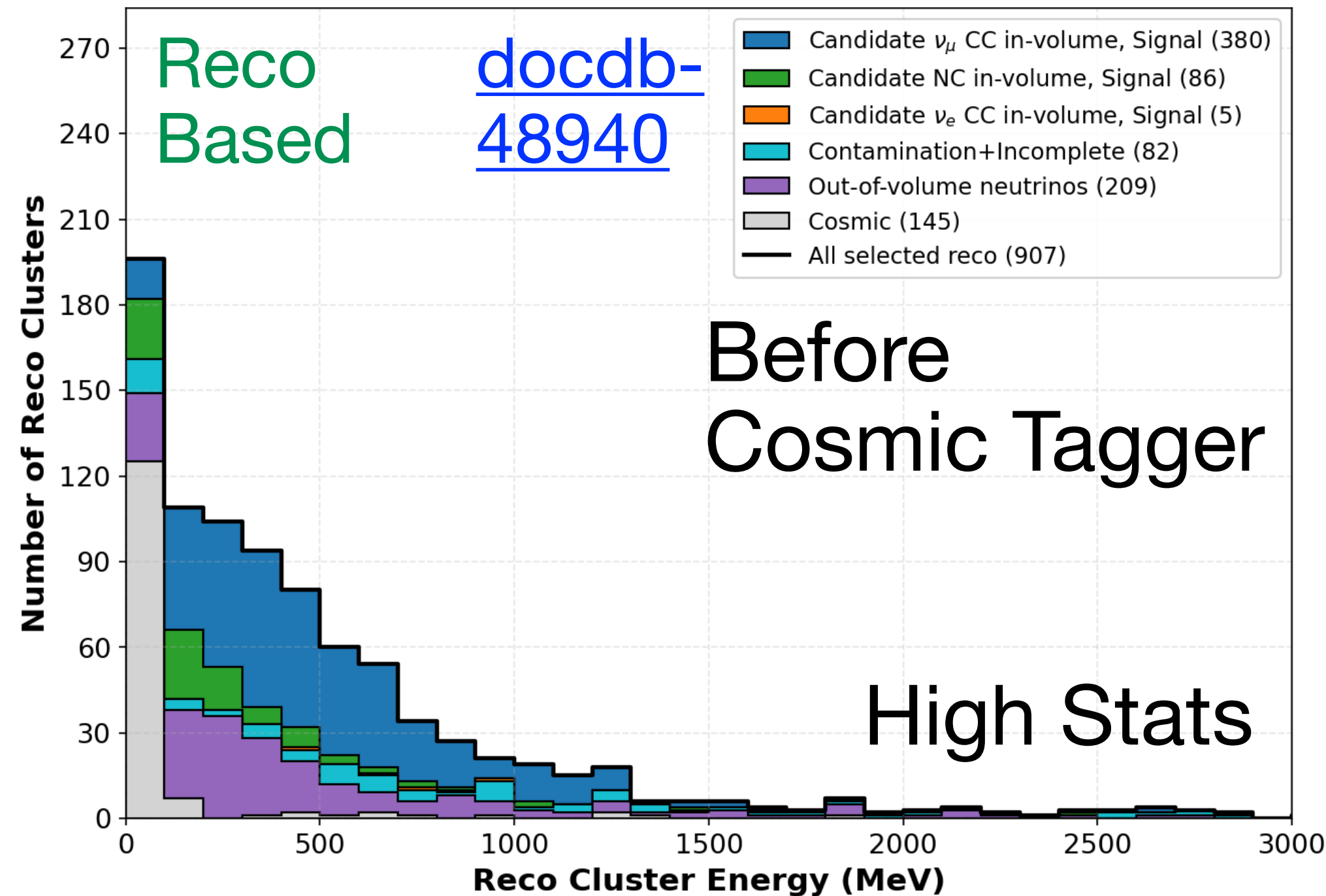
Prabhjot Singh, 28 Aug 2026

Motivation

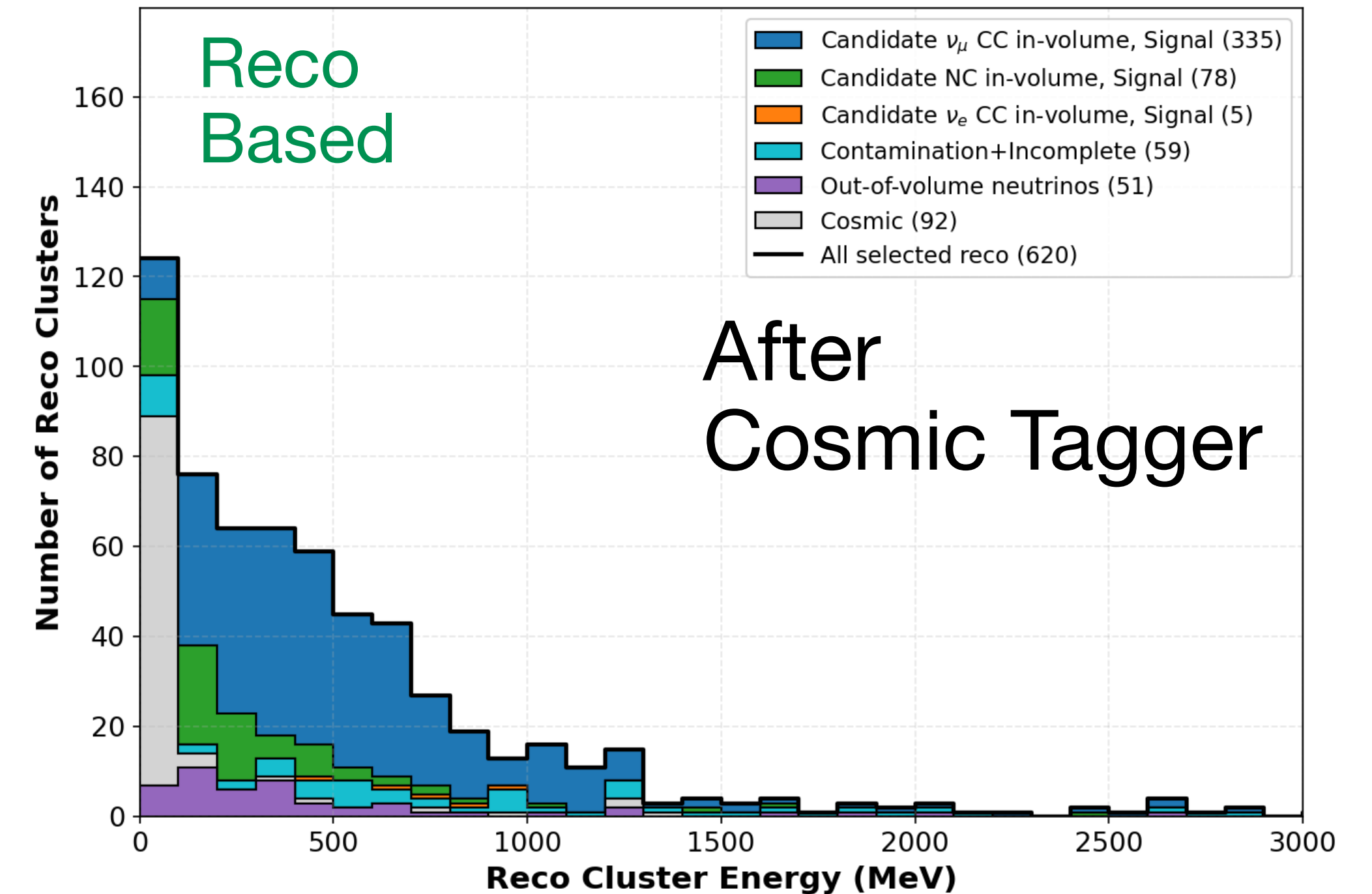


- Status of wirecell based reconstruction was presented in the SBND Reco meeting this Tuesday, 18 Aug 2026 in [docdb-48940](#)
- Only in-beam window cut was applied to select in-beam window activity
- No cosmic tagger was applied
- Vertex-out-of-volume neutrinos and cosmic are background which can be further removed using cosmic taggers
- Neutrinos contaminated by a cosmic will also be removed by taggers

Impact of Cosmic Tagger



Cosmic Tagger
→



- After including cosmic tagger, backgrounds: out-of-volume-neutrinos and cosmic are reduced
- Neutrinos contaminated by cosmic are also reduced
- Some impact is also seen on $\nu_\mu CC$, and NC signal events which are also removed by cosmic tagger

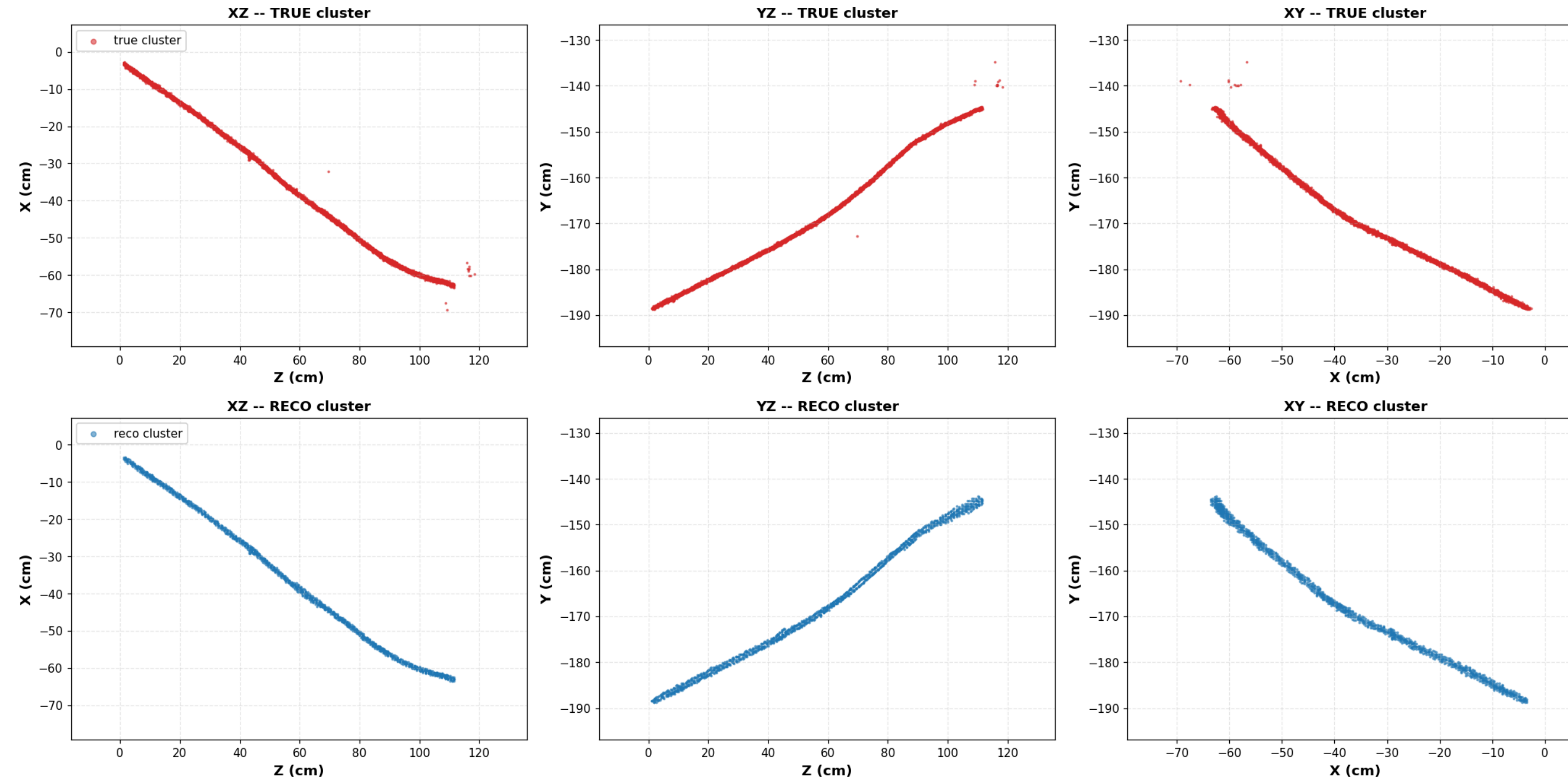
Impact of Cosmic Tagger

Reco Clusters	Numu CC	NuE CC	NC	Contamination + Incomplete	Out-volume Neutrinos	Cosmics
Before Tagger	380	5	86	82	209	145
After Tagger	335	5	78	59	51	92
Impact of cosmic tagger	12%	0%	9%	28%	75%	36%

- Cosmic Tagger need further improvements to understand
 - “signal” removed by cosmic tagger
 - “background” (out-of-volume) NOT removed by cosmic tagger

Successful Examples of Cosmic Taggers

event chunk0_7 | numu_CC | OUT-of-volume | purity 1.000 | completeness 0.997 | true E 312 MeV | reco E 227 MeV | true id 99993 | reco id 4.000 | REMOVED: tagged by stm



[Bee-link](https://www.phy.bnl.gov/twister/bee/set/3a3bfd4-5020-4f10-a4de-890170f1563c/event/7/)

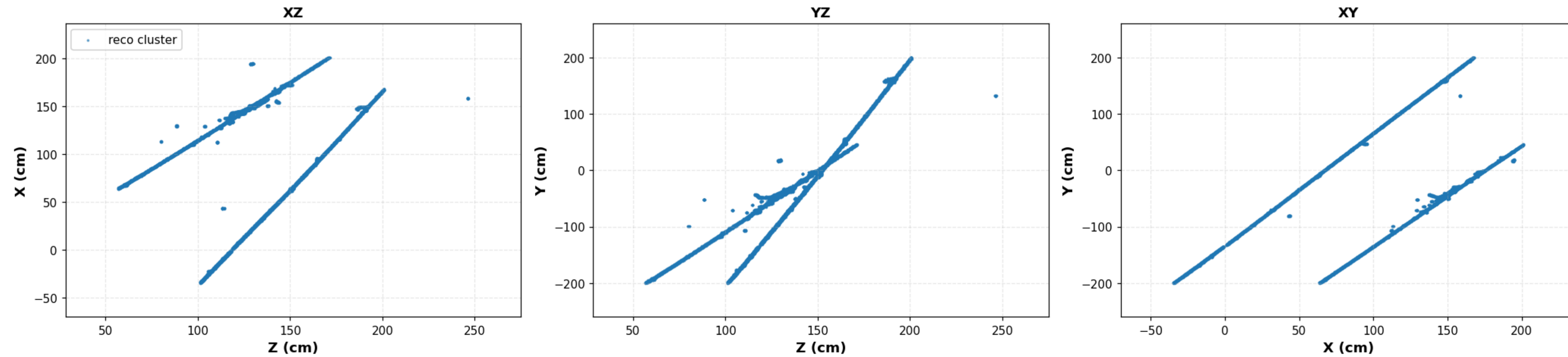
bee-display: <https://www.phy.bnl.gov/twister/bee/set/3a3bfd4-5020-4f10-a4de-890170f1563c/event/7/>

- “Background” out-of-volume correctly tagged and removed by cosmic tagger

Successful Examples of Cosmic Taggers

event chunk0_73 | tagged by tgm (4409 pts) | reco id 18.000 | 8964 points in cluster | flash t 1.54 us

[Bee-link](#)

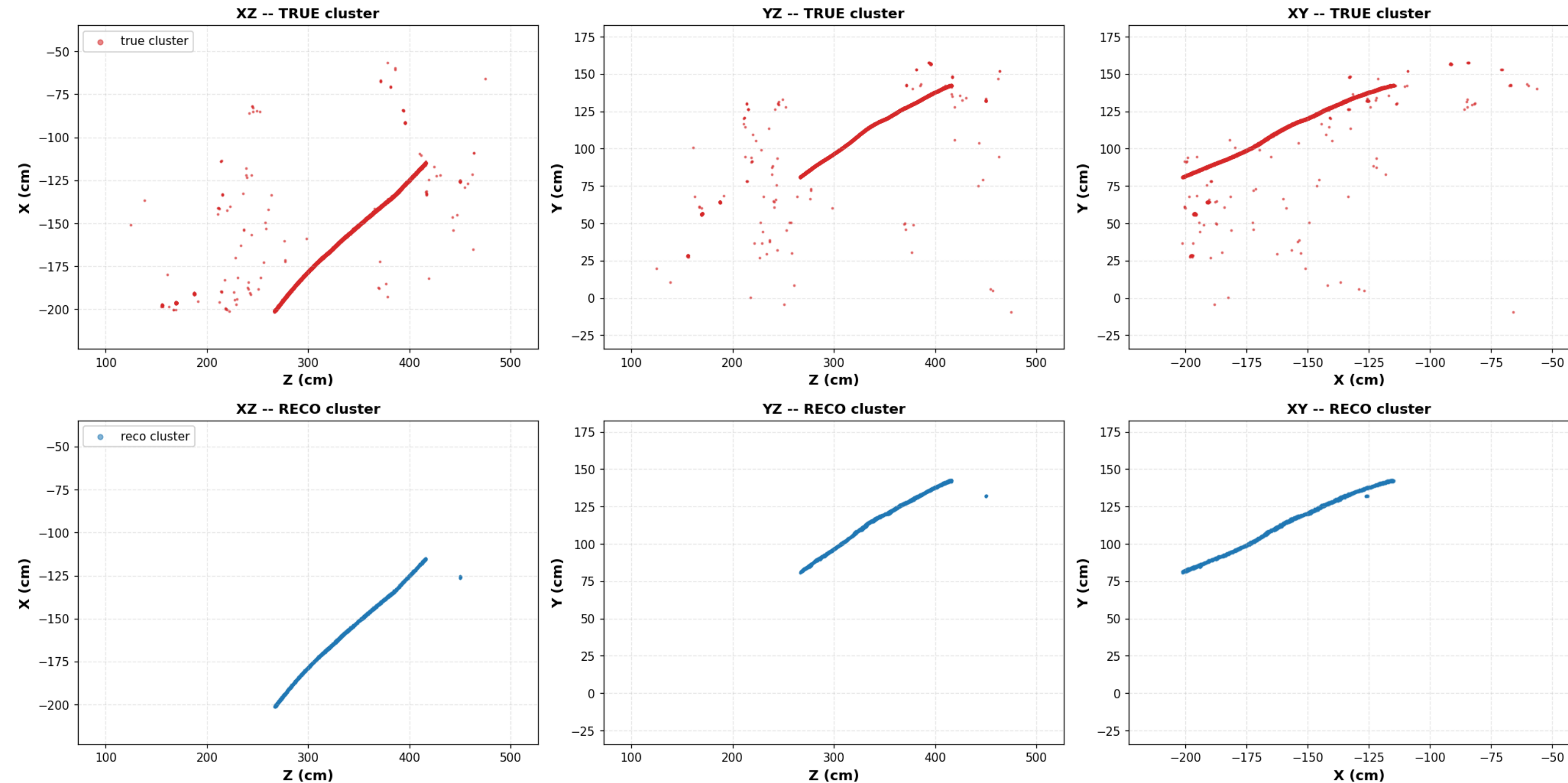


bee-display: <https://www.phy.bnl.gov/twister/bee/set/3a3bfcd4-5020-4f10-a4de-890170f1563c/event/73/>

- “Background” cosmic correctly tagged and removed by cosmic tagger

Failure Examples of Cosmic Taggers

event chunk0_144 | numu_CC | in-volume | purity 1.000 | **REMOVED by the cosmic tagger cut -- in-volume neutrino**
completeness 0.965 | true E 430 MeV | reco E 309 MeV | true id 99992 | reco id 4.000 | REMOVED: tagged by stm



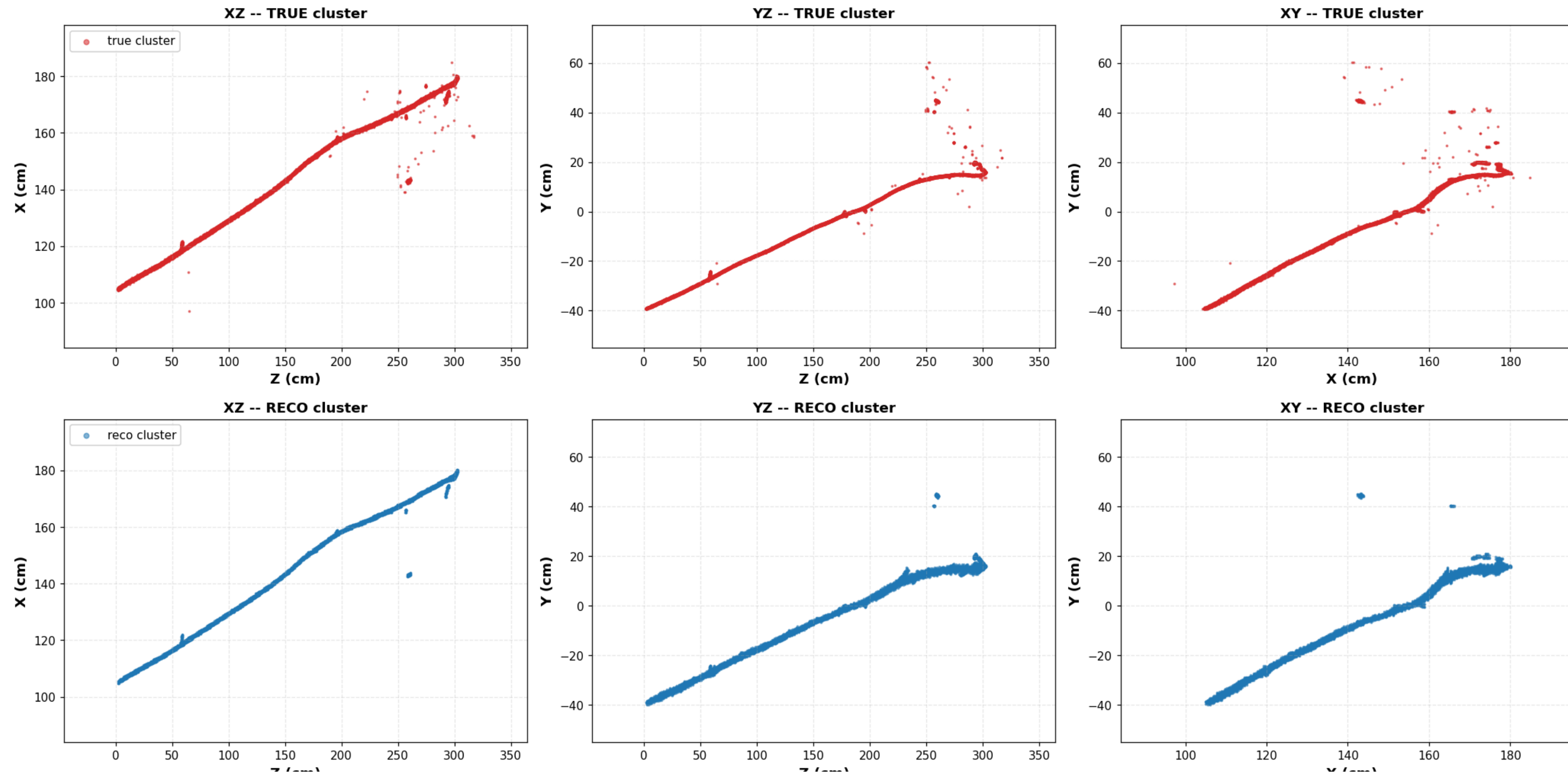
[Bee-link](https://www.phy.bnl.gov/twister/bee/set/3a3bfcd4-5020-4f10-a4de-890170f1563c/event/144/)

bee-display: <https://www.phy.bnl.gov/twister/bee/set/3a3bfcd4-5020-4f10-a4de-890170f1563c/event/144/>

- “Signal” $\nu_{\mu}CC$ wrongly tagged and removed by cosmic tagger

Failure Examples of Cosmic Taggers

[Bee-link](#)



- “background” (out-of-volume) NOT removed by cosmic tagger

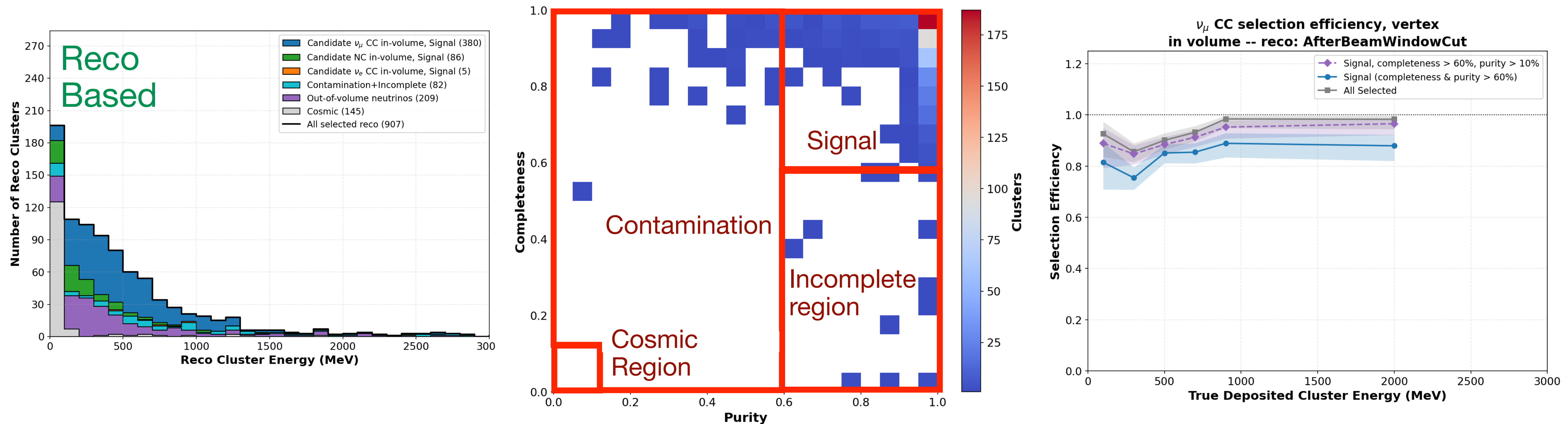
Conclusion

- In first order cosmic tagger has worked as we expected it to tag and remove vertex-out-of-volume neutrinos and cosmic
- Though cosmic tagger need further improvement because
 - “signal” removed by cosmic tagger
 - “background” (out-of-volume) NOT removed by cosmic tagger
- I have prepared full list of bee-displays for debug
 - “signal” removed by cosmic tagger - [bee-links](#)
 - “background” (out-of-volume) NOT removed by cosmic tagger - [bee-links](#)

Backup

Motivation

[docdb-48940](#)



- Status of wirecell based reconstruction was presented in the SBND Reco meeting this Tuesday, 18 Aug 2026 in [docdb-48940](#)
- Results were well received and we showed our generic selected reconstructed clusters, quality of reconstruction, and selection efficiency

Next Steps

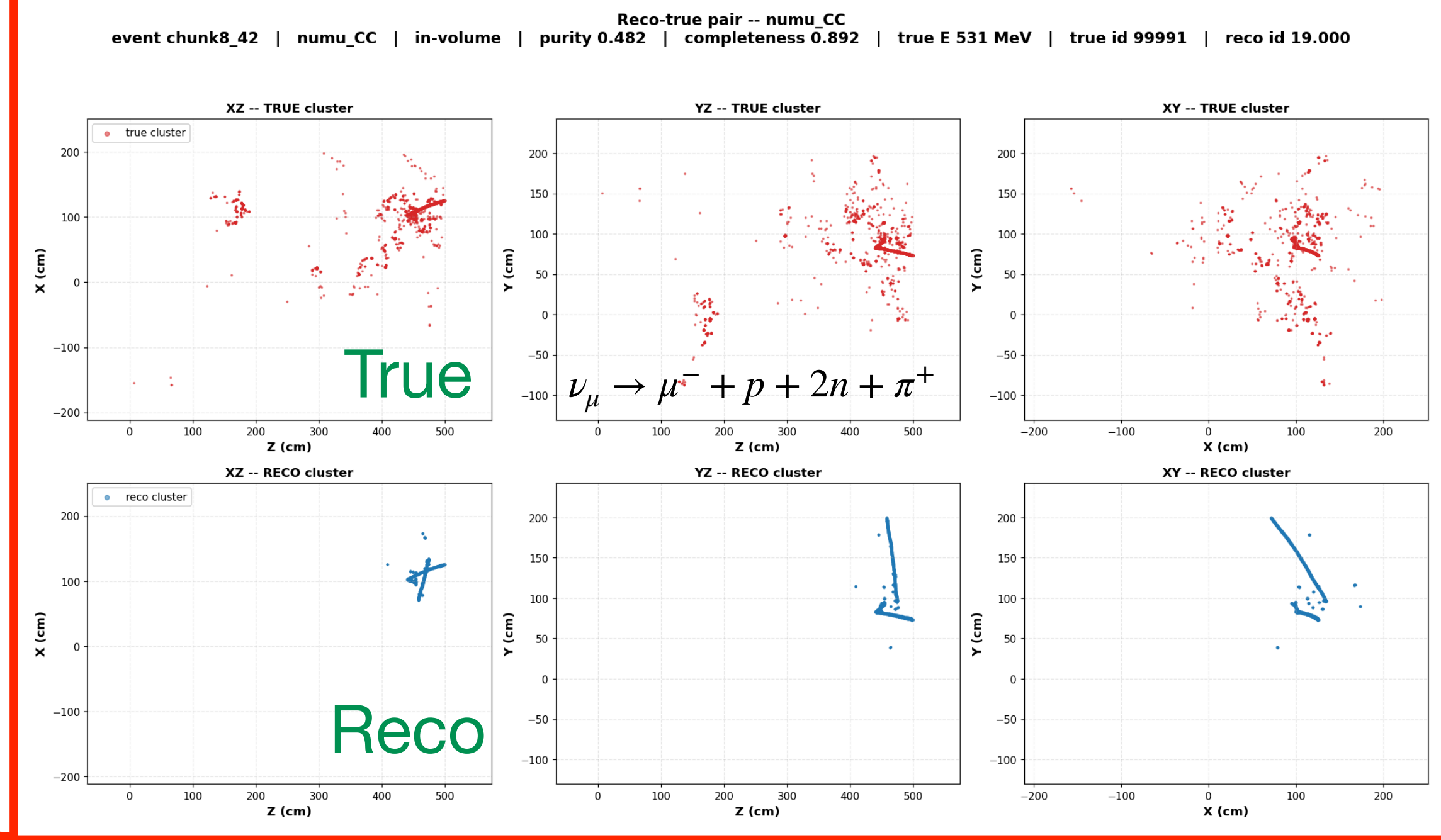
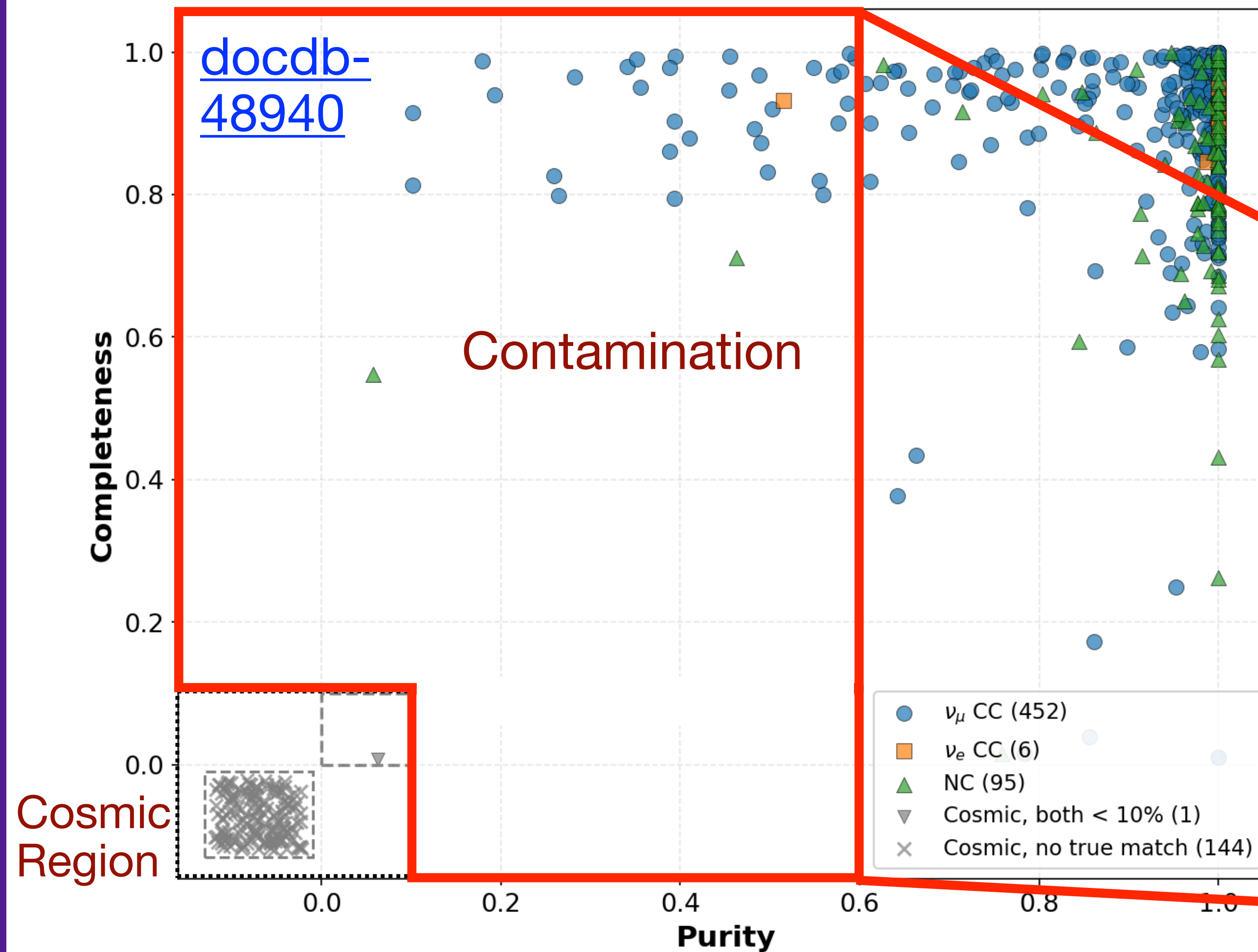
- Further investigation on contaminated events
- Evaluation of NC selection efficiency
- Evaluation of nueCC selection efficiency using special nueCC MC sample
- Evaluation of cosmic taggers (to reduce both neutrino out-of-volume and in-beam cosmics)
- Handscan of preliminary pattern recognition results from Xin

Next Steps

- Further investigation on contaminated events

High Completeness Moderate to Low Purity:
Challenging Signal

- In-beam neutrino contaminated by a cosmic
- Pattern Recognition will help in mitigating these cases by removing cosmic



[Bee display: link](#)

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For these we need to run reconstruction
on special nueCC, and NC samples

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We already have cosmic tagger. I need to include them in my selection and evaluation scripts

Next Steps

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