Thoughts to enrich samples in b-quarks

Luca Perrozzi (ETHZ), Pierluigi Bortignon (UF), Josh Bendavid (CalTech)
for the CMS collaboration

Example use case: V+b(b) for VH(bb)

- V+bb plays a role in:
  - VH(bb) systematics uncertainty
  - Scale factor extraction in control regions
  - Background in signal region
  - Regression validation
  - Control of gluon splitting
  - BDT signal classification

- VH(bb) needs a large number of boosted V+bb events (V_{pT}>50 GeV)
  - V+Jets madgraph 5F PDF did a good job at 8TeV
  - V+Jets cross section increases from 8TeV to 13TeV
  - more events expected/needed for the same integrated luminosity

- VH(bb) is certainly not the only use case for b-enriched samples
  - SM and top measurements, ttH and SUSY searches…

How to increase efficiency?

- Produce V+b(b) samples with 5F PDF
  - Not all the bs are produced at ME level
  - Non negligible contribution from bs coming from PS
  - Easy to integrate with V+jets inclusive 5F PDF samples
  - **Filter efficiency for events with a b is very low (~ few %)**
  - Most suitable for 0b, 1b case

- Produce V+b(b) samples with 4F PDF
  - Produces all bs at LHE
  - Not easy to integrate with V+jets inclusive 5F PDF samples
  - Most suitable for 2b case

V+b(b) samples with 5F PDF

- The V+b enriched sample consists of 2 requests
  1) Enriched Matrix Element V+b and Pythia8 shower
  2) Inclusive Matrix element V+jets
     a) LHE filter to reject events containing outgoing b partons
     b) Pythia8 shower with multiple hadronizer to boost the efficiency (events get weights different from +/-1)
     c) Parton Shower filter to select events containing at least 1 status 2 b hadron