Trigger information in Physics DPD

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- What trigger information is needed for analysis?
  - A few use cases
- Two scenarios
  - What is the minimal trigger information needed?
  - What info is needed to do Tag&Probe?
- Trigger slimming tools: possible scenarios
  - An example of application to ttbar events
- Conclusions

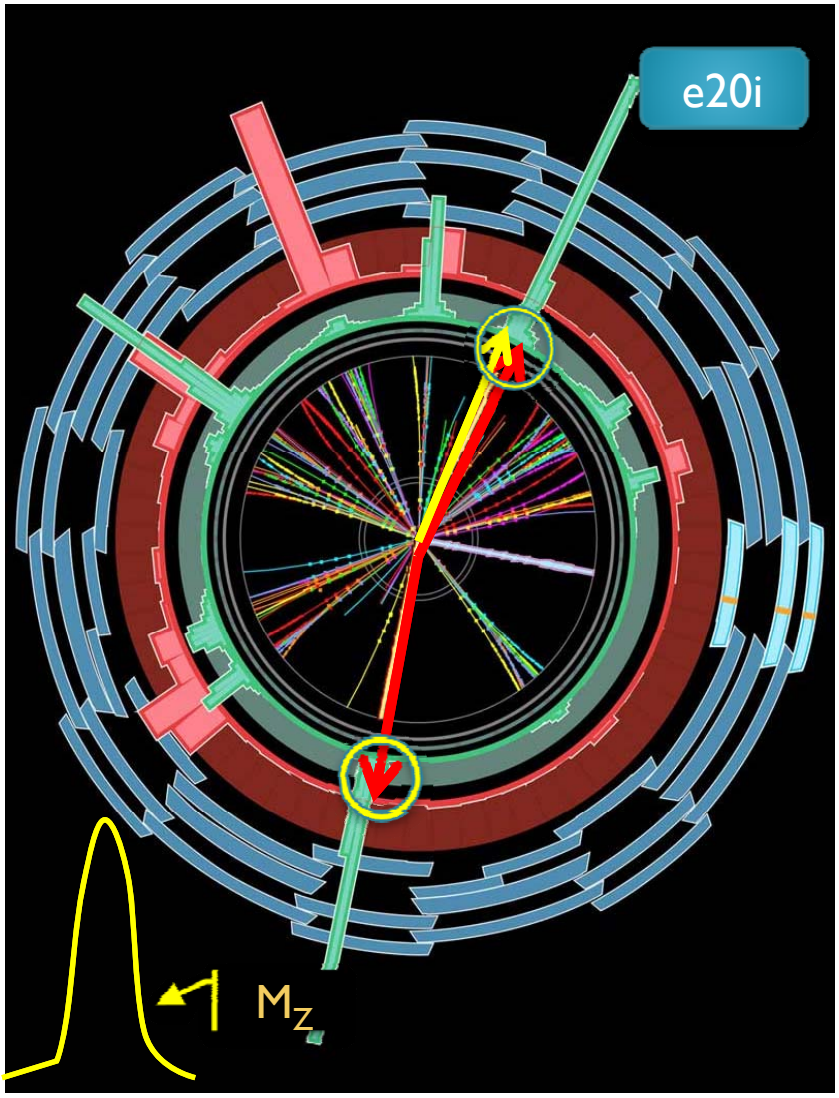
Trigger information in DPD & etc

- Trigger-related info:
  - Trigger event data (physical objects, navigation) and configuration in data files (ESD/AOD/DPD)
  - Trigger Data Quality info: integrated with ATLAS DQ
  - Menu and running periods: partially in place and in development…
    - Which runs have mu20i_loose active? When did trigger change?
  - What is the "official" tau35i, mu20i, e20_loose efficiency? Future work…

- Minimal information for analysis:
  - Trigger configuration:
    - Was trigger A running? What was its pre-scale?
  - Yes/no trigger decision:
    - Did trigger A accept event? Did triggers A or B pass event?
  - Pre-scale/pass-through decision:
    - Did trigger A fail just because of pre-scale? (e.g. for events accepted by trigger B)

Trigger information in DPD

- Enough for tag&probe:
- Selected events with single-lepton trigger
- Offline: select $Z \rightarrow l^+l^-$ events
  - Reconstruct >=2 leptons
  - Apply m_Z and fiducial cuts etc
- Match one of the 2 leptons with a trigger lepton passing single trigger
- Search for second matching trigger lepton
- Count successes in 2nd matching



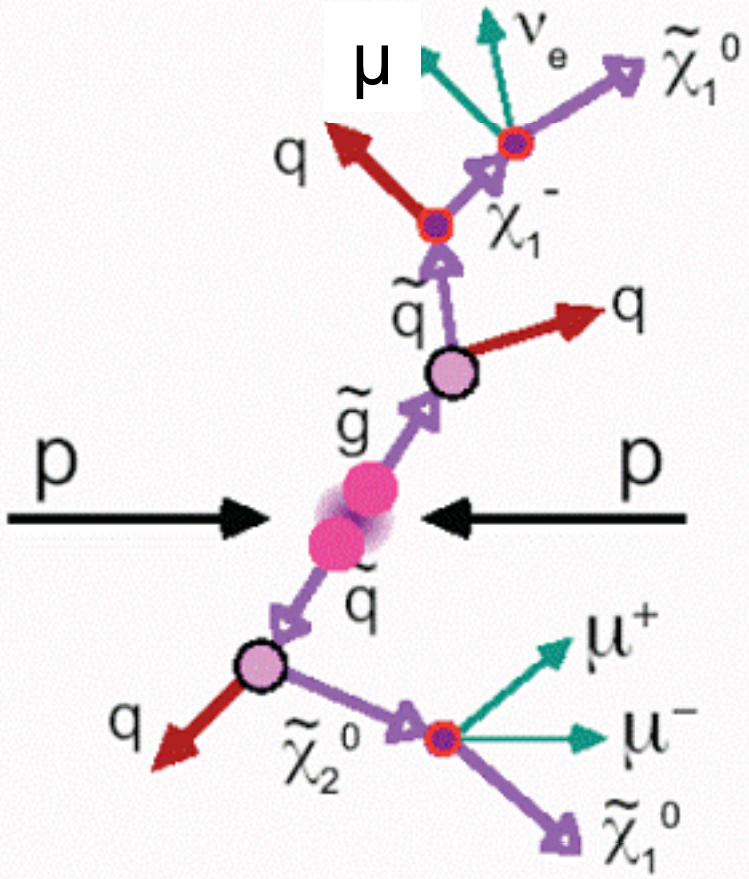
Need to be able to match offline objects with online objects:

✓Minimal info needed is RoI η and φ

✓Better matching would need trigger objects (muon hits, perigee, etc)

Another example (artificial?... not so much)

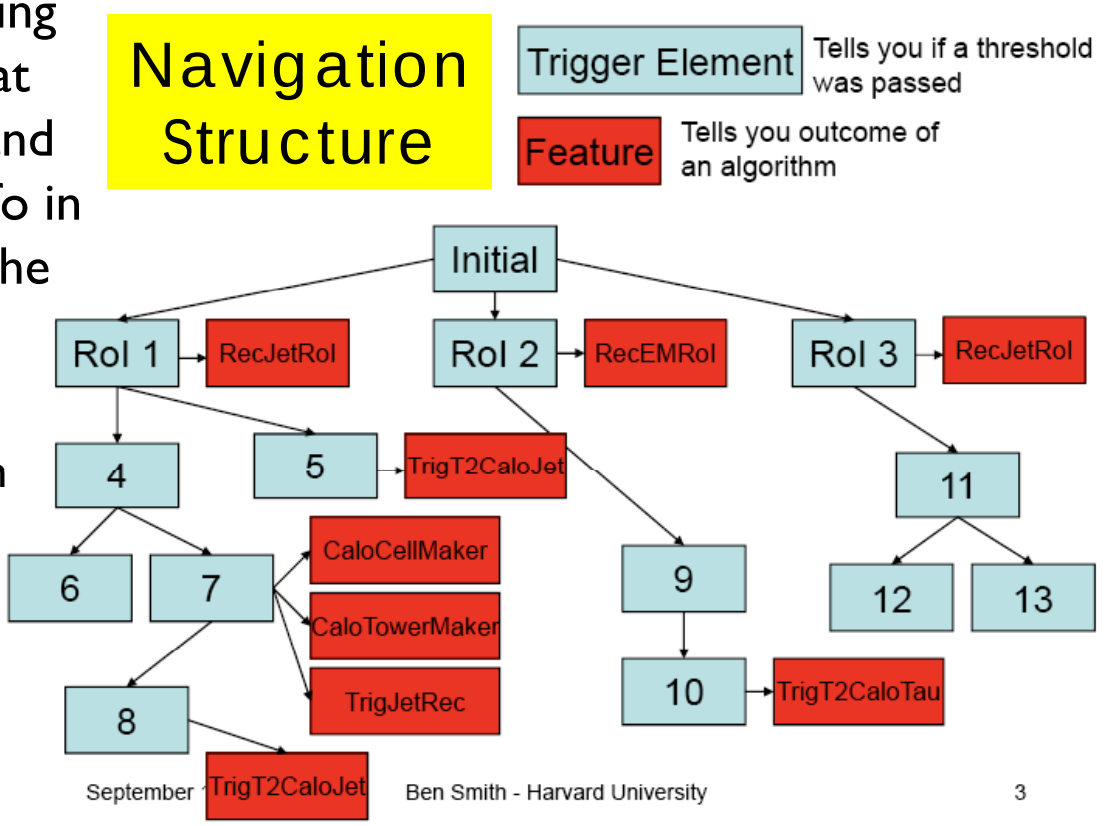
- X_2^0 cross section:
  - $\sigma = (N_{obs}-N_{bkg})/(A\ \varepsilon_{trig}\ \varepsilon_{off}\ L)$
  - Trigger and offline muon efficiency determined per initial muon (tag&probe)
  - Select events with >= 2 μ to increase stats
  - Find μμ pair in one side of event and identify X_2^0
  - Correct trigger efficiency ε_{trig} for events with 3 muons
- Needs to match trigger and offline objects to avoid miscalculation



What trigger info for Tag&Probe

- All needed information is contained in the features and navigation in **HLTResult_EF**
  - Is any of the physics analyses interested in the L2 features ?
  - What about the performance groups (performance DPDs)?

- There are Trigger slimming tools (see Ben's talk) that can provide a helping hand to remove unwanted info in the Trigger and reduce the total size of the Trigger objects
  - Can envisage more than one scenarios in which these tools can be applied.



Case 1)

- Keep HLTResult_EF as it is, remove L2 Navigation
  - Full removal of EF/L2 navigation available since 14.2.0
  - L2 navigation is copied into EF navigation – no functionality sacrificed

Type (ttb events)	Size (kb/evt)	Trigger containers
AOD	273	HLTResult_EF (7.06 kb/evt) HLTResult_L2 (4.5 kb/evt)
DPD		
Remove L2 navigation		HLTResult_EF (7.06 kb/evt) HLTResult_L2 (0.125 kb/evt)

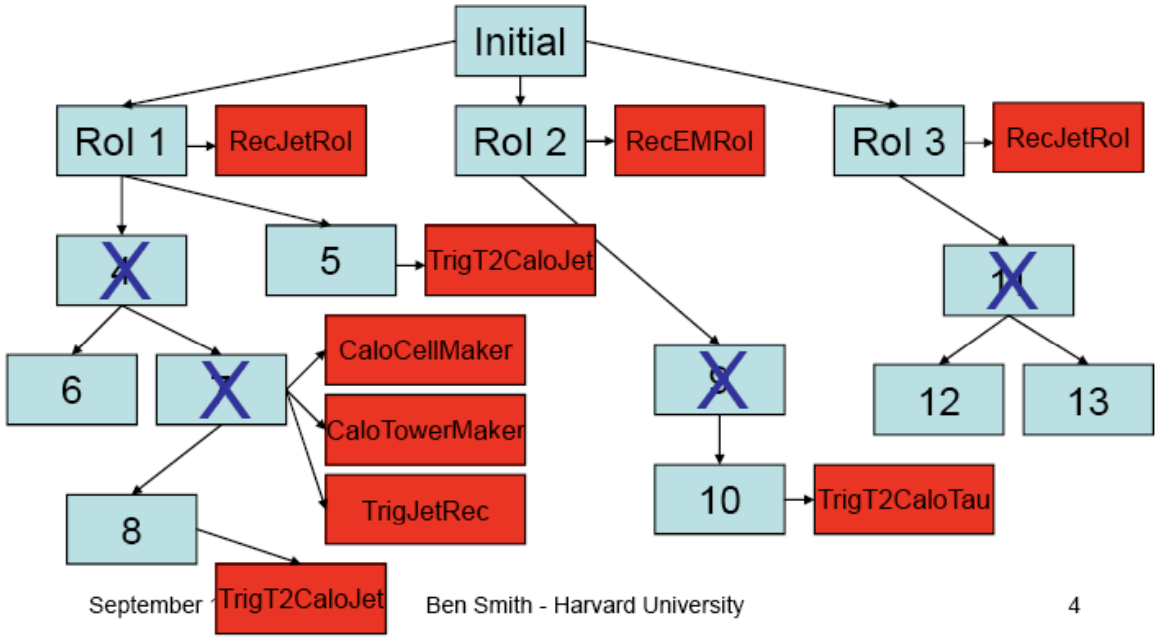
Navigation slimming

- Squeezing and removing ghosts comes at no cost in terms of functionality – see Ben's talk

```
slimmerAlg.Squeeze = 0
slimmerAlg.RemoveFeatureless = 0
slimmerAlg.RemoveGhosts = 0
slimmerAlg.WriteTree = 1
slimmerAlg.ProtectOtherStreams = 1
slimmerAlg.StreamInclusionList = [ ]
slimmerAlg.StreamExclusionList = [ ]
slimmerAlg.GroupInclusionList = [ ]
slimmerAlg.GroupExclusionList = [ ]
slimmerAlg.ChainInclusionList = [ ]
slimmerAlg.ChainExclusionList = [ ]
slimmerAlg.FeatureInclusionList = [ ]
slimmerAlg.FeatureExclusionList = [ ]
slimmerAlg.BranchInclusionList = [ ]
slimmerAlg.BranchExclusionList = [ ]
```

Squeezing

Remove all TE's that are not RoI's or terminal and update relations accordingly



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Case 2)

- Slim HLTResult_EF using Trigger slimming tools
  1) Remove trigger elements with no features
  2) Squeeze: trigger elements that are not initial, RoI or terminal nodes are removed
  3) Remove 'ghosts'
- Remove L2 Navigation

Type (ttb events)	Size (kb/evt)	Trigger containers
AOD	273	HLTResult_EF (7.06 kb/evt) HLTResult_L2 (4.5 kb/evt)
DPD		
Slimming EF navigation (1 - 3)		HLTResult_EF (4.69 kb/evt)
Remove L2 navigation		HLTResult_L2 (0.125 kb/evt)

Preliminary results applying slimming

- Trigger/Track slimming in SUSY common DPDs

Type	Size (kb/evt)	Biggest containers
AOD	273	
Common DPD	107	McTruth (59 kb/evt) TrackParticle (36 kb/evt) HLTResult_EF (7.06 kb/evt) HLTResult_L2 (4.5 kb/evt)
Track slimming (remove error matrix, pT > 5) Truth slimming (remove parton shower)	58.6	McTruth (9.1 kb/evt) TrackParticle (26 kb/evt)
Slimming EF navigation (1 - 3)	56.29	HLTResult_EF (4.69 kb/evt)
Slimming EF navigation (4)	56.27	HLTResult_EF (4.67 kb/evt)
Remove L2 navigation	52.07	HLTResult_L2 (0.125 kb/evt)
Extra track slimming (keep Perigee only)	36.0	TrackParticle (10 kb/evt)

Conclusions

- Minimal info:
  - Save about 10kB/(ttbar) event
  - Not able to match trigger and offline objects
  - …do some studies on AOD
- Extended info – 2 scenarios with no info loss:
  - Case 1: save about 4.5kB/(ttbar) event
  - Case 2: save about 6.6kB/(ttbar) event
- Caveat:
  - Numbers are from ttbar
  - They don't scale linearly with event size