W mass direct measurement via eνW process

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—> Updates and current status of my study

Recently working on

- Study on systematics of hadronization models.
    - three W—>qq samples were generated(100k) and then simulated(50k) by ILD_o1_v05
        - PYTHIA default
        - OPAL tune (DBD)
        - ALEPH tune
    - generator input : m_W = 80.419 (for all)
    - (see back up slides to get detailed changes of parameters)
    - check each m_W from these samples to decide a solid value of systematic error from hadronization parameter

Differences in fraction

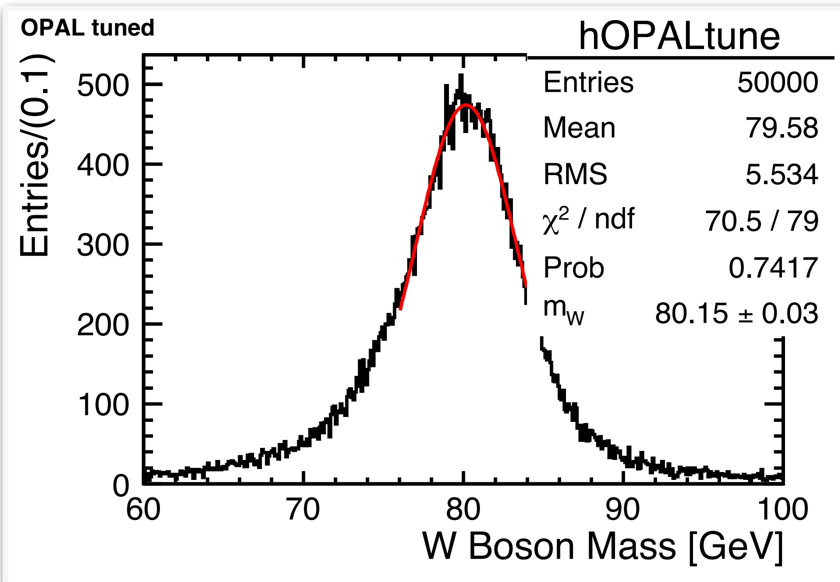
- calculate average number of each particles par W—>qq jets
- e^+e^- —> eνW, 100k statistics, E_{CM} = 250 GeV, generator level

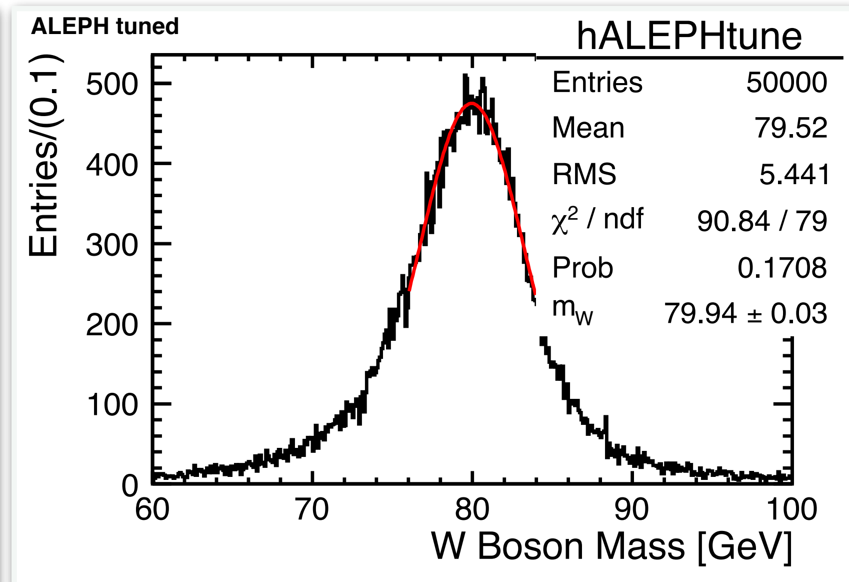
N in W—>qq jets	OPAL tuned	ALEPH tuned	PYTHIA default
p+/p-	0.90	1.05	1.22
π+/π-	16.37	15.49	15.85
K+/K-	1.93	1.95	2.11
K^0_{Long}	0.93	0.96	1.01
n^0	0.86	1.02	1.17

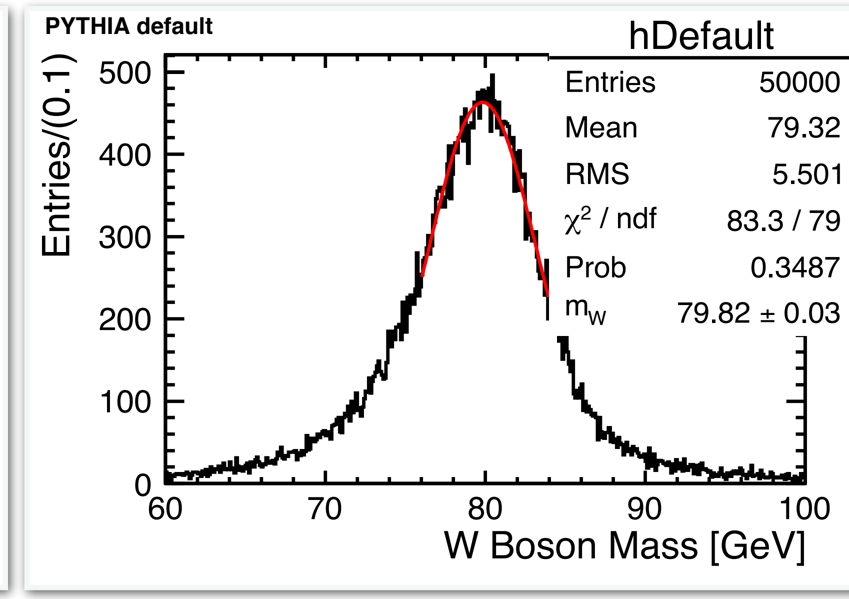
- default tune gives the largest number of hadrons
- ALEPH tune gives a bit larger number of neutral hadrons than that of OPAL tune

W mass shift

$m_W^{input} = 80.419$







Pythia tuning	OPAL tuned	ALEPH tuned	PYTHIA default
MPV [GeV] (analytic fitting)	80.15 ± 0.03	79.94 ± 0.03	79.82 ± 0.03
MPV shift [GeV]	—	0.21 ± 0.03	0.34 ± 0.03
median [GeV] (statistical method)	79.91	79.80	79.64
median shift [GeV]	—	0.11	0.27

Consideration

- In this method m_W shift between OPAL and ALEPH tuned data is 210MeV, I think one of the reasons which makes large shifts is due to PFA tunings.
- Recent PandoraPFA parameters are tuned for DBD (i.e. hadronization model from 'OPAL tune'). Hence the results are completely wrong if we use other generated sample with different hadronization parameters such as 'ALEPH tuning'.
    - perhaps, influences of the parameters in PFA which manage the weight of hadronic energies are critical
- To avoid this and to get pure hadronization effects, we have to do some calibrations of PFA parameters for the 'ALEPH tuned' data.
    - but it probably needs much time and also CPU resources to simulate necessary data. . .
        - at least the order of magnitude of 10M statistics are necessary to achieve a few MeV error on the hadronic W/Z mass
- Any other ideas to estimate the hadronization systematic error are very welcome.

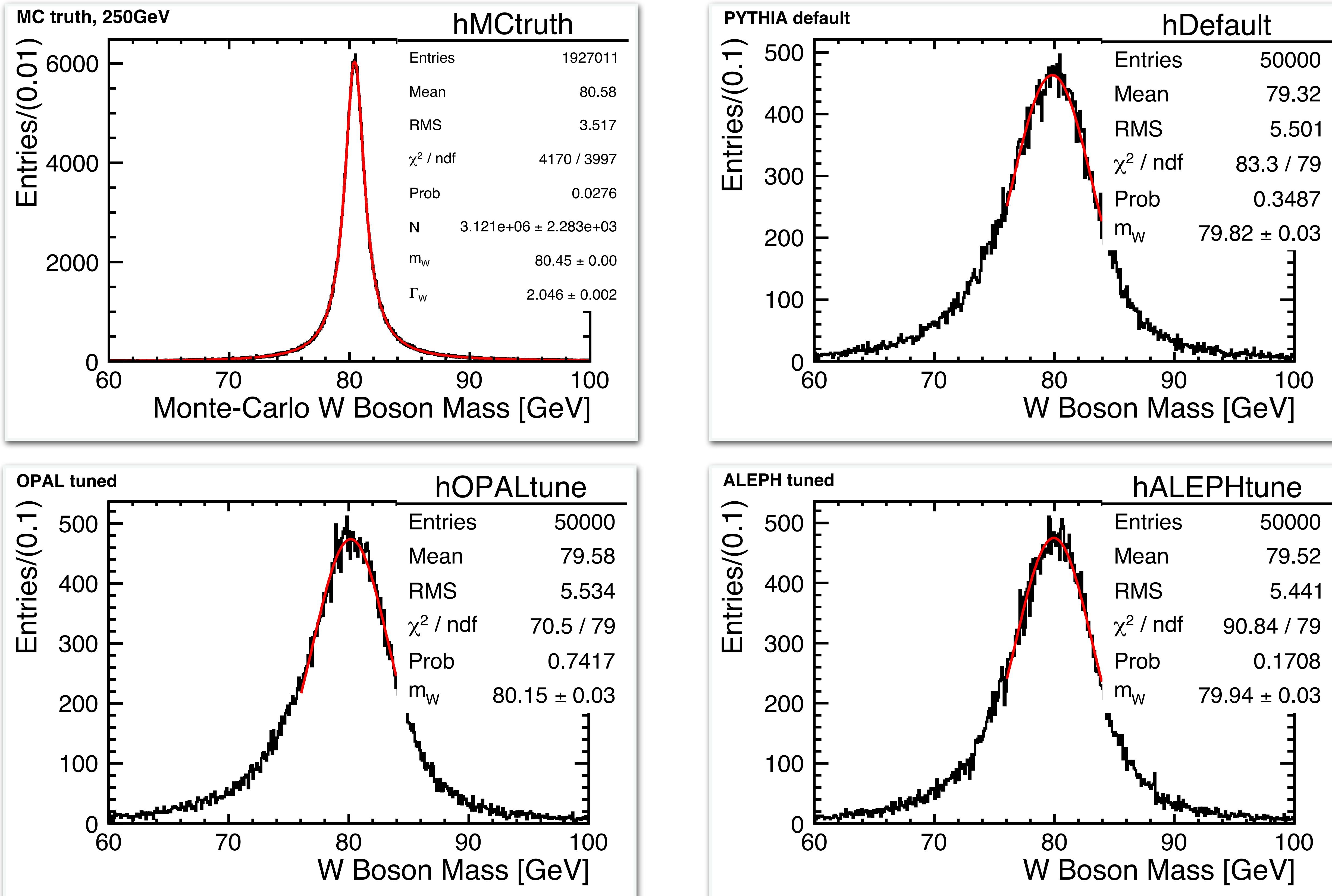
Back up

Tunes: OPAL, ALEPH, and default

The actual values:

parameter	name in program	OPAL tuned	ALEPH tuned	PYTHIA default
longitudinal FF	MSTJ(11)	3	3	4
Λ meaning	MSTP(3)	1	-	2
qq/q	PARJ(1)	0.08500	0.105	0.10
s/u	PARJ(2)	0.31000	0.283	0.30
su/du	PARJ(3)	0.45000	0.71	0.40
S=1/S=2 diquark suppr.	PARJ(4)	0.02500	-	0.05
(S=1) d,u	PARJ(11)	0.60000	0.54	0.50
(S=1) s	PARJ(12)	0.40000	0.46	0.60
(S=1) c,b	PARJ(13)	0.72000	0.65	0.75
S=1,s=0 prob.	PARJ(14)	0.43000	0.12	0.0
S=0,s=1 prob.	PARJ(15)	0.08000	0.04	0.0
S=1,s=1 prob.	PARJ(16)	0.08000	0.12	0.0
tensor mesons (L=1)	PARJ(17)	0.17000	0.20	0.0
leading baryon suppr.	PARJ(19)	-	0.58	1.0
σ_q (GeV)	PARJ(21)	0.40000	0.362	0.36
η' suppression	PARJ(26)	-	0.27	0.40
a of LSFF	PARJ(41)	0.11000	0.4	0.30
b of LSFF, (GeV^{-2})	PARJ(42)	0.52000	0.824	0.58
ϵ_{charm}	PARJ(54)	-0.03100	0.04	0.05
ϵ_{bottom}	PARJ(55)	-0.00200	0.0018	0.005
Λ_{QCD} (GeV)	PARJ(81)	0.25000	0.286	0.29
PS cut-off (GeV)	PARJ(82)	1.90000	1.47	1.0

plots


MC truth, 250GeV
hMCtruth
Entries 1927011
Mean 80.58
RMS 3.517
χ2 / ndf 4170 / 3997
Prob 0.0276
N 3.121e+06 ± 2.283e+03
mW 80.45 ± 0.00
ΓW 2.046 ± 0.002
Entries/(0.01)
Monte-Carlo W Boson Mass [GeV]
PYTHIA default
hDefault
Entries 50000
Mean 79.32
RMS 5.501
χ2 / ndf 83.3 / 79
Prob 0.3487
mW 79.82 ± 0.03
Entries/(0.1)
W Boson Mass [GeV]
OPAL tuned
hOPALtune
Entries 50000
Mean 79.58
RMS 5.534
χ2 / ndf 70.5 / 79
Prob 0.7417
mW 80.15 ± 0.03
Entries/(0.1)
W Boson Mass [GeV]
ALEPH tuned
hALEPHtune
Entries 50000
Mean 79.52
RMS 5.441
χ2 / ndf 90.84 / 79
Prob 0.1708
mW 79.94 ± 0.03
Entries/(0.1)
W Boson Mass [GeV]