Trigger design for di-higgs Production

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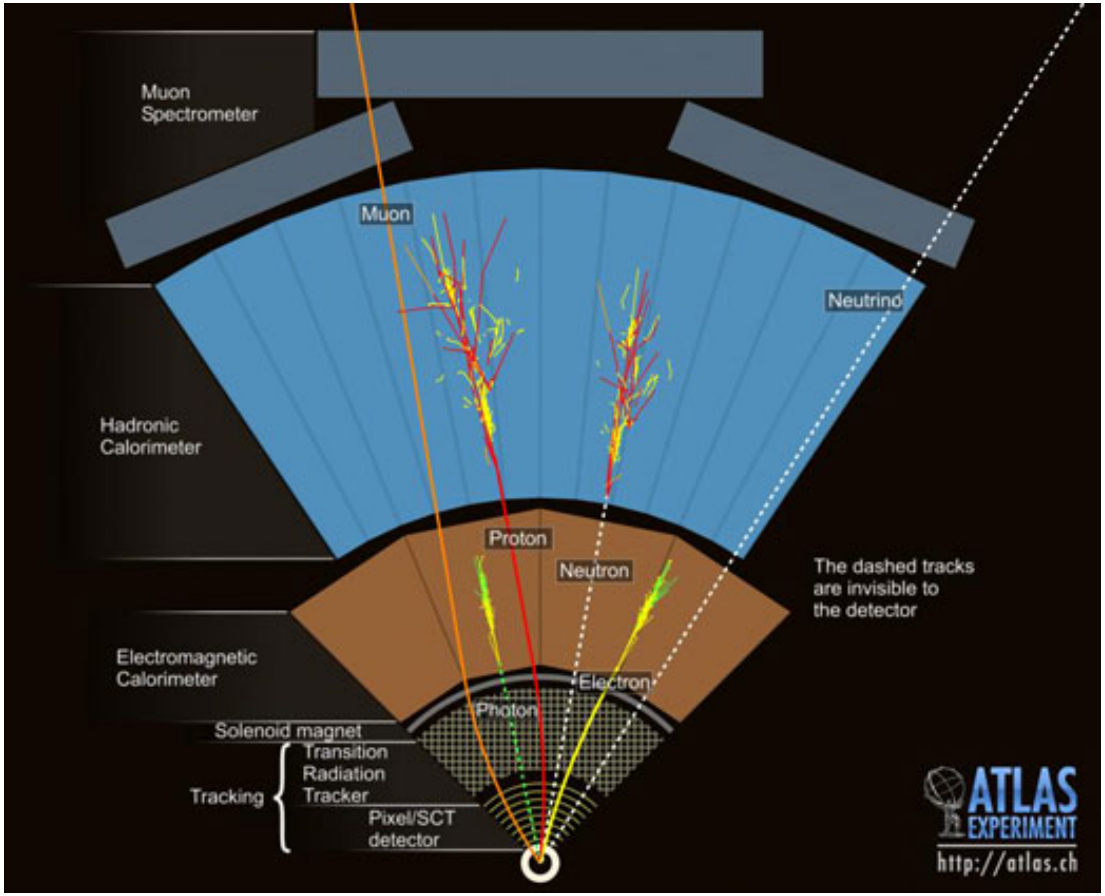
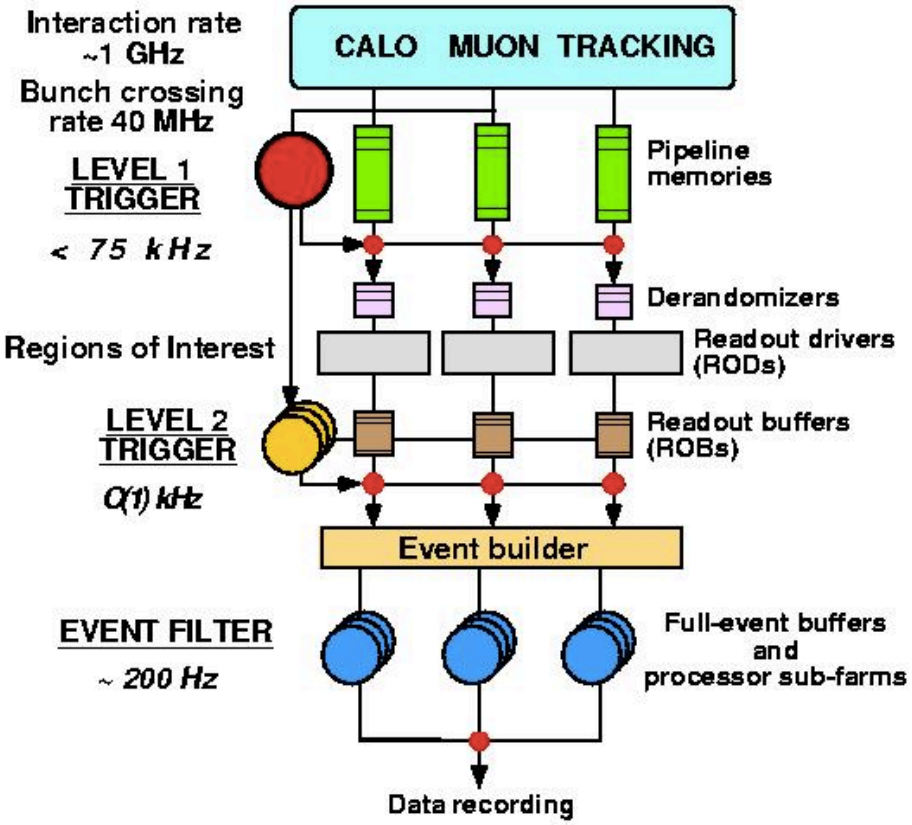
ATLAS



General detector!

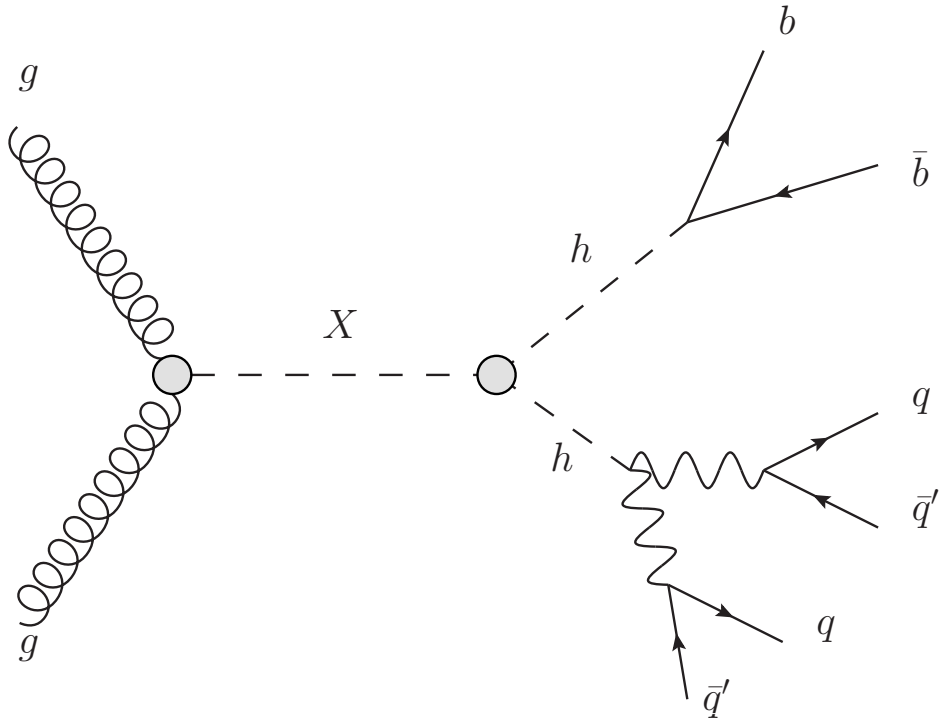
What is a trigger?



- Jet
- *b*-tag or *b*-jet
- "p_t" = transverse momentum

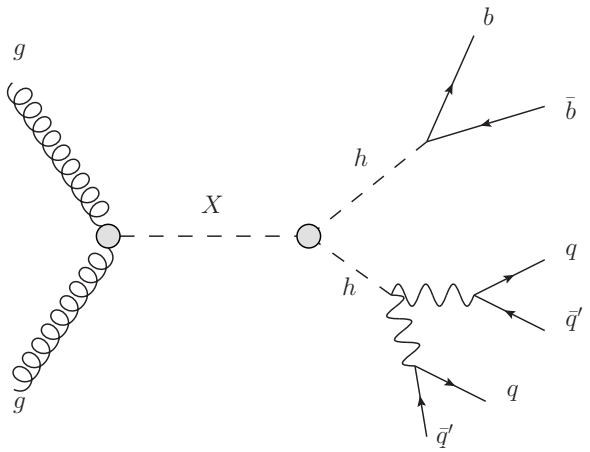
Di-higgs production

- Fully hadronic channel



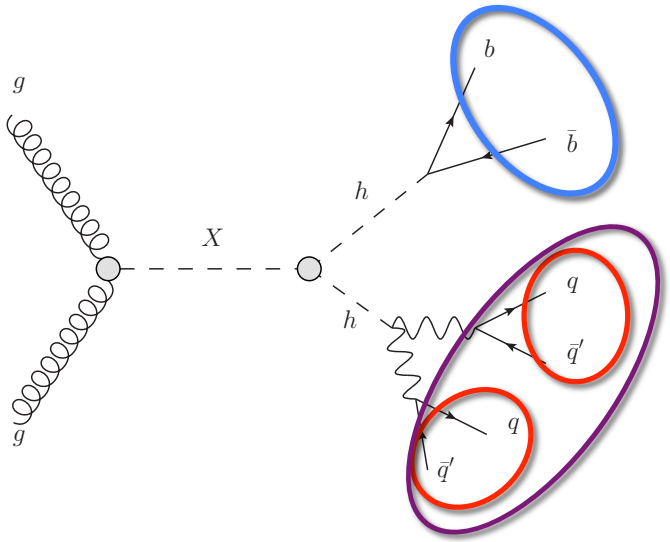
Different topologies

Resolved
(small m_x)



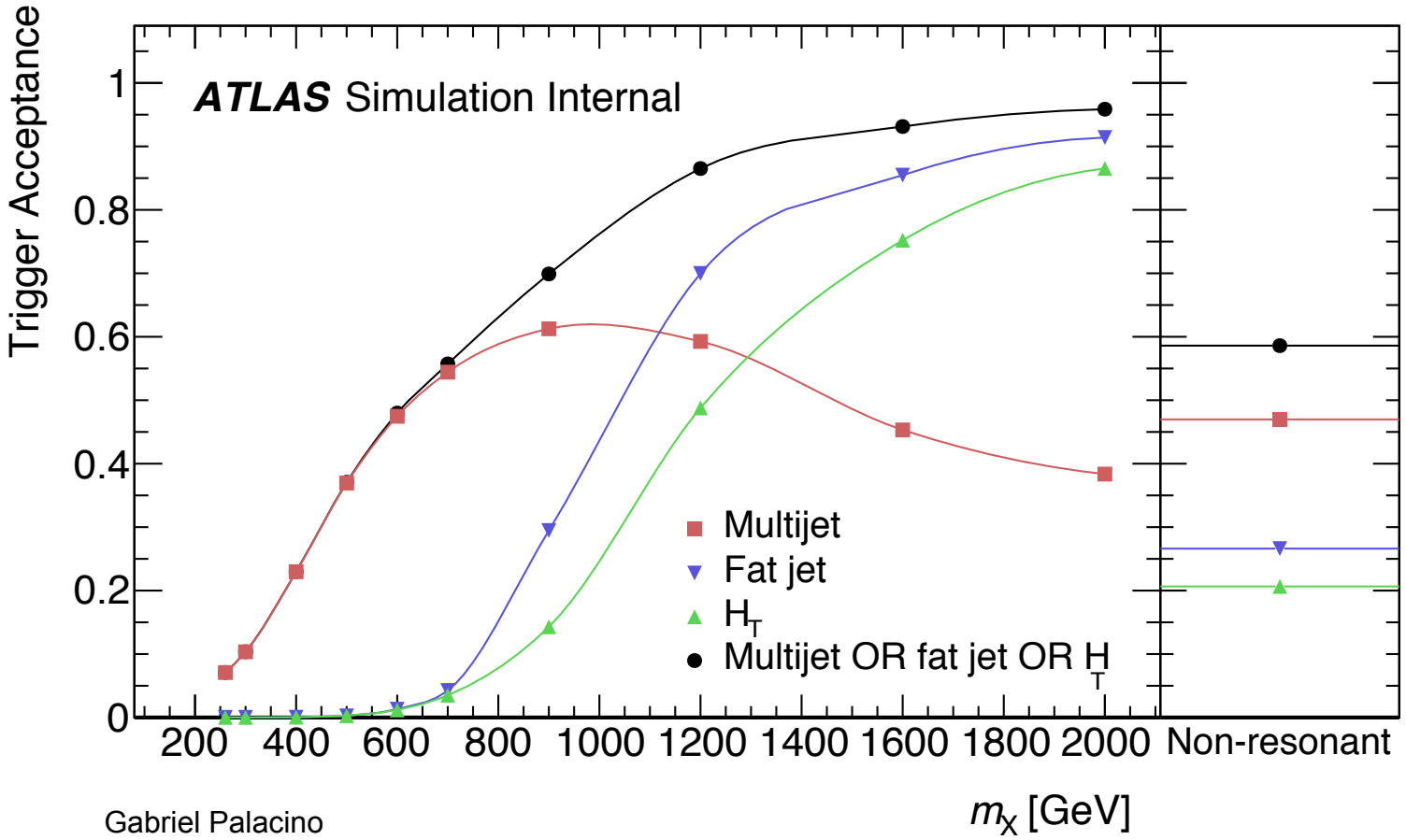
- 2 b-jets from h decay
- 4 light jets from W decays

Boosted
(large m_x)



- 1 fat jet containing 2 b-jets
- 1 or 2 jets from W decays

September status



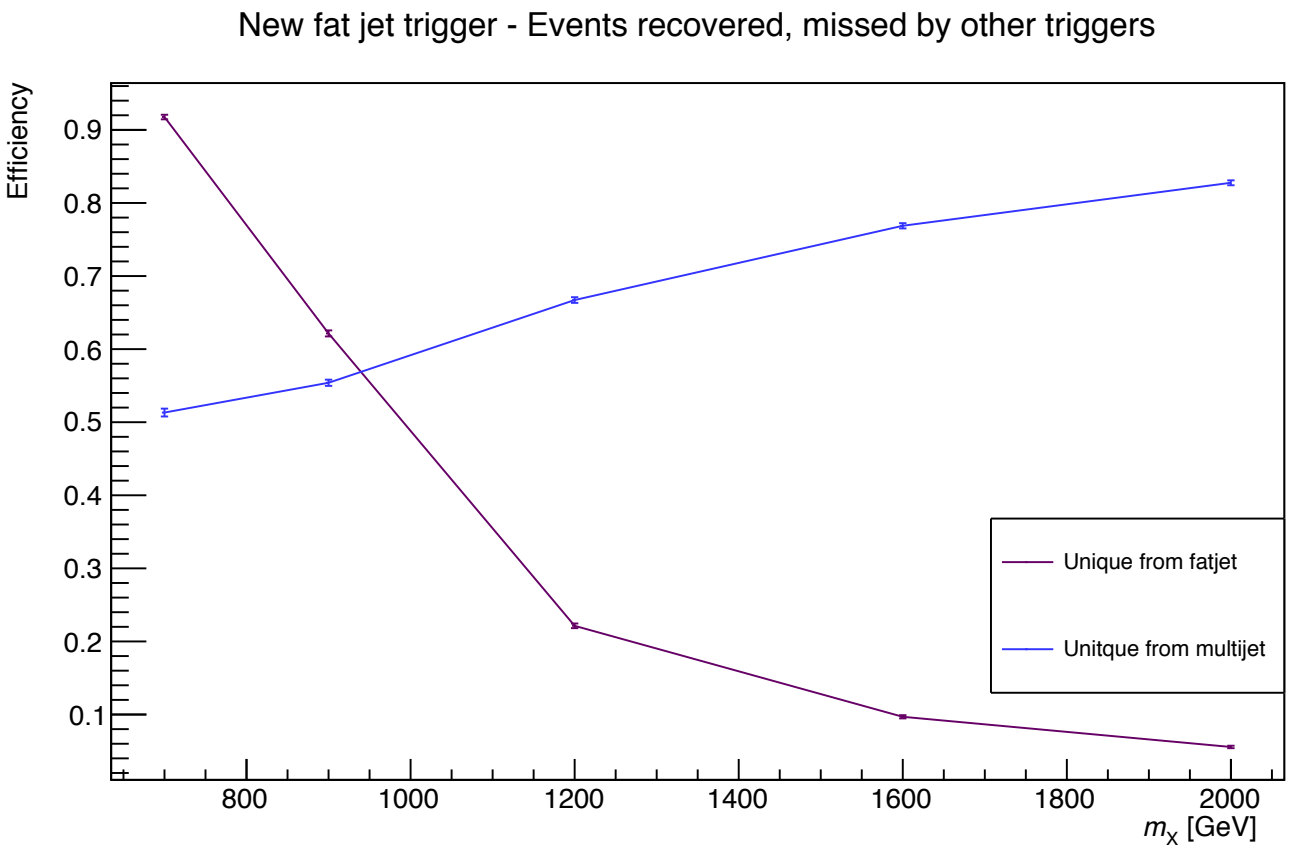
Designing new trigger

- High level trigger = software only
- Based on L1 J100
- Available next year

- High overall signal acceptance
- Low background
- Recovers events missed by multi jet and fat jet trigger

- Fat jet with p_t > 200 GeV and mass > 40 GeV
- Plus *b*-jet with p_t > 35 GeV

Recovered Events

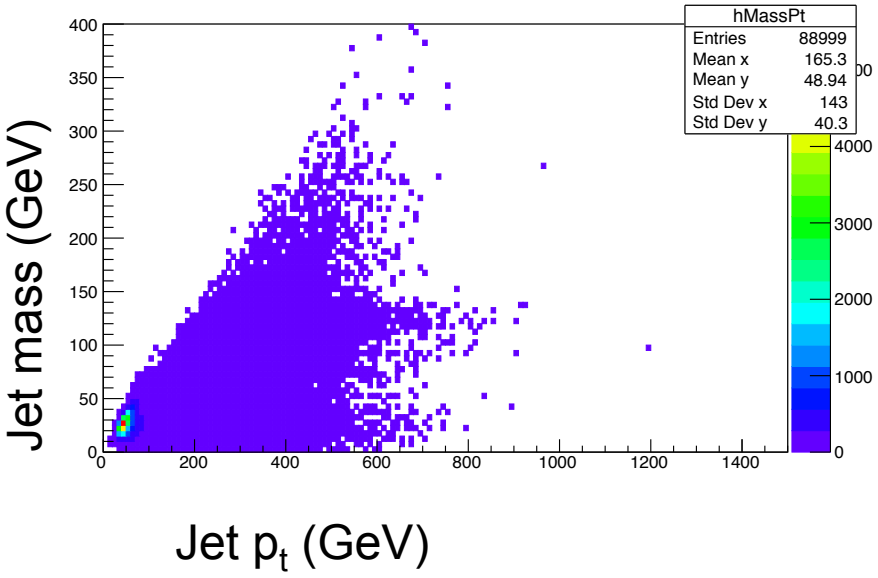


New trigger recovers events from

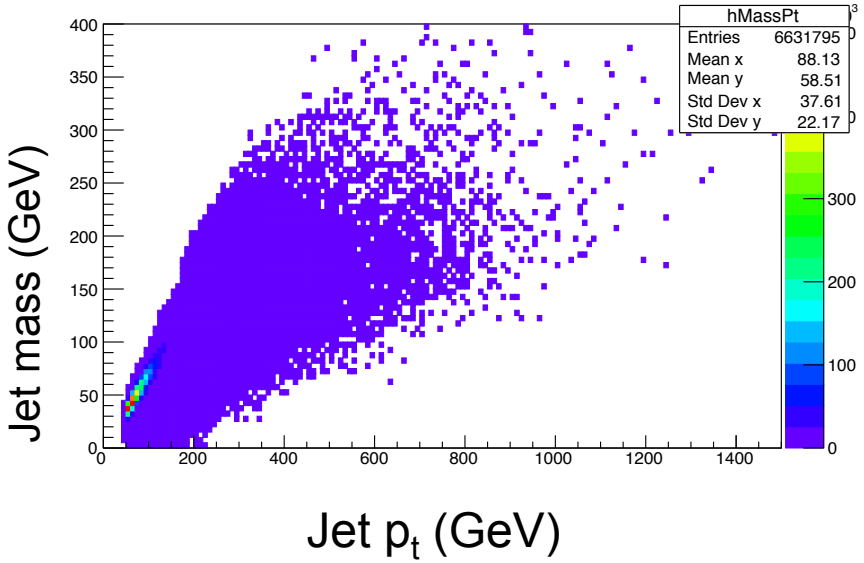
- High mass signal missed by multijet
- Low mass signal missed by fat jet

Leading fat jet mass and p_t

Signal sample (900 GeV)

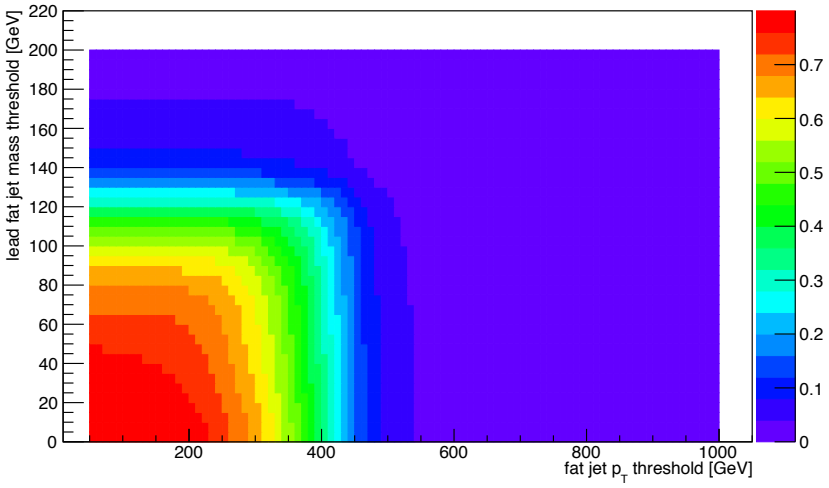


Enhanced bias

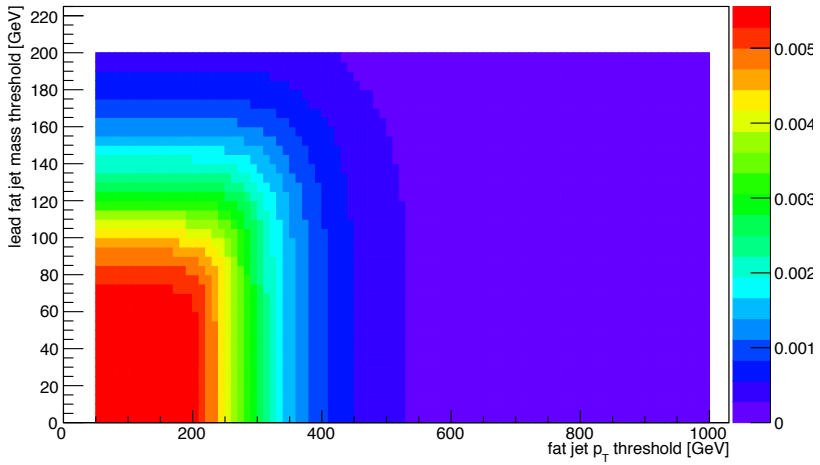


Trigger efficiency with different requirements

900 GeV signal

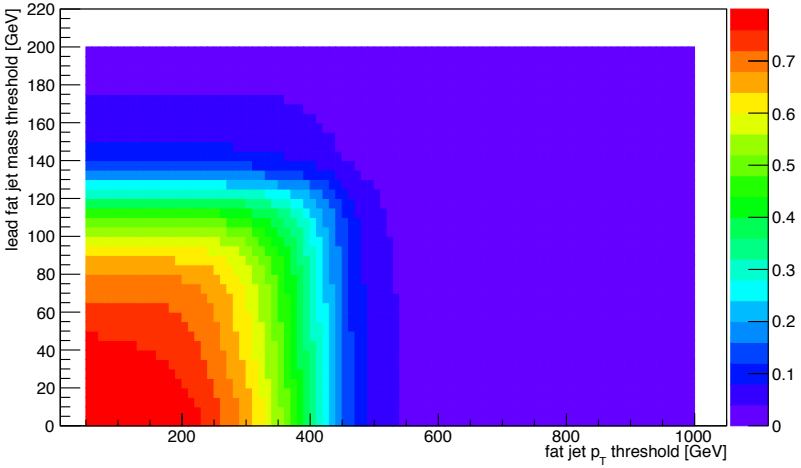


Enhanced bias

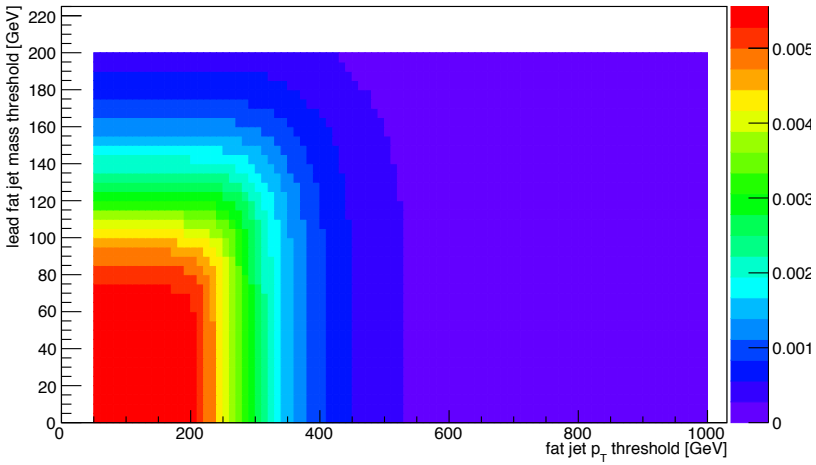


Adding in significance

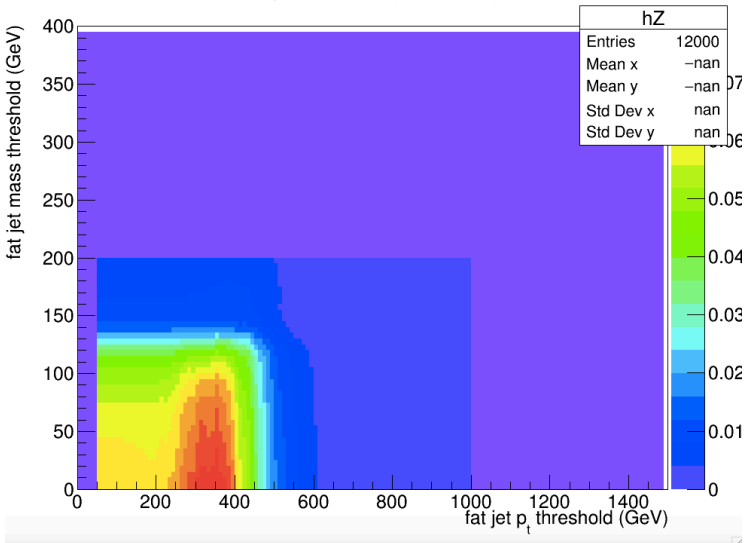
900 GeV signal



Enhanced bias



Significance (900GeV)



significance = ε / (1 + sqrt (b))

ε = signal efficiency

b = number of background events passed

Final steps

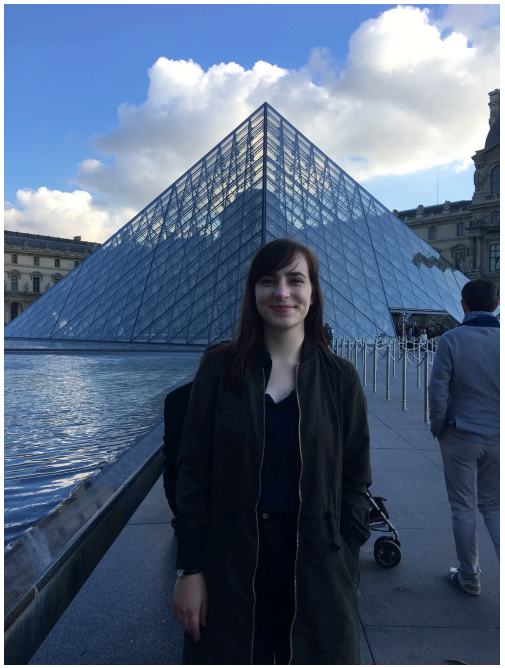
- Finalize exact p_t and mass requirements
- Mysterious high mass of enhanced bias sample
- Calculate exact trigger rate for enhanced bias sample

- Writing ATLAS note
- Formal testing process
- Hopefully this trigger will run in 2017!

ATLAS Note

Trigger design for di-higgs search in fully-hadronic channel

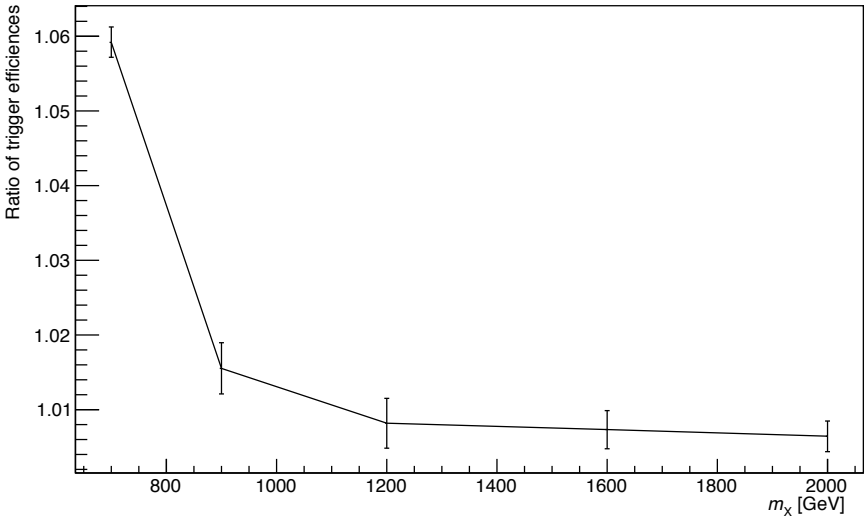

CERN



Backup

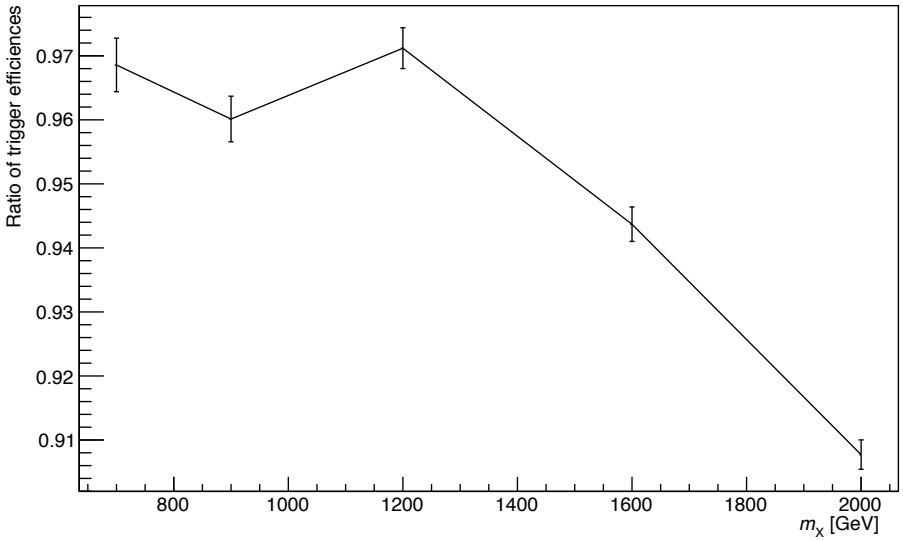
Trigger Emulation Results

Ratio of Trigger Efficiencies j420 [emulation/ATLAS]



- Pass L1 jet > 100 GeV
- Fat jet with pt > 420 GeV

Ratio of Trigger Efficiencies 2j35b & 2j35 [emulation/ATLAS]

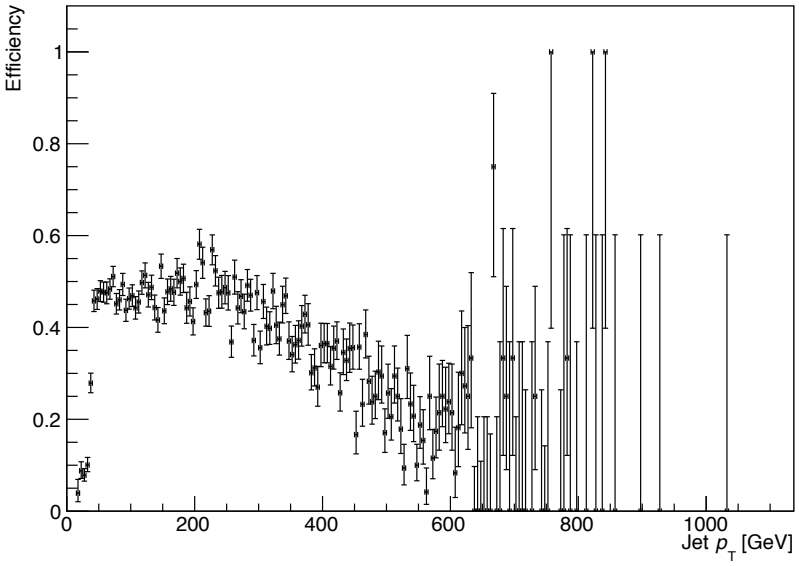


- Pass L1 4 jets > 15 GeV
- 2 b-jets with pt > 35 GeV
- 2 other jets pt > 35 GeV

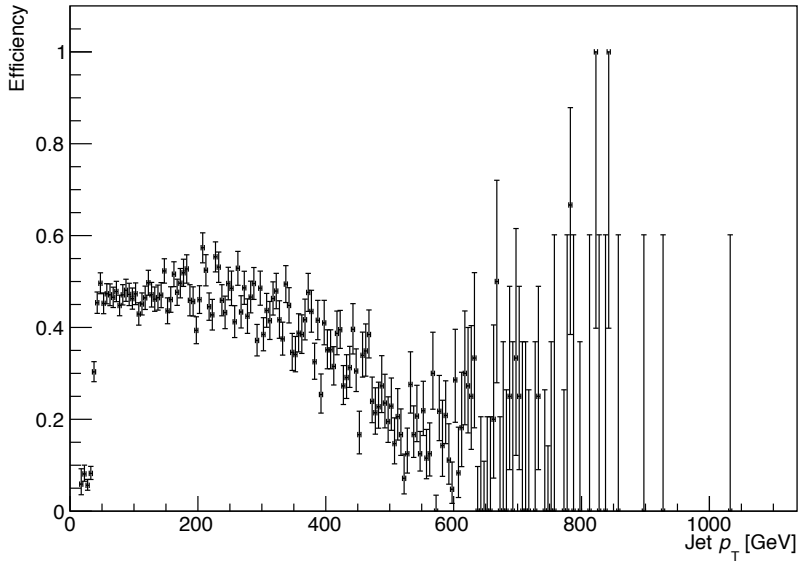
Trigger Emulation Results

Efficiency vs. pt of leading b-tagged jet in 2j35 and 2j35b

ATLAS



Emulation



b-tagging

- To fill *b*-tag histograms: MVc10
- We use working point for 70% eff (0.8244273)

- In emulation: MVc20
- We use the working point for 77% eff (-0.4434) to match online 70% eff trigger

Triggers used for recovered events

- Multijet:

- HLT_j75_bmv2c2077_split_3j75_L13J25.0ETA23
- HLT_j150_bmv2c2077_split_j50_bmv2c2077_split
- HLT_j100_2j55_bmv2c2077_split
- HLT_2j35_bmv2c2070_split_2j35_L14J15.0ETA25
  HLT_2j55_bmv2c2070_ht300_L14J20
- HLT_j55_bmv2c2070_ht500_L14J20
- HLT_2j70_bmv2c2070_split_j70

Fat jet:

HLT_j420_a10_lcw_sub_L1J100