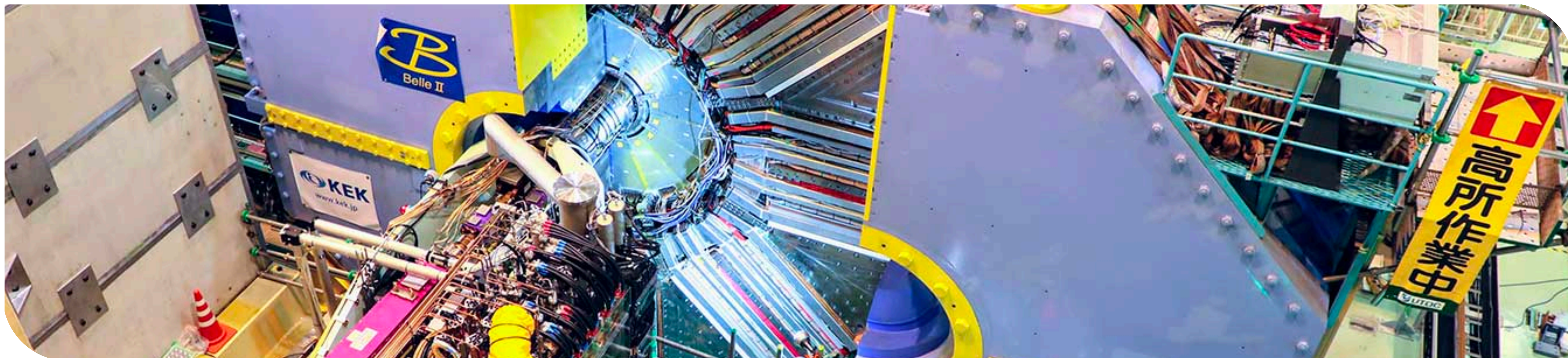


ML4DVTRG: ML for displaced vertex triggers

KIT/MPI Future Trigger Meeting, 28.04.2022

Torben Ferber (torben.ferber@kit.edu), Slavomira Stefkova, Patrick Ecker

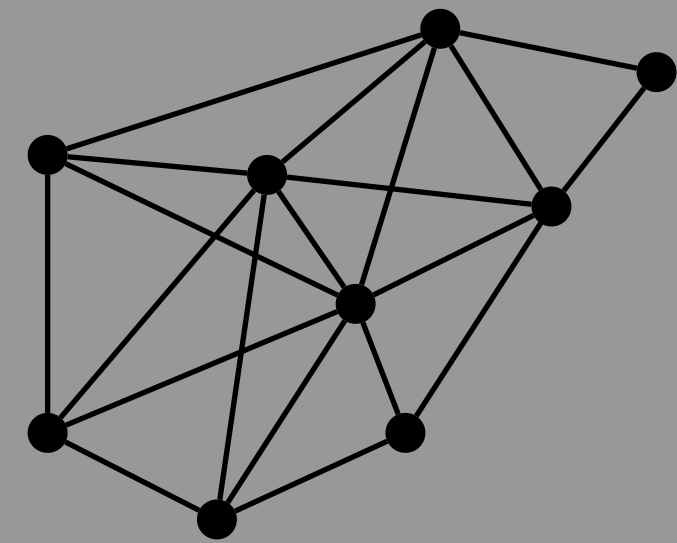


Strategy 1: Graph Neural Network(s)

CDC Hits
(Nodes)

Segments
(Edges)

Graphs

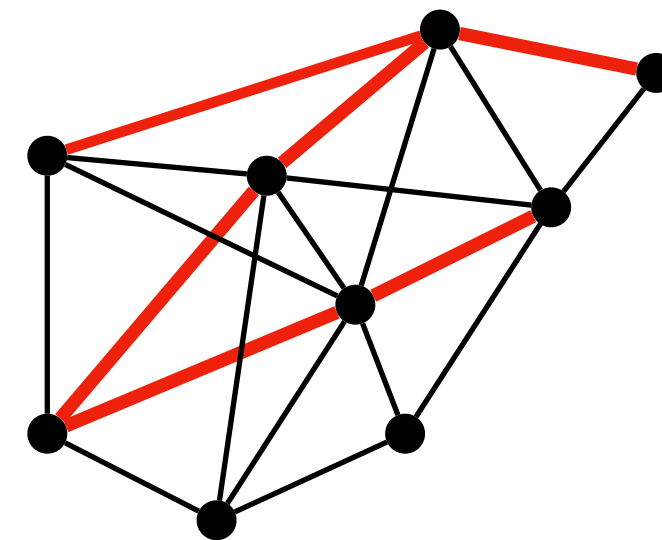


typical: connect neighbouring layers
with $\Delta\Phi/dr$ slope and dr distance
cuts

*ML4TRG next step: need hits in
same layers as well*

GNN 1

Edge-Classification



target (binary edge classification)

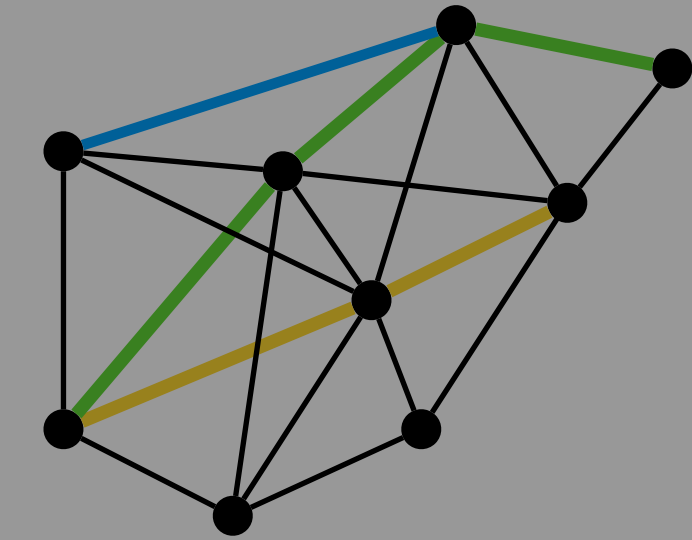
- true connections are assigned 1
- fake connections are assigned 0

“true” == both nodes have SimHits from
the same primary MCParticle*

**ML4TRG next step: Nodes can have
hits from multiple MCParticles**

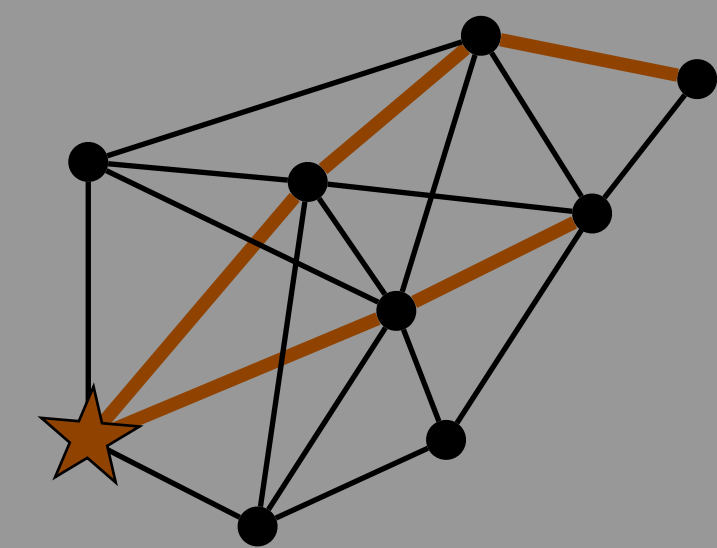
GNN 2

Trackfinding



GNN 3

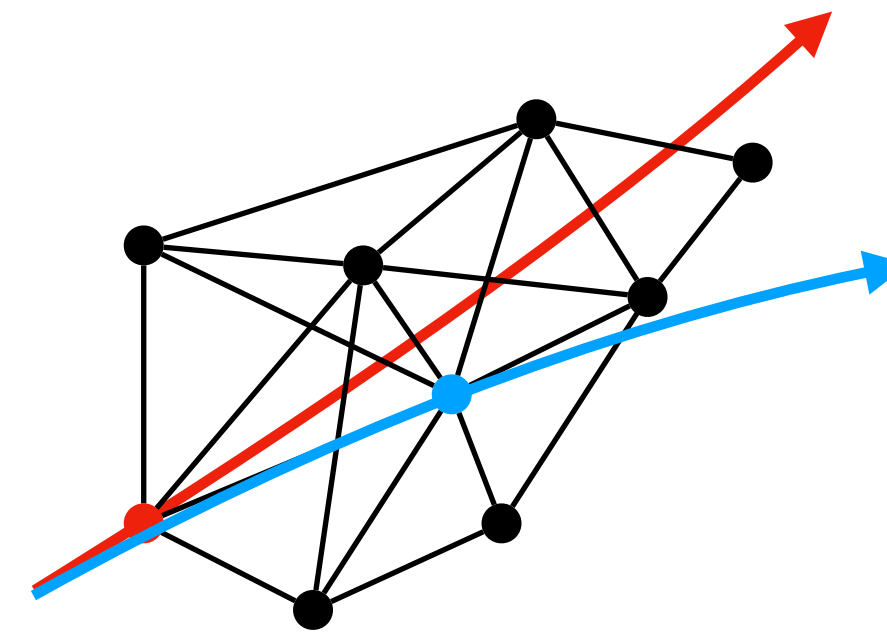
Vertexing



- MC matching to more than one particle

edge not labelled 'signal' because MC matching reported different matches (closest to wire)

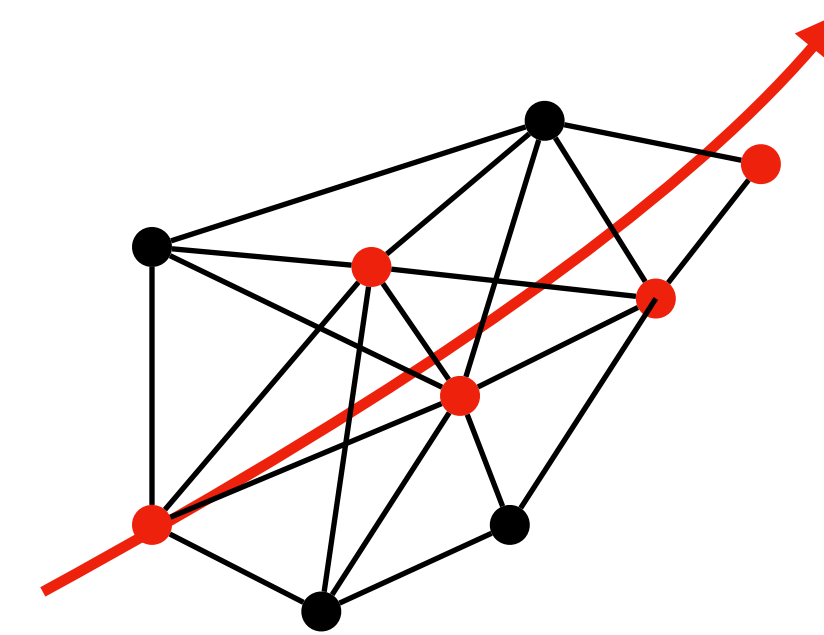
→ fixed (next slide)



- Hits from the same particle in the same layer

particle can leave energy depositions in neighbouring wires, while for tracking finding one wire is sufficient

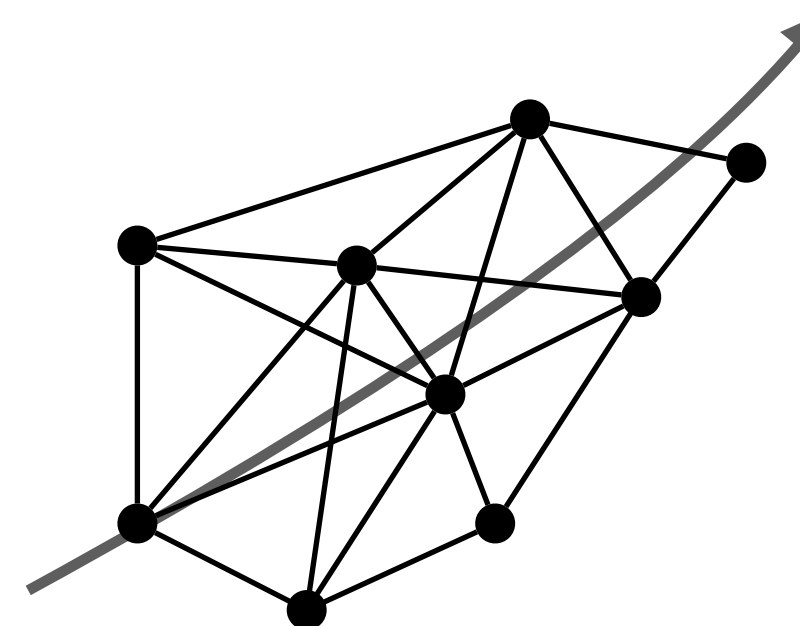
→ can be solved offline by clever preselection



- Tracks in beam background

tracks have no MC matches, but clearly tracks

→ we are studying dedicated beam background samples that have this information (Sally)



Multi-MC matches in CDC

- optionally store up to three MC matches:
<https://stash.desy.de/projects/B2/repos/basf2/pull-requests/907/overview> (now merged to main)
- modify python steering:

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

- store additional branch:

```
MCParticlesToCDCHitsNamedMultipleMatchedParticles
```

- use new named relation:

```
mcrelations = cdchit.getRelationsWith['MCParticle']('MCParticles', 'MultipleMatchedParticles')
```