ZH Branching ratio study at Ecm=350 GeV

ILC physics and software meeting
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ZH study current status

- Ecm=250 GeV H→cc study is reported at JPS
- Ecm=350 GeV flavor tagging efficiency is checked and compare with 250 GeV for ννH, qqH jet modes
- Plan to attend the ECFA WS at CERN (Oct. 18-24)

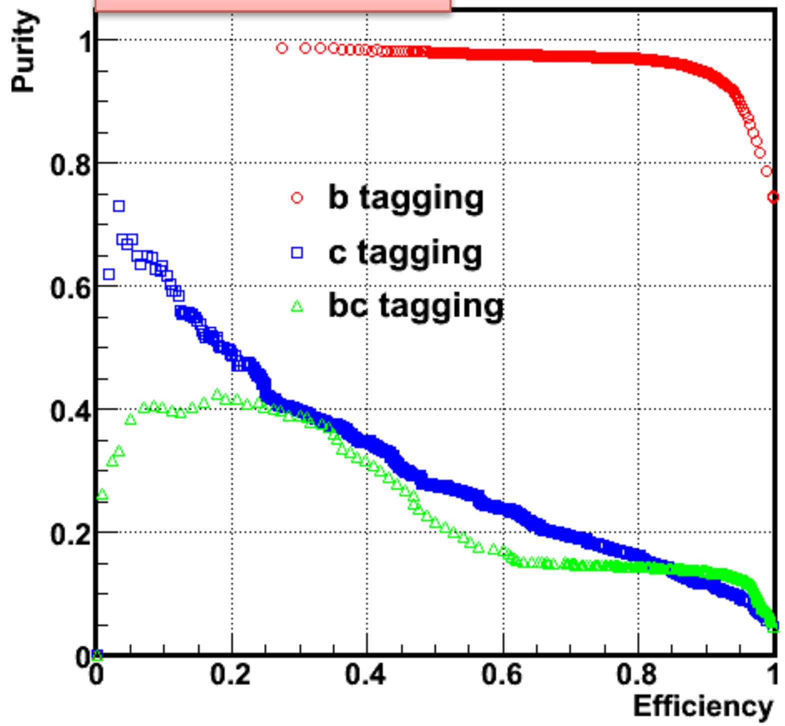
Data samples

- Data samples generated at KEK (by A. Miyamoto-san) with grid system
  - lfn:/grid/ilc/users/miyamoto/CDS/reconstructed/ILD_00/CMS_350
- Summary of the generated samples:
  - http://wiki.kek.jp/display/~miyamoto/ILC+Common+Generator+Samples
- Beam parameter: **SB2009 w/ TF,** Ecm=350 GeV
- ZH→qqH (hadronic mode)
- ZH→ννH (neutrino mode)
  - some inconsistency with reconstrected_2 dir data

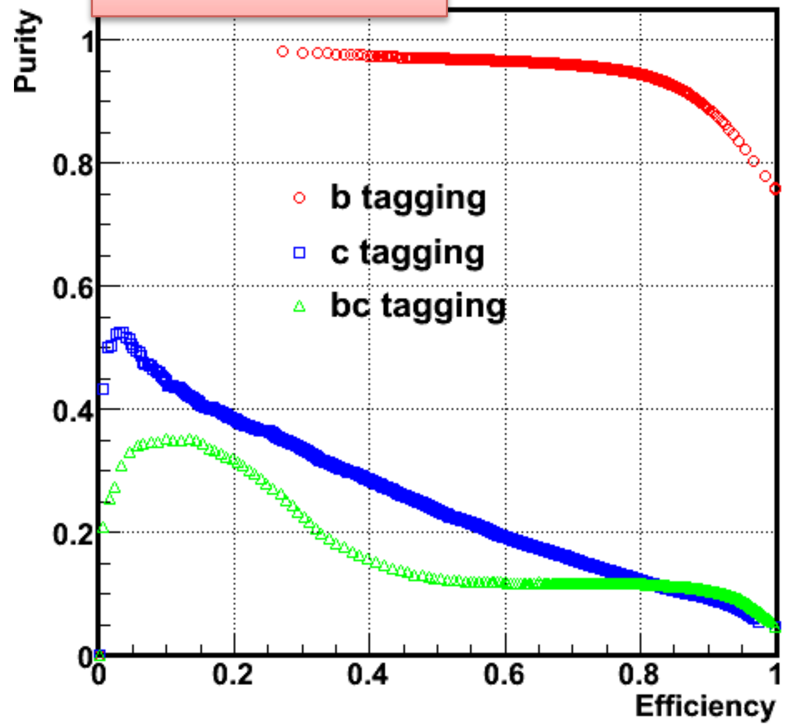
Vertex tagging performance comparison

ZH→qqH (hadronic mode) with $\chi^2 < 10$ cut (better Z/H combination is required)

Ecm=350 GeV



Ecm=250 GeV

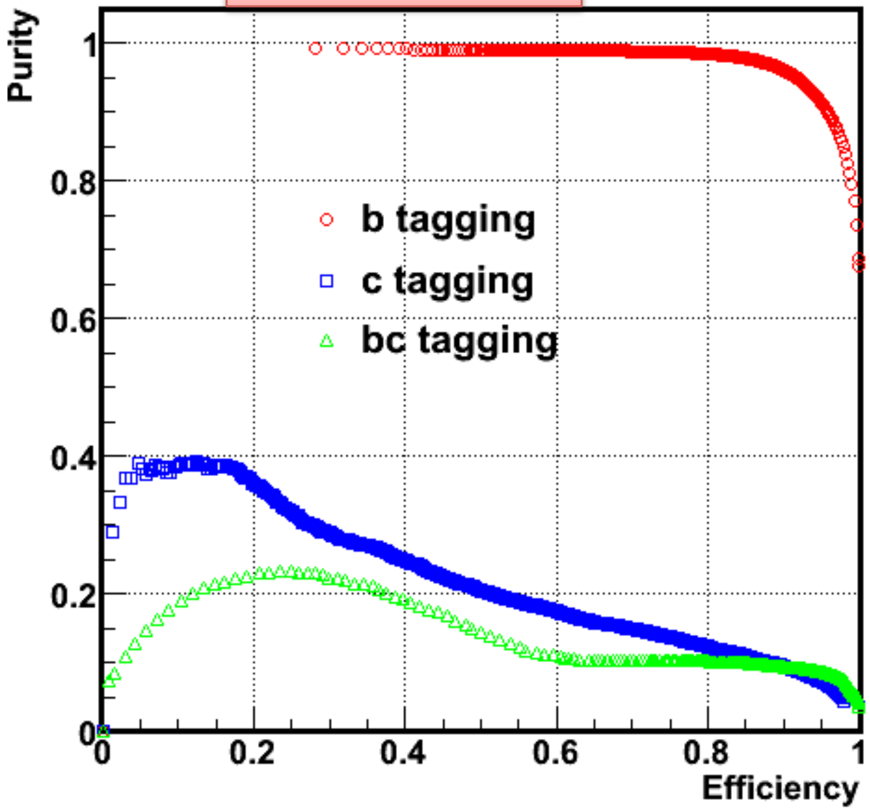


Efficiency with true jet flavor vs purity
Tagging performance looks slightly better at 350 GeV compare to 250 GeV
c/bc-tagging efficiency looks poor even for Ecm=250 GeV.

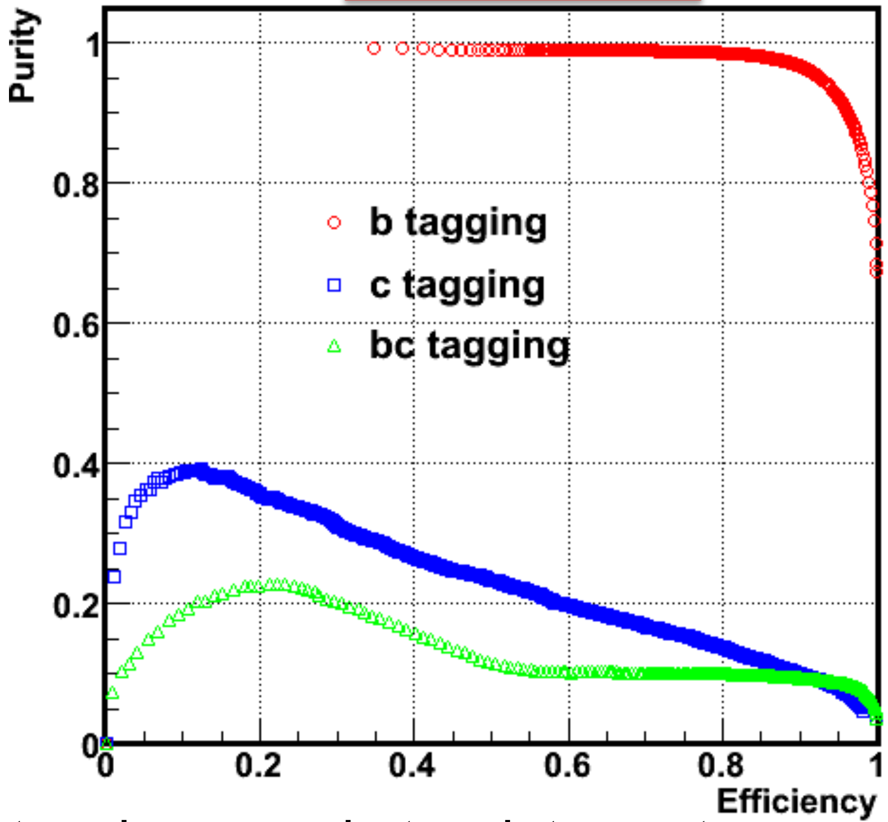
ZH→vvh neutrino mode

ZH→vvH (neutrino mode) without any cuts

Ecm=350 GeV



Ecm=250 GeV



Poor efficiency for c/bc-tagging even in two jet event

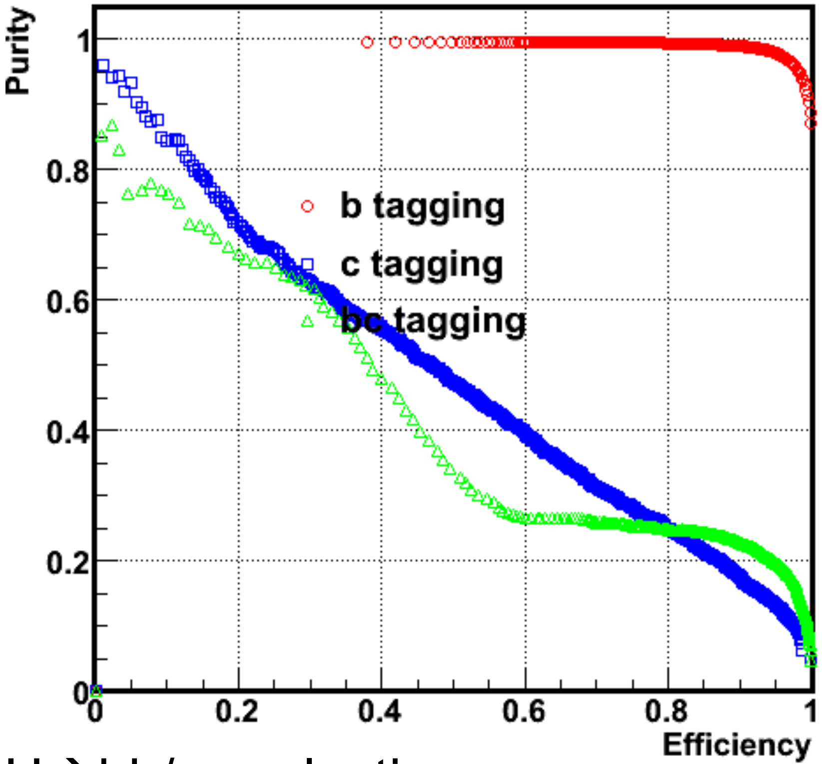
Not yet well understanding this behavior

After all cuts applied

Selection criteria

- 80<MissMass<140 GeV
- 20<Pt<70 GeV
- |Pl|<60 GeV
- # chdtrk>10
- P_{max}<30 GeV
- Y+<0.02”
- 0.2<Y-<0.8
- 100<MH<130 GeV

Ecm=250 GeV



Improve the performance with the H→bb/cc selection,

Next step : $N_{ZH}*\sigma_{xx}$ will be compared with flavor tagging cut

Flavor tagging performance on ILD LOI

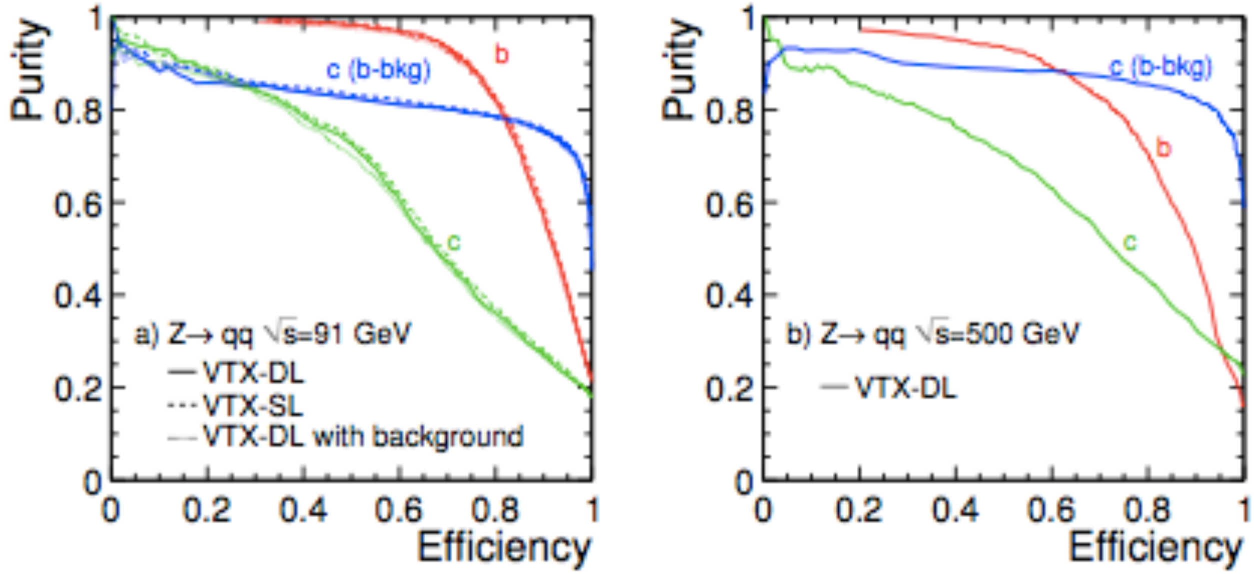
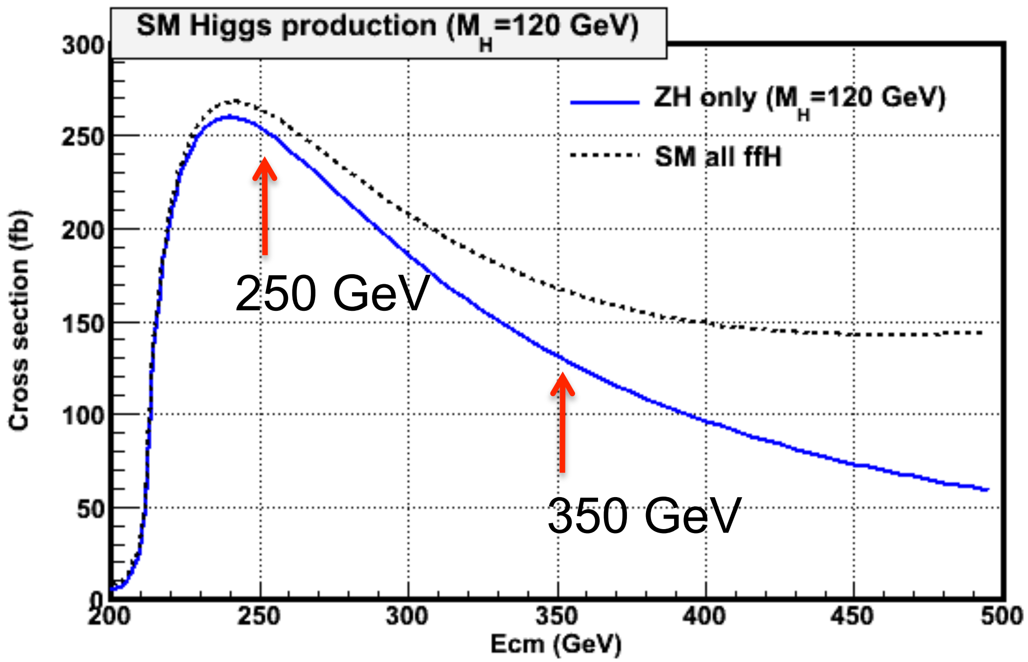


FIGURE 1.2-11. a) Flavour tagging performance of the ILD detector for 91 GeV $Z \rightarrow q\bar{q}$ events for both the three double-sided ladders (VTX-DL) layout and with five single-sided ladder layout (VTX-SL). Also shown for the VTX-DL is the impact of background on the flavour tagging performance. b) Flavour tagging performance of the ILD detector for 91 GeV $Z \rightarrow q\bar{q}$ events for the VTX-DL layout. In all cases the acceptance corresponds to $|\cos\theta_{\rm jet}| < 0.95$.

The flavour tagging performance [5] of ILD is studied for the two vertex detector geometries considered, three double-sided ladders (VTX-DL) and five single-sided (VTX-SL) ladders. No significant differences in the input variables for the ANNs are seen for two geometries, and therefore the ANNs trained for the VTX-DL option were used for both VTX configurations. The samples used in the training consisted of 150000 $Z \rightarrow q\bar{q}$, at the Z pole energy, equally distributed among the three decay modes $q = b, c$ and light quarks. The test samples used to evaluate the flavour tagging performance were generated independently and consist of 10000 events of $Z \rightarrow q\bar{q}$ generated at both $\sqrt{s} = 91$ GeV and $\sqrt{s} = 500$ GeV, with the SM flavour mix of hadronic final states. The ILD flavour tagging performances at 91 GeV for the two vertex detector options are shown in Figure 1.2-11a). The performance differences between the two VTX geometries are small ($\lesssim 1\%$). Uncertainites due to the statistical fluctuations of the test sample and in those introduced in the ANN training are estimated to be $\lesssim 2\%$. The performance for $Z \rightarrow q\bar{q}$ at $\sqrt{s} = 500$ GeV is shown in Figure 1.2-11b). It should be noted that for the 500 GeV results the ANNs were not retrained, *i.e.* those obtained for $\sqrt{s} = 91$ GeV were used. Consequently, improvements in the performance are expected.

Backup

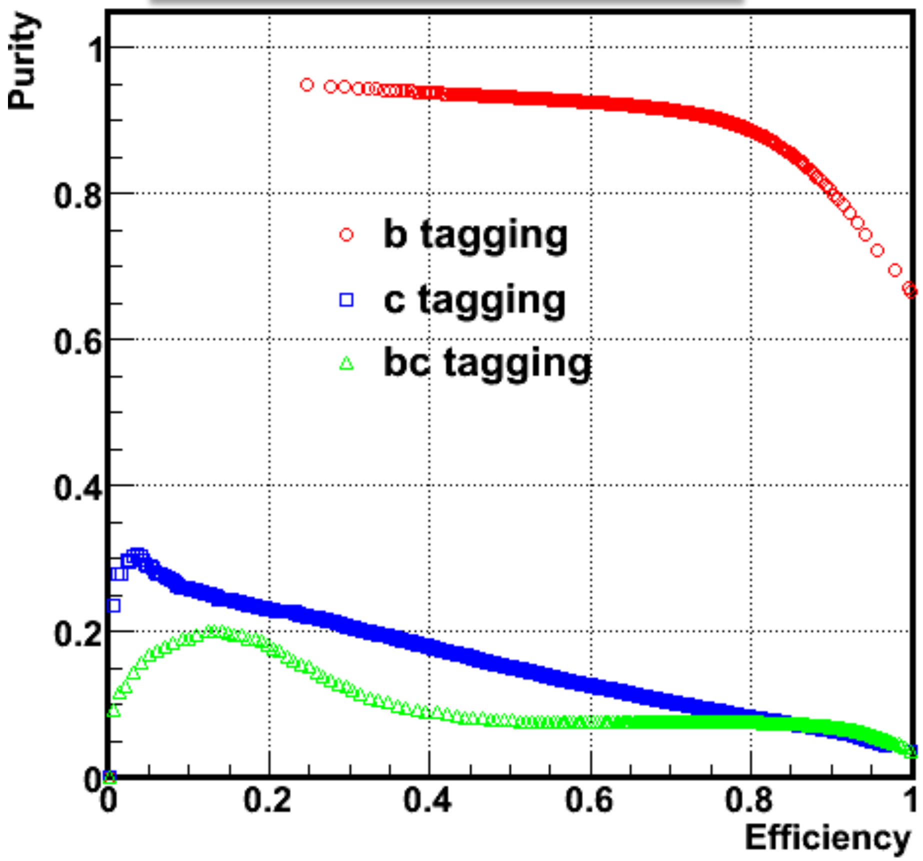
Cross-section of ZH at Ecm=350 GeV



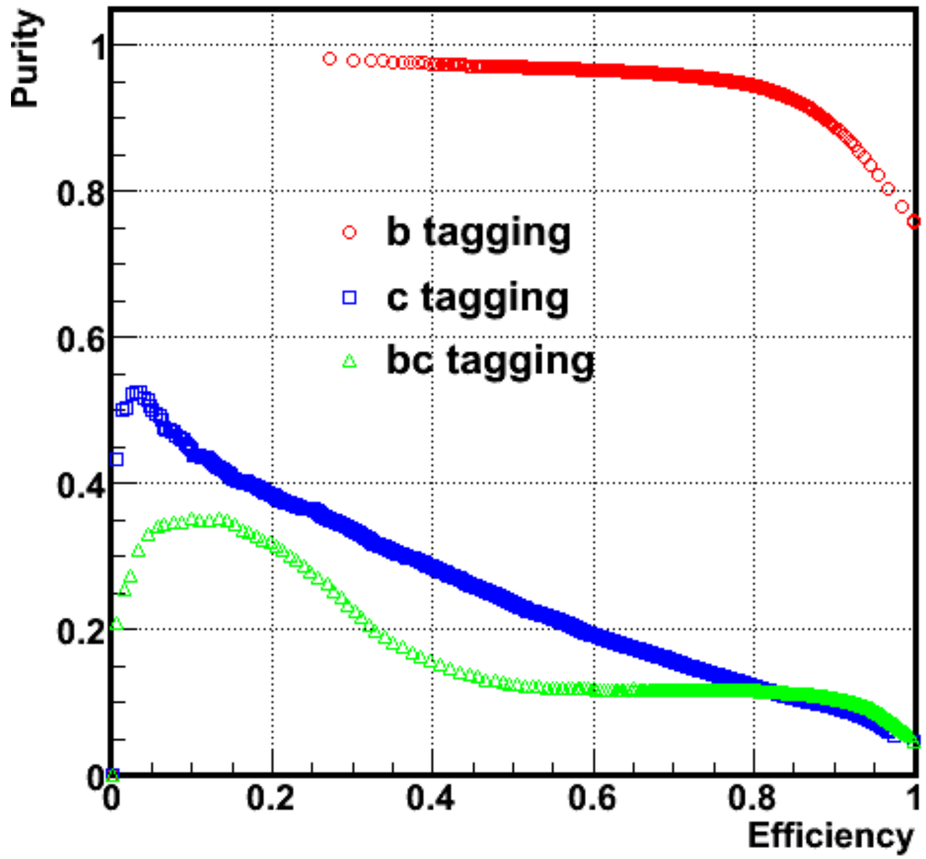
Cross section	Ecm=250GeV	Ecm=350GeV
ZH (hprod)	264 fb^{-1}	168 fb^{-1}
ZH→qqH	210 fb^{-1}	90 fb^{-1}

Vertex tagging performance at 250 GeV

ZH→qqH, Ecm=250 GeV



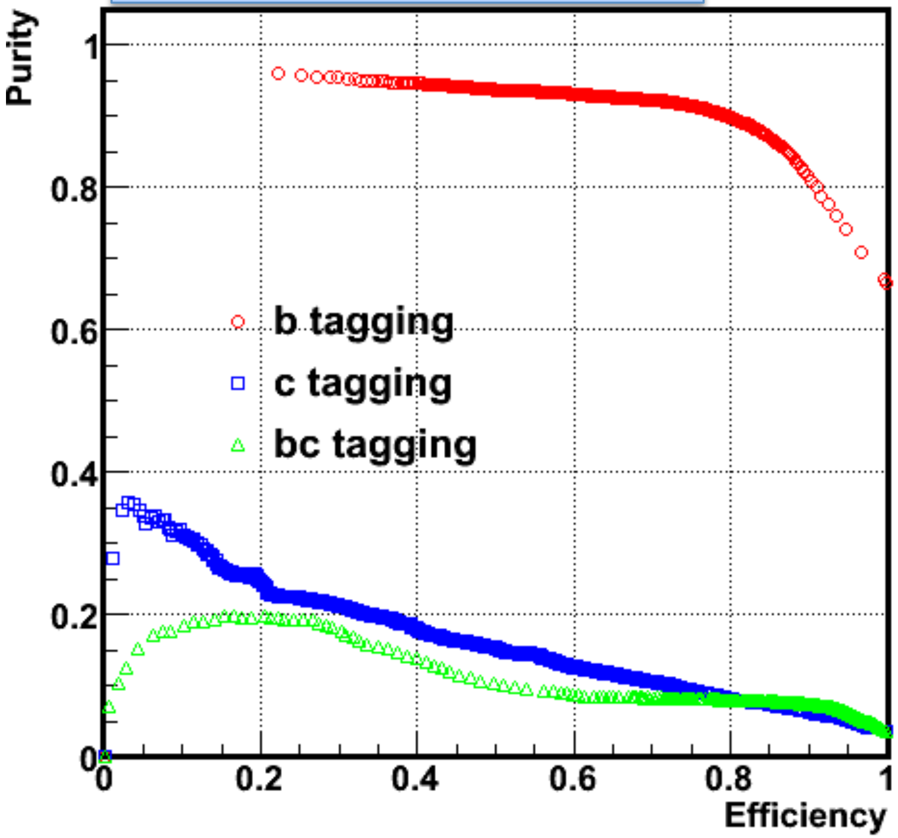
Apply χ^2 cut to select true combination

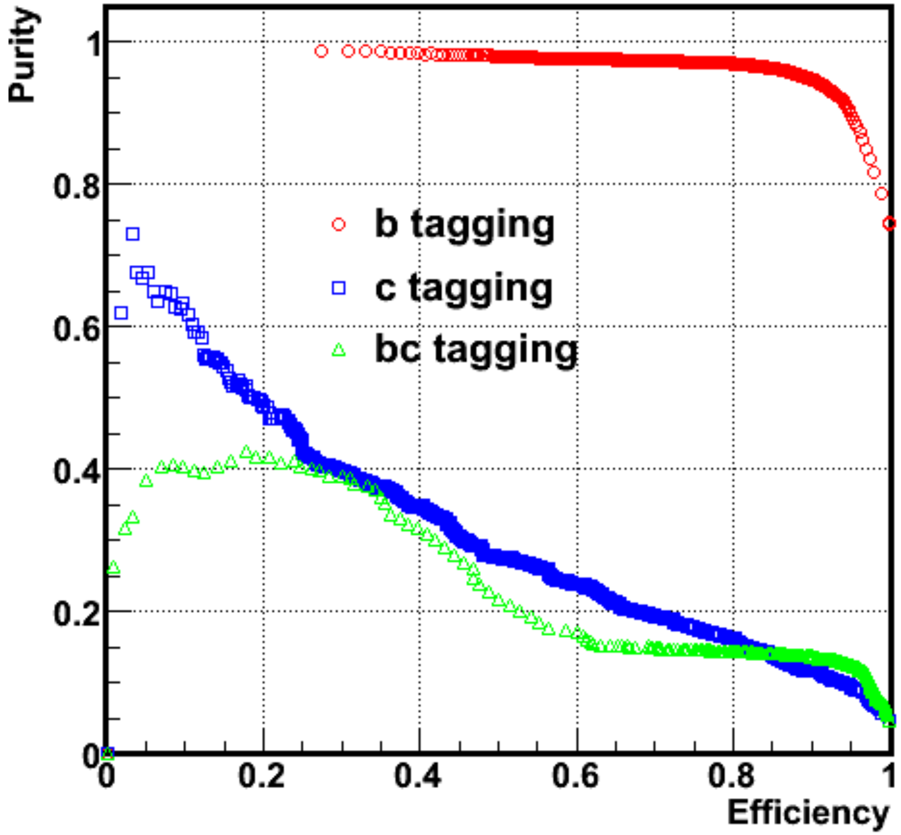


Vertex tagging performance at 350 GeV

ZH→qqH, Ecm=350 GeV

Apply χ^2 cut to get true combination





χ^2 reject the miss jet pair combination

SB2009 wTF parameters

	RDR			SB2009 w/o TF				SB2009 w TF			
CM Energy (GeV)	250	350	500	250.a	250.b	350	500	250.a	250.b	350	500
Ne- ($*10^{10}$)	2.05	2.05	2.05	2	2	2	2.05	2	2	2	2.05
Ne+ ($*10^{10}$)	2.05	2.05	2.05	1	2	2	2.05	1	2	2	2.05
nb	2625	2625	2625	1312	1312	1312	1312	1312	1312	1312	1312
Tsep (nsecs)	370	370	370	740	740	740	740	740	740	740	740
F (Hz)	5	5	5	5	2.5	5	5	5	2.5	5	5
γex ($*10^{-6}$)	10	10	10	10	10	10	10	10	10	10	10
γey ($*10^{-8}$)	4	4	4	3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.5
βx (mm)	22	22	20	21	21	15	11	21	21	15	11
βy (mm)	0.5	0.5	0.4	0.48	0.48	0.48	0.48	0.2	0.2	0.2	0.2
σz (mm)	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3
σx eff ($*10^{-9}$ m)	948	802	639	927	927	662	474	927	927	662	474
σy eff ($*10^{-9}$ m)	10	8.1	5.7	9.5	9.5	7.4	5.8	6.4	6.4	5.0	3.8
L (10^{34} $cm^{-2}s^{-1}$)	0.75	1.2	2.0	0.2	0.22	0.7	1.5	0.25	0.27	1.0	2.0

SB2009 new beam parameters

	200	250	350	500	1000
Rate (Hz)	10	10(5)	5	5	4
Δp/p(e-)(%)	0.22	0.22(0.220)	0.22(0.218)	0.21(0.207)	0.11
Δp/p(e+)(%)	0.17	0.14(0.130)	0.10(0.093)	0.07(0.065)	0.04
β_x*(mm)	16	12(21)	15	11	30
σ_x*(mm)	904	700(927)	662	474	554
σ_y*(mm), wTF	6.0	5.3(6.4)	4.5(5.0)	3.8	2.7
L(x10^{34}cm^{-2}s^{-1}),wTF	0.5	0.8(0.27)	1.0	2.0	2.8[2]

[1]parameters different from sb2009 are listed. Values in ( ) are SB2009 values.
[2] Luminosity without traveling focus.

Miyamoto-san's slide at ILD optimization meeting 2010. Sep. 08