Displaced Vertex Trigger Studies

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Belle II ML-based Trigger Meeting
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Bundesministerium
für Bildung
und Forschung

Belle II

KIT
Karlsruher Institut für Technologie

ETP
Institut für Experimentelle Teilchenphysik

Organisation

We have our bi-weekly indico to see the agenda and store our progress:

- Link: https://indico.cern.ch/category/15365/
- CERN-hosted, everyone can login via their institution using eduGAIN (click Login (top right) on https://indico.cern.ch
- For those who never logged into CERN indico:
  1. Please login to CERN indico
  2. **Please send me the email with which you logged in (my email is slavomira.stefkova@kit.edu)**
- The previous procedure is necessary so that I can make the category private :)
- For now, me and Torben are managers, however I think each participating institute should be have managerial rights: **Kai** and **Christian** are you OK if I add you?
- **To do:** session creation + material upload available to our group

Simulation Samples: Update

Solve MCParticle overlap problem

- Main motivation: particle overlap is a problem in supervised ML
- Torben implemented a possibility to store for each CDCHit up to three MCParticle relations
- For more details, follow PR: https://stash.desy.de/projects/B2/repos/basf2/pull-requests/907/overview
  (merged with master)
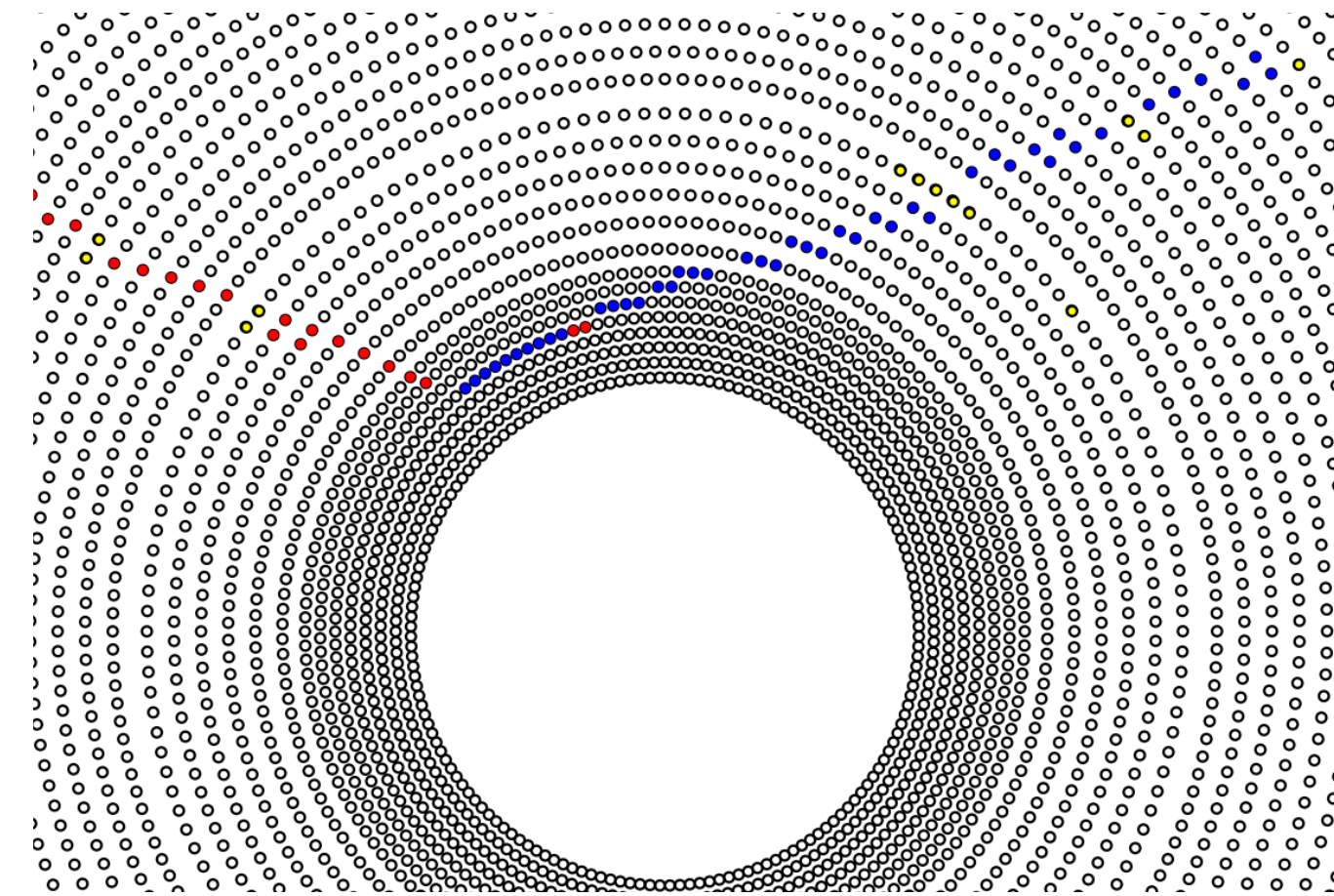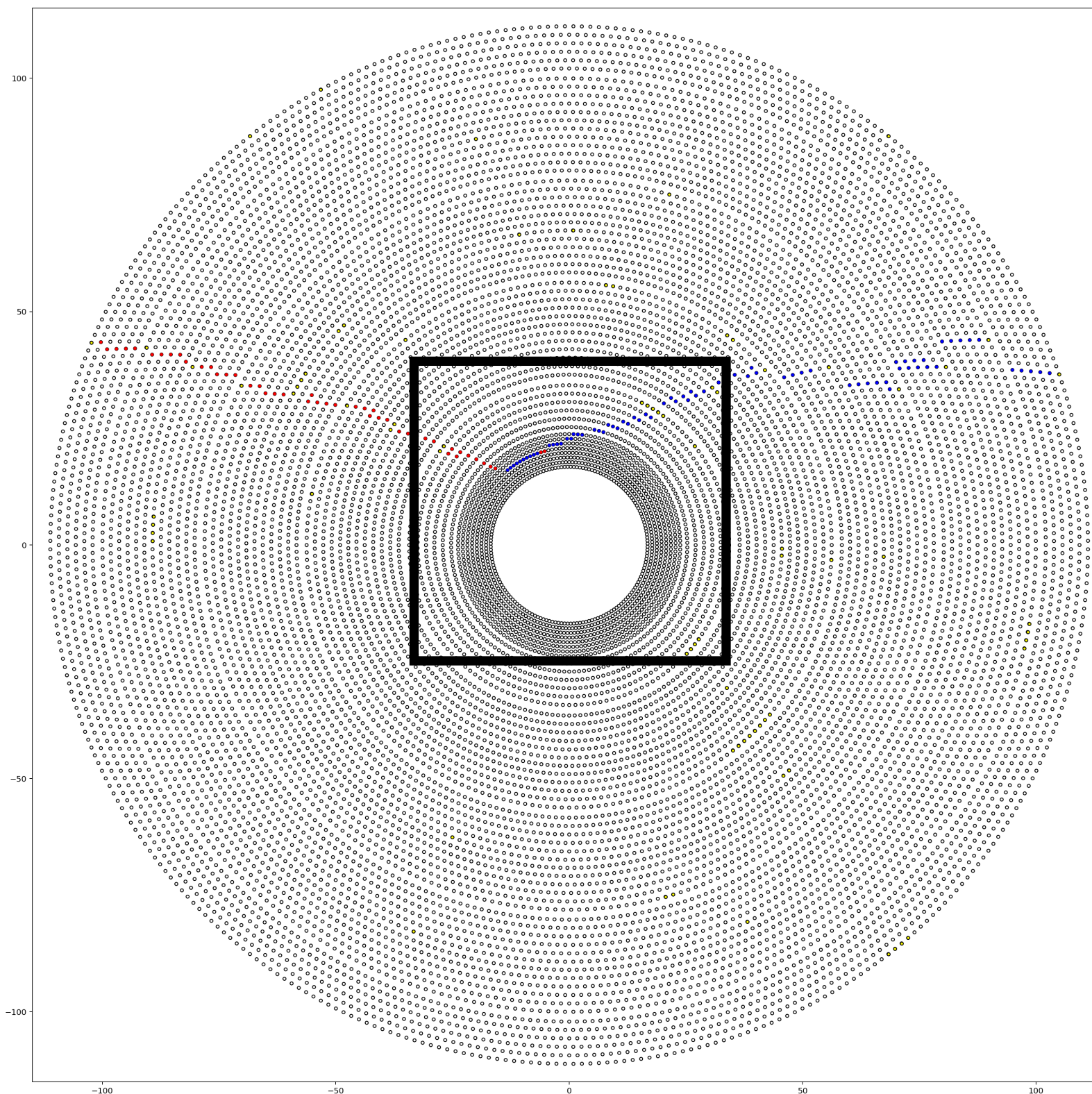
1) activate multi-matching for CDCHits after adding add_simulation():

```
modules = main.modules()
for m in modules:
    if "CDCDigitizer" in m.name():
        m.param('OptionalMCParticlesToHitsName', 'MultipleMatchedParticles')
        m.param('MatchAllParticles', True)
```

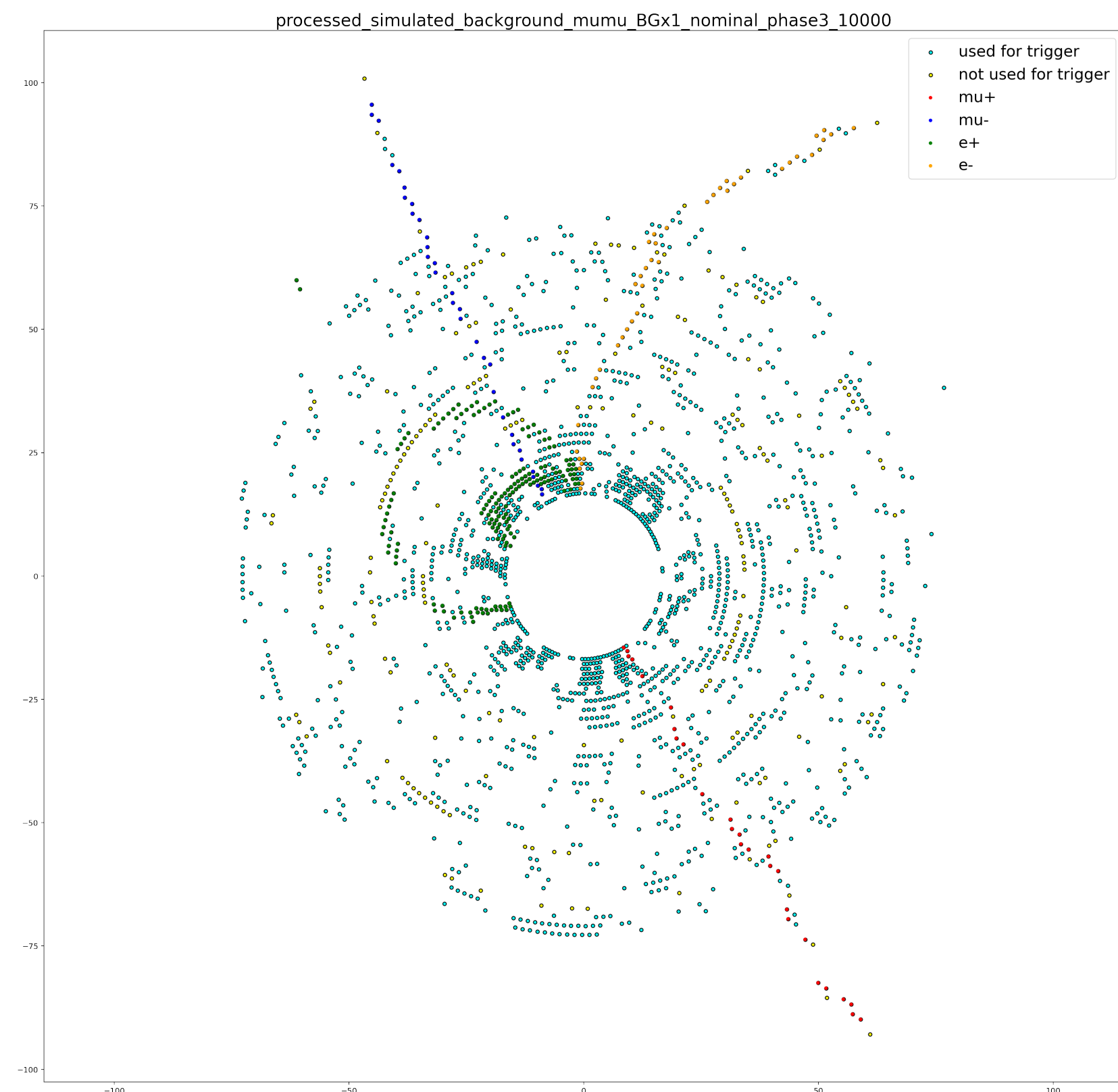2) store the additional relation branch:

```
MCParticlesToCDCHitsNamedMultipleMatchedParticles
```

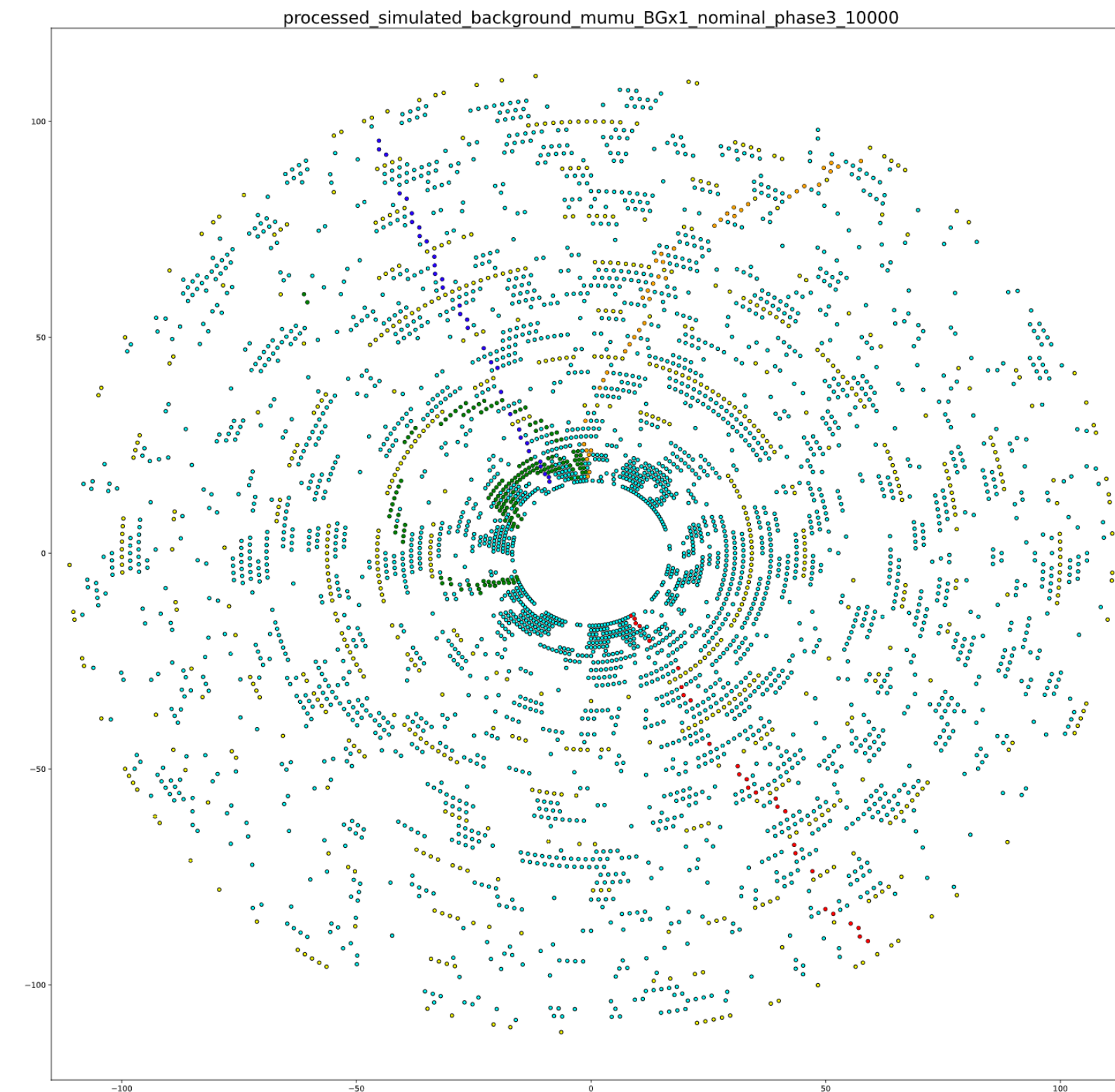# Samples with Nominal BKG: Missing Hits

- Last time I showed **problem** with nominal samples: **missing hits in outer wires**
- My mistake: processing module only stored the first 2000 hits —> now have bigger padding (10000)

Before

Now

Sample Status @ NAF: Backgrounds

Background type, old, updated (up to 3 relations)

1) beam background

early phase 3: /nfs/dust/belle2/user/sstefkov/displaced_trigger_simulation/backgrounds/beam_backgrounds/beambackground_BGx1_early_phase3_10000.root

nominal phase 3: /nfs/dust/belle2/user/sstefkov/displaced_trigger_simulation/backgrounds/ beam_backgrounds/beambackground_BGx1_nominal_phase3_10000.root

2) ee -> ee(g) Radiative Bhabha

early phase 3: /nfs/dust/belle2/user/sstefkov/displaced_trigger_simulation/bhabha/babayaganlo_BGx1_early_phase3_10000.root

nominal phase 3: /nfs/dust/belle2/user/sstefkov/displaced_trigger_simulation//bhabha/babayaganlo_BGx1_nominal_phase3_10000.root

No backgrounds: : /nfs/dust/belle2/user/sstefkov/displaced_trigger_simulation/bhabha/babayaganlo_all_relations_BGx0_none_10000.root

early phase 3: /nfs/dust/belle2/user/sstefkov/displaced_trigger_simulation/bhabha/babayaganlo_all_relations_BGx1_early_phase3_10000.root

nominal phase 3: /nfs/dust/belle2/user/sstefkov/displaced_trigger_simulation//bhabha/babayaganlo_all_relations_BGx1_nominal_phase3_10000.root

3) ee-> mumu

No background: /nfs/dust/belle2/user/sstefkov/displaced_trigger_simulation/mumu/mumu_BGx0_none_10000.root

early phase 3: /nfs/dust/belle2/user/sstefkov/displaced_trigger_simulation/mumu/mumu_BGx1_early_phase3_10000.root

nominal phase 3: /nfs/dust/belle2/user/sstefkov/displaced_trigger_simulation//mumu/mumu_BGx1_nominal_phase3_10000.root

No background: /nfs/dust/belle2/user/sstefkov/displaced_trigger_simulation/mumu/mumu_all_relations_BGx0_none_10000.root

early phase 3: /nfs/dust/belle2/user/sstefkov/displaced_trigger_simulation/mumu/mumu_all_relations_BGx1_early_phase3_10000.root

nominal phase 3: /nfs/dust/belle2/user/sstefkov/displaced_trigger_simulation//mumu/mumu_all_relations_BGx1_nominal_phase3_10000.root

Sample Status @ NAF: Signal

Signal type, old, updated (~7500 events)

1) Dark Higgs m_H = [0.5 GeV, 2.5 GeV]
   No backgrounds: /nfs/dust/belle2/user/sstefkov/displaced_trigger_simulation/signal/dark_higgs/no_background
   Early Phase 3: /nfs/dust/belle2/user/sstefkov/displaced_trigger_simulation/signal/dark_higgs/early_phase3
   Nominal Phase 3: /nfs/dust/belle2/user/sstefkov/displaced_trigger_simulation/signal/dark_higgs/nominal_phase3
   Early Phase 3: /nfs/dust/belle2/user/sstefkov/displaced_trigger_simulation/signal/dark_higgs/early_phase3_bigger_samples/

signal: dark higgs with early phase 3 background 1 GeV
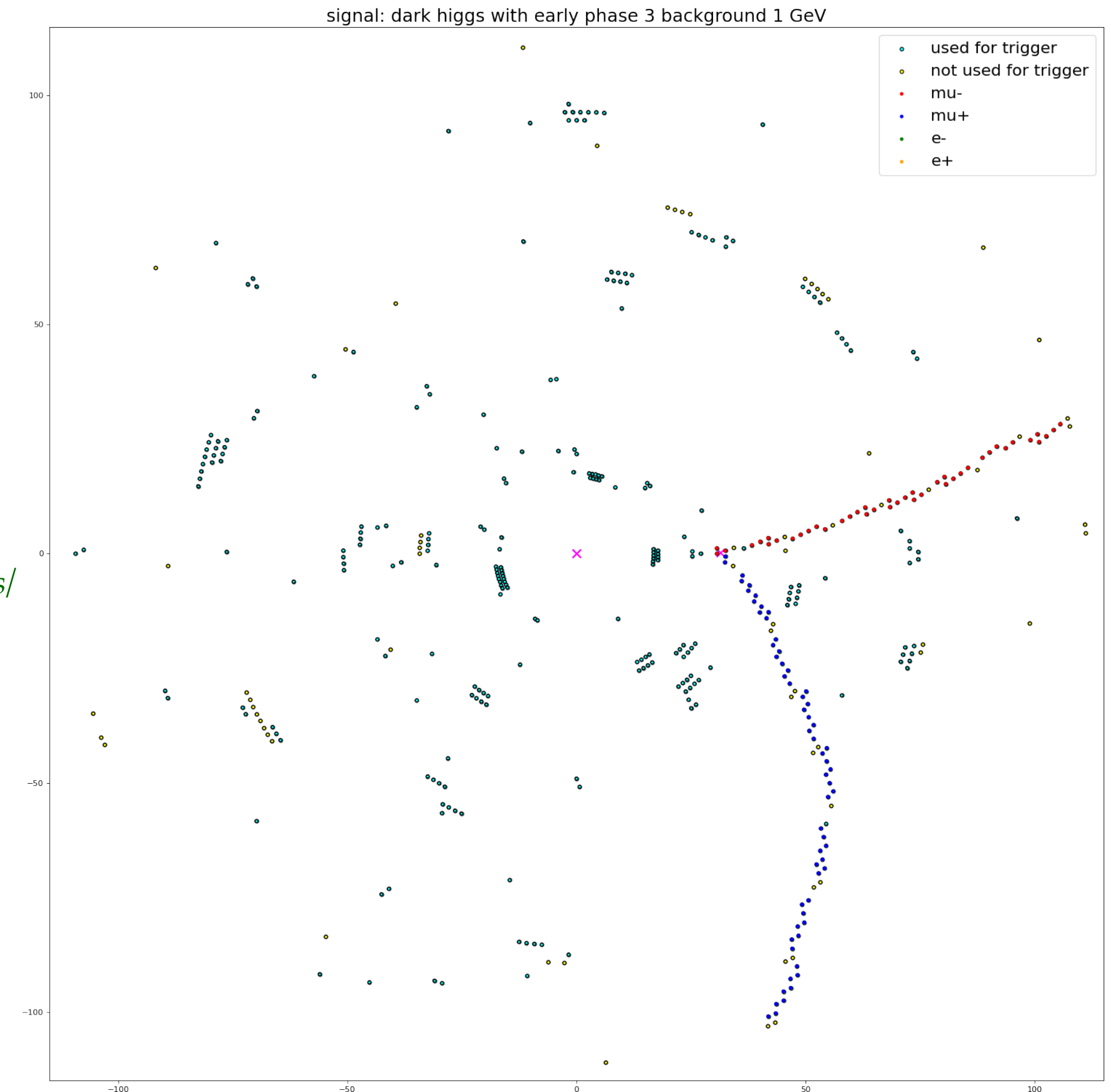
Processed Samples @ KIT

Signal type, old

1) **Dark Higgs m_H = [0.5 GeV, 2.5 GeV]**

No backgrounds: /ceph/sstefkova/displaced_trigger_studies/idm_processed_simulation_v1/ BGx0.hdf5*

Early Phase 3: /ceph/sstefkova/displaced_trigger_studies/idm_processed_simulation_v1/ BGx1.hdf5*

Nominal: /ceph/sstefkova/displaced_trigger_studies/idm_processed_simulation_v1/ nominal.hdf5*

Background type, old, updated (up to 3 relations)

1) beam background

early phase 3: /ceph/sstefkova/displaced_trigger_studies/idm_processed_simulation_v1/processed_simulated_background_beambackground_BGx1_early_phase3_10000.hdf5
nominal phase 3: /ceph/sstefkova/displaced_trigger_studies/idm_processed_simulation_v1/processed_simulated_background_beambackground_BGx1_nominal_phase3_10000.hdf5

2) ee -> ee(g) Radiative Bhabha

No backgrounds: : /ceph/sstefkova/displaced_trigger_studies/idm_processed_simulation_v2/processed_simulated_background_babayaganlo_all_relations_BGx0_none_10000.hdf5
early phase 3: /ceph/sstefkova/displaced_trigger_studies/idm_processed_simulation_v2/processed_simulated_background_babayaganlo_all_relations_BGx1_early_phase3_10000.hdf5
nominal phase 3: /ceph/sstefkova/displaced_trigger_studies/idm_processed_simulation_v2/processed_simulated_background_babayaganlo_all_relations_BGx1_nominal_phase3_10000.hdf5

3) ee-> mumu

No background: /ceph/sstefkova/displaced_trigger_studies/idm_processed_simulation_v2/processed_simulated_background_mumu_all_relations_BGx1_early_phase3_10000.hdf5
early phase 3: /ceph/sstefkova/displaced_trigger_studies/idm_processed_simulation_v2/processed_simulated_background_mumu_all_relations_BGx1_nominal_phase3_10000.hdf5
nominal phase 3: /ceph/sstefkova/displaced_trigger_studies/idm_processed_simulation_v2/processed_simulated_background_mumu_all_relations_BGx0_none_10000.hdf5

Versioning @ KIT

- *v1: store primary particle properties (no decay vertex!), add ADC count, highest primary and secondary gammas per event*
- *v2: bigger padding (10000), include up to 3 MCParticle relations for each CDC hit*

Plans

Sample Generation:

○ Update all existing samples (signal + backgrounds) to v2

○ Produce other signal sample

○ Produce also control samples

Beam Background Tracks:

○ Write a small module which stores MCParticle information for beam backgrounds hits/tracks

○ Add overlay event identifier

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BACKUP