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High mass 'Twin peaks' in HYDJET+Z mixed sample

Problem

- while running on a mixed sample minbias_HYDJET+Z0signal_Pythia6PtYDistGun, a secondary peak 'peaked out' in an invariant mass plot created with *reconstructed* muons (GLB-GLB) when the pt_dimuon>10GeV/c;
- to reproduce: dongho's original config file used to do the mixing

Preliminaary thoughts:

- from the pt_dimuon study of the invariant mass plots, looks to me the TP is alway there, but comes to light only because of the falling spectrum of the generated signal
    - ♦ this can be tested with a flat pT gun, same mass region, different pT intervals (see bellow)
- the cfg itself has 2 problems, none which can give the problem though:
    - ♦ 1) it is not a flat pT gun, flat y, but a flat y, and a pT distrib from the

        ```
        kinematicsFile = cms.FileInPath('HeavyIonsAnalysis/Configuration/data/jpsipbpb.root'
        ```
    - ♦ 2) all the blocks included in the PythiaParameters, besides

        ```
        'pythiaUESettings','pythiaZtoMuons'
        ```

        are redundant.

Tackle

- Q: is a reco problem or not?
    - ♦ A: look in the simTracks (gen+GEANT) --- TP is there
- Q: is it from gen or from GEANT
    - ♦ A1: look at gen info: for signal+background (reco::GenParticleCollection with label), background only (HepMCProduct, with label), signal only (HepMCProduct with label); --- TP is coming from the generated signal exclusively
    - ♦ A2: by looking at the signal sample from 2 directions, from the Z to mu and from mu to Z: Z is generated fine (selecting pdg_id()==23 particles and plotting M everything looks fine); the problem comes in when you are trying to reform the Z0 from the decaying muons.--> some final state effects that can screw up things... final state radiation (tried this one), 'kT' effects, ...
- Q: is it a future of the PYTHIA decay or is a bug?
    - ♦ A: look in regular PYTHIA generated events -- there are entries for the same kinematics, but much smaller comparative to the signal --> gun problem!
- Q: what is going on in the gun used?
    - ♦ A1: tested 2 guns: 1 used by Dongho (Pythia6PtYDistGun, with same input file for the pT distrib, then flat in y[-2.4,2.4] and phi[-pi,pi]), and one used by the pp people more often (Pythia6PtGun), flat pT [0,20]GeV/c, flat phi, and a non-flat y distrib. -- the same feature are in both cases
    - ♦ A2: printing all descendents for a found Z0, and all parents for a given muon (which is in the descendents list), 2 things are noticed:
        - ◊ a gamma (final state radiation) is always among the TP Z0 descendents
        - ◊ a '94' comes out all the time!
    - ♦ A3: the '94' is not present in any of the PYTHIA, gun+radiation_OFF cases; only in gun+radiation_ON case. (Note: I did check that when turning OFF the radiation,

MSTP(71)=0, the rebuilt Z0 and the initial Z0 have identical kinematics, and there is no extra contribution to the low mass indeed ==> it is a problem that is related to how the radiation is dealt with)
- ♦ A4 printed the E of the gamma, plus the number of the gamma-s found among hte descendents of a Z0, in 2 cases:
  - ◊ both the mumu_rebuilt_Z0 and the Z0 initially generated are in the M[60,80]
  - ◊ the mumu_rebuilt_Z0 is in the M[60,80], while the generated one is not
- ♦ A5 from these numbers (see presentation), in the 'anomalous' cases, there are very high E gammas emitted (E>10GeV)
- Q what is the pT_dimuon dependence of this 'second' peak
  - ♦ A: flat PYTHIA gun, looked in the same mass window [60,80]GeV, varying the pT_dimuon; as expected, it's everywhere, pretty constant relative to the signal in the [80,100] window.

- Q is it only Z0 (high Q) or it's the same also when generating lower mass dimuons; tried with JPsi (pdgid=443); unfortunatelly, another bug showed up with this occasion: the JPsi (and Upsilon) is generated with *one* single mass value 3.097GeV; already emailed Julia Yarba who confirmed the problem and will work on fixing it.

Conclusions:

- the PYTHIA particle gun has a bug in it, in the way it deals with accounting for generated final state radiation -> send email to Generator hypernews and cc Yulia Yarba

Data sample used:

- mixed sample produced by Dongho, -fitlered-:

```
isGlobalMuon,  'mass > 50 & mass < 100 & pt > 10'), opposite sign pairs)
```

  --> selected 280 events
- my own production: 50K of each
  - ♦ PYTHIA: Z0->mumu only (MSEL=0, MSUB(1)=1, MSTP(43)=2 all MDME(174-187)=0, except MDME(184)=1), pt_hat[10,20](CKIN(3)=10, CKIN(4)=20), y[-2.4,2.4](CKIN(7), CKIN(8));
  - ♦ PTYHIA gun: [pt: flat, y-not flat, -Pythia6PtGun-], [pt-not_flat, y-flat, -Pythia6PtYDistGun-], with initial(which shouldn't count)/final state radiation ON/OFF (MSTP(61)=0,MSTP(71)=0)

Presentations with most of the plots:

- dilep meeting, august 11, 2010: preliminary
- generator hypernews: summary

-- CameliaMironov - 15-Jul-2010

- rootfiles.zip: rootfiles

- logs.zip: logs output

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Presentations with most of the plots: