

# BR(H → bb/cc/gg)

- Target channel:
  - $e^+e^- \rightarrow ZH, Z \rightarrow qq, H \rightarrow bb/cc/gg$
- Simulation setup:
  - ILC parameters:
    - $\sqrt{s} = 250 \text{ GeV}$
    - Polarization  $\{(-0.8,+0.3), (+0.8,-0.3)\}$
    - Luminosity:  $250 \text{ fb}^{-1}$
  - Detector: ILD latest setting (mc-2020)

- Event reconstruction:

1. IsolatedLeptonTagging

- require  $\#IsoLep = 0$

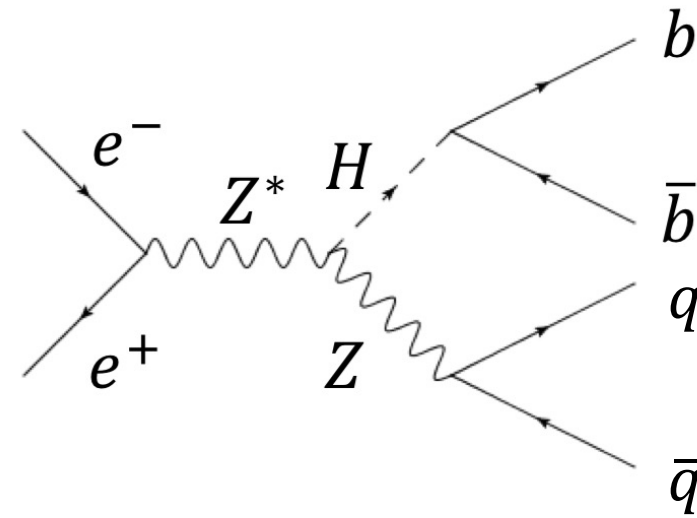
2. LCFIPlus

- Jet clustering: Durham forced to 4 jets
- Flavor tagging

3. Basic jet pairing

$$\chi^2 = \left( \frac{M_{j_1 j_2} - M_Z}{\sigma_Z} \right)^2 + \left( \frac{M_{j_3 j_4} - M_H}{\sigma_H} \right)^2$$

- $\sigma_Z = 4.7 \text{ GeV}, \sigma_H = 4.4 \text{ GeV}$



- Samples:

- Signal
  - $qqh_{bb/cc/gg}$
- Background
  - $qqh_{others}$
  - $2f_{z_h}$
  - $4f_{zz_h}$
  - $4f_{ww_h}$
  - $4f_{zzorww_h}$

# BR(H → bb/cc/gg)

- Previous study: H. Ono and A. Miyamoto, Eur.Phys.J. C73 (2013) 2343

**Table 2** Summary of  $q\bar{q}H$  channel background reduction assuming  $\mathcal{L} = 250 \text{ fb}^{-1}$  with  $P(e^-, e^+) = (-0.8, +0.3)$

CM energy	250 GeV			350 GeV		
	Condition	Sig.	Bkg.	Condition	Sig.	Bkg.
Generated		52507	45904900		36099	22210900
$\chi^2$	$\chi^2 < 10$	32447	2608980	$\chi^2 < 10$	20207	1034810
# of charged tracks	$N_{chd} > 4$	25281	1120950	$N_{chd} > 4$	14900	305649
$Y_{34}$ value	$-\log(Y_{34}) > 2.7$	25065	1002125	$-\log(Y_{34}) > 2.7$	14543	250995
thrust	thrust < 0.9	24688	935950	thrust < 0.85	13522	144560
thrust angle	$ \cos \theta_{thrust}  < 0.9$	21892	696201	$ \cos \theta_{thrust}  < 0.9$	12523	107025
Higgs jets angle	$105^\circ < \theta_H < 160^\circ$	20062	622143	$70^\circ < \theta_H < 170^\circ$	11185	77650
Z di-jet mass	$80 < M_Z < 100 \text{ GeV}$	16359	411863	$80 < M_Z$		
H di-jet mass	$105 < M_H < 130 \text{ GeV}$	16359	411863	$105 < M_H$		
Likelihood ratio	$LR > 0.375$	13726	166807	$LR > 0.1$		
Significance (Efficiency)	$S/\sqrt{S+B}$	32.3 (26.1 %)		$S/\sqrt{S+B}$		

**Table 4** Summary of template fitting results  $r_s$  and accuracies of  $(\sigma \cdot BR)$  and  $BR$  after correcting  $\sigma$  for an accuracy of 2.5 % at  $\sqrt{s} = 250 \text{ GeV}$  assuming  $\mathcal{L} = 250 \text{ fb}^{-1}$  with  $P(e^-, e^+) = (-0.8, +0.3)$

	$\nu\bar{\nu}H$	$q\bar{q}H$	$e^+e^-H$	$\mu^+\mu^-H$	Comb.
$r_{b\bar{b}}$	$1.00 \pm 0.02$	$1.00 \pm 0.01$	$1.00 \pm 0.04$	$1.00 \pm 0.03$	$1.00 \pm 0.01$
$r_{c\bar{c}}$	$1.02 \pm 0.11$	$1.01 \pm 0.10$	$1.02 \pm 0.27$	$1.01 \pm 0.23$	$1.02 \pm 0.07$
$r_{gg}$	$1.02 \pm 0.14$	$1.02 \pm 0.13$	$1.05 \pm 0.33$	$1.02 \pm 0.24$	$1.02 \pm 0.09$
$\frac{\Delta(\sigma \cdot BR)}{\sigma \cdot BR}(H \rightarrow b\bar{b})$ (%)	1.7	1.5	3.8	3.3	1.0
$\frac{\Delta(\sigma \cdot BR)}{\sigma \cdot BR}(H \rightarrow c\bar{c})$ (%)	11.2	10.2	26.8	22.6	6.9
$\frac{\Delta(\sigma \cdot BR)}{\sigma \cdot BR}(H \rightarrow gg)$ (%)	13.9	13.1	31.3	33.0	8.5
$\frac{\Delta BR}{BR}(H \rightarrow b\bar{b})$ (%)	3.0	2.9	5.7	4.5	2.7
$\frac{\Delta BR}{BR}(H \rightarrow c\bar{c})$ (%)	11.4	10.5	31.3	22.8	7.3
$\frac{\Delta BR}{BR}(H \rightarrow gg)$ (%)	14.2	13.3	33.1	24.0	8.9

# Event Selection

- Before KF
  - No isolated lepton
  - Number of charged particles  $> 30$
  - $E_{\text{visible}} > 180 \text{ GeV}$
  - $|M_H - 125 \text{ GeV}| < 35 \text{ GeV}$
  - $50 \text{ GeV} < M_Z < 120 \text{ GeV}$
  - $\log_{10} Y_{34} > -2.3$
  - $\log_{10} Y_{23} > -2.$
  - $|\cos\theta_j^{\text{E}_{\text{max/min}}}| < 0.99/0.98$
  - Thrust  $< 0.9$
- After KF
  - $\log_{10} \chi^2_{\text{qqH}} < 3.$
  - $\log_{10} \chi^2_{\text{WW}} > 1.7$
  - $\log_{10} \chi^2_{\text{ZZ}} > 1.5$

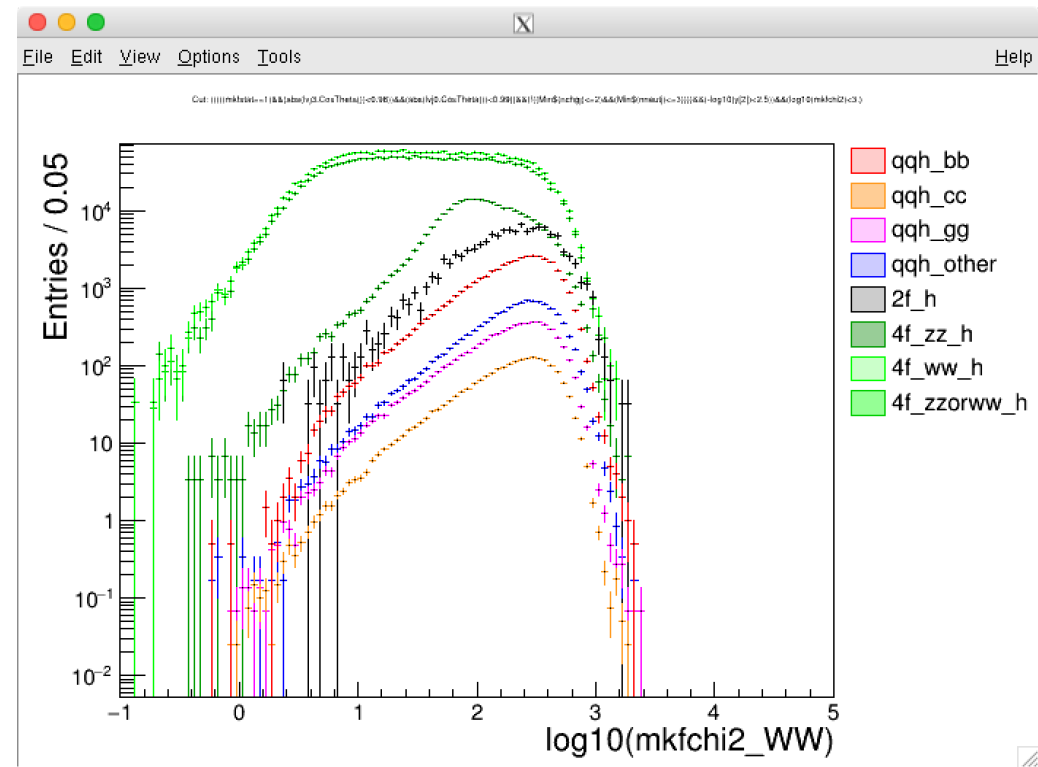
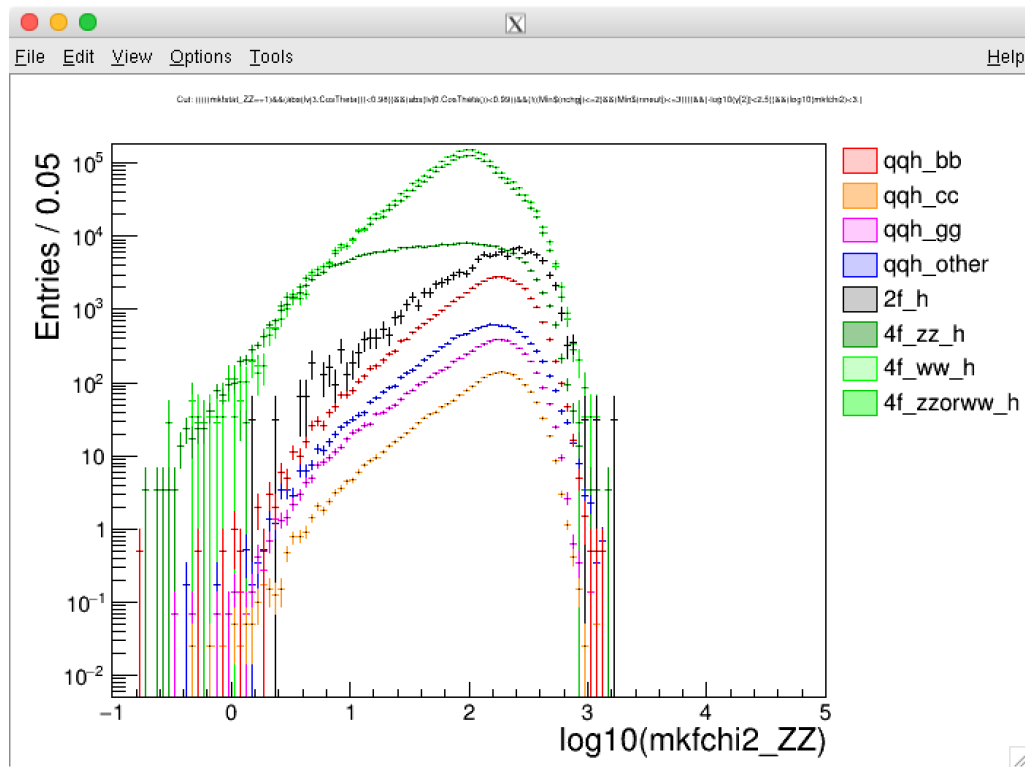
# Kinematic fit

- FitObject
  - 4 JetFitObject + 1 ISRPhotonFitObject
- For qqH
  - Jet resolution: b-jet
  - Constraint (Hard)
    - Total Energy/Px/Py/Pz for all FOs
    - Higgs mass = 125 GeV
    - Z mass = 91.2 GeV
- For ZZ/WW
  - Jet resolution: uds-jet
  - Constraint (Hard)
    - Total Energy/Px/Py/Pz for all FOs
    - Z/W mass = 91.2/80.4 GeV
- Fit is performed for all pairing combinations and select the pair with the best  $\chi^2$



# Kin-fit for ZZ/WW

- $ZZ > 1.5$ ,  $WW > 1.7$

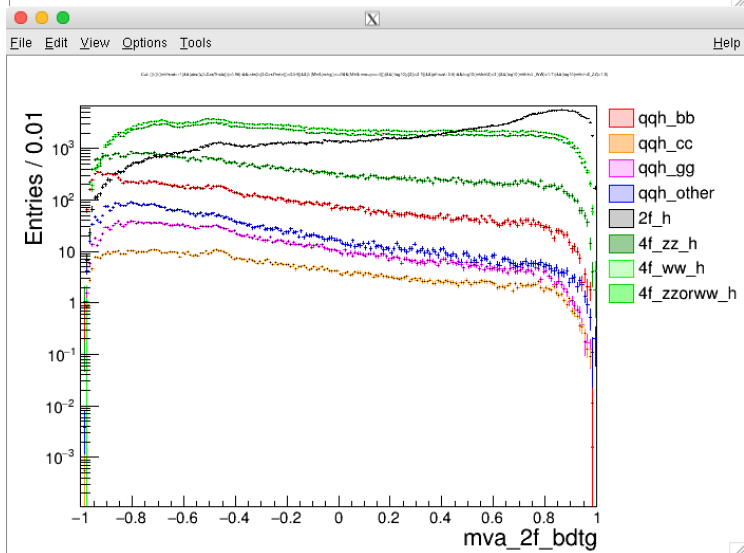
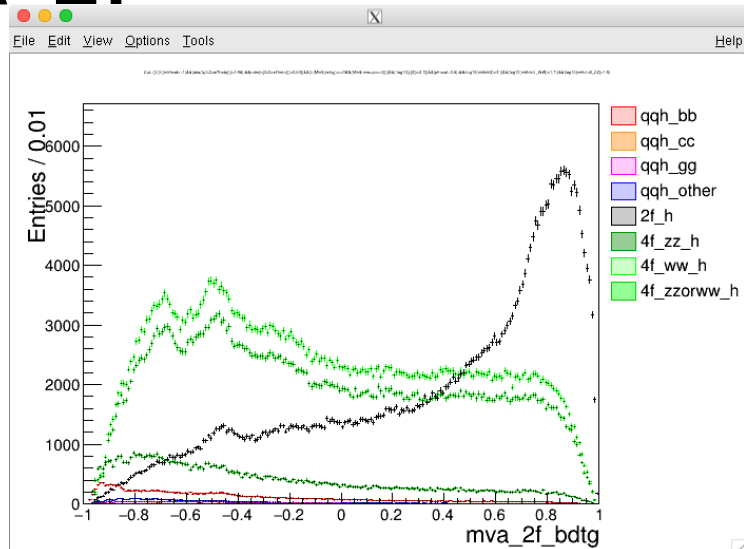


# MVA

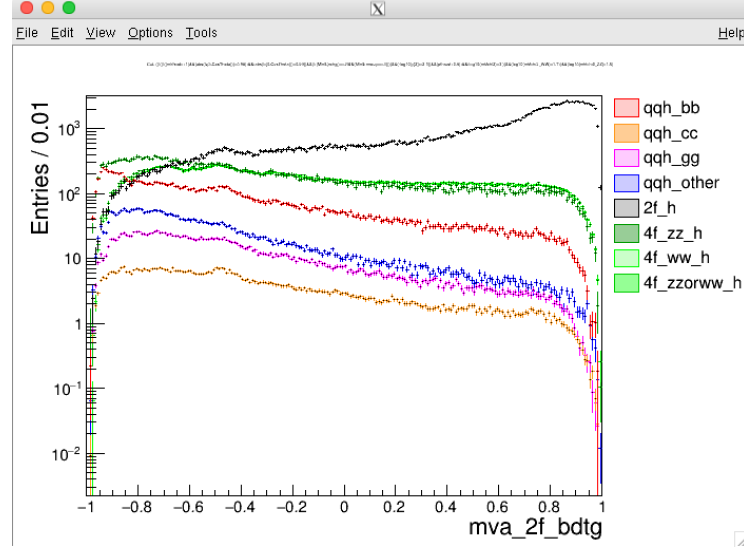
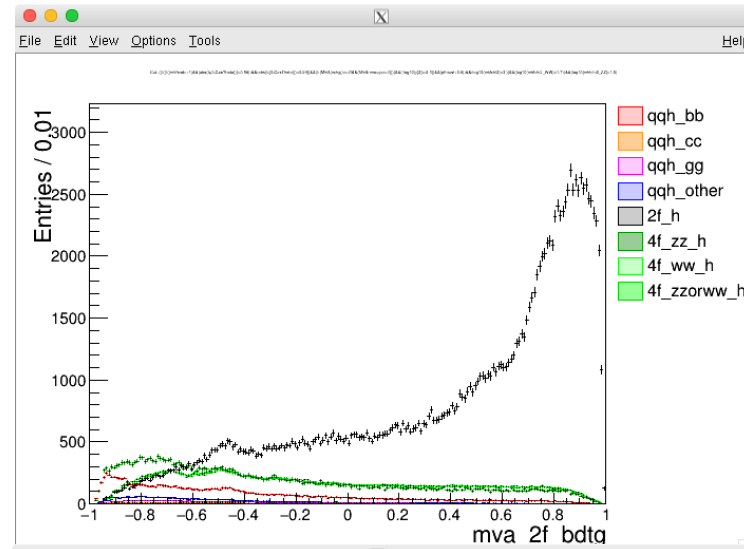
- Method: BDTG
- 2f vs 4f (mva\_2f\_bdtg)
  - Variables
    - $\log_{10}(y_{34})$ ,  $\text{Min}\$(n_{chjj})$ ,  $\text{Min}\$(n_{neutj})$ ,  $\text{mkfminangle}$ ,  $p_{thrust}$ ,  $\text{abs}(\text{costhrust})$
- Higgs vs 4f (mva\_4f\_bdtg)
  - Variables
    - $\log_{10}(\text{mkfchi2})$ ,  $\log_{10}(\text{mkfchi2}_{WW})$ ,  $\log_{10}(\text{mkfchi2}_{ZZ})$ ,  
 $\text{mva\_2f\_bdtg}$ ,  $\text{abs}(\text{mkfrestangle}[1])$ ,  $\text{abs}(\text{mkflrzH.CosTheta}())$ , higgs multiplicity

# MVA 2f

Pol: -1



Pol: +1



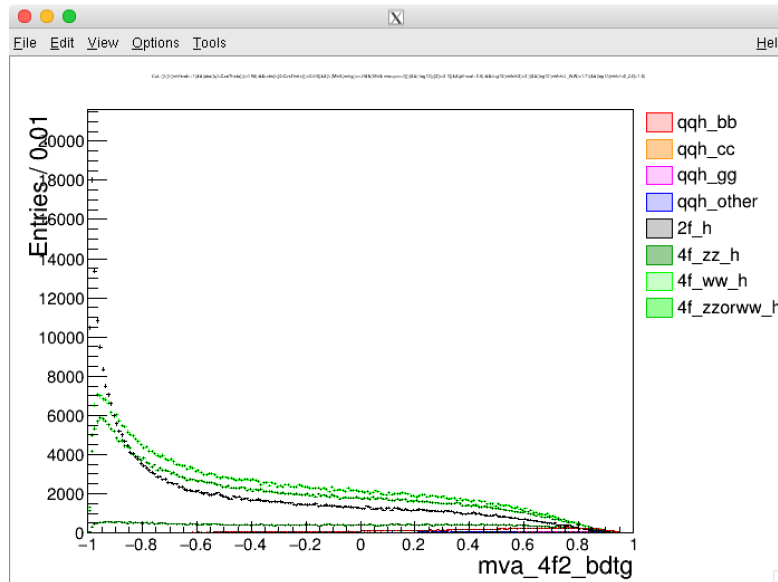
Note

- MVA is trained with “Pol -1”

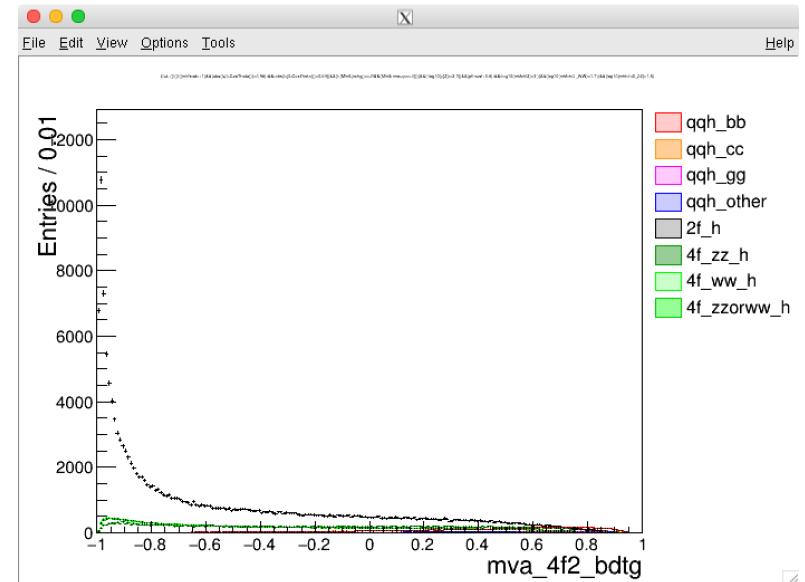


# MVA\_4f

Pol: -1

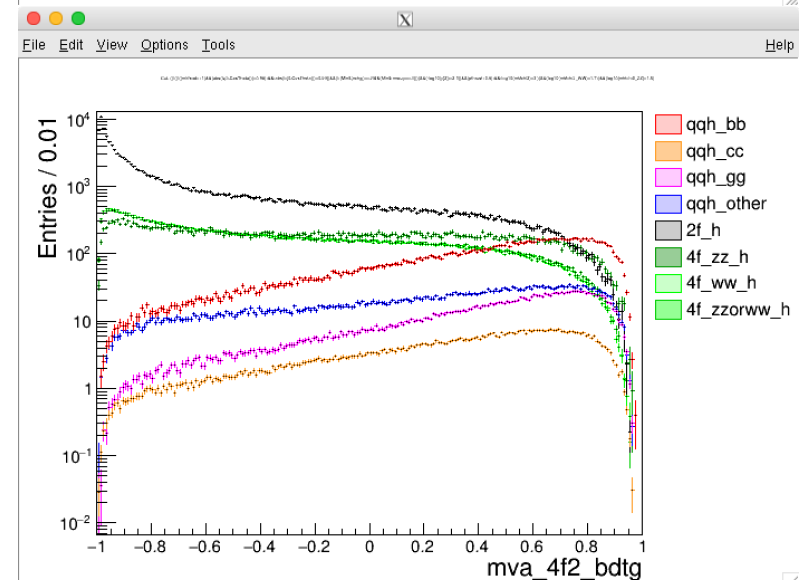
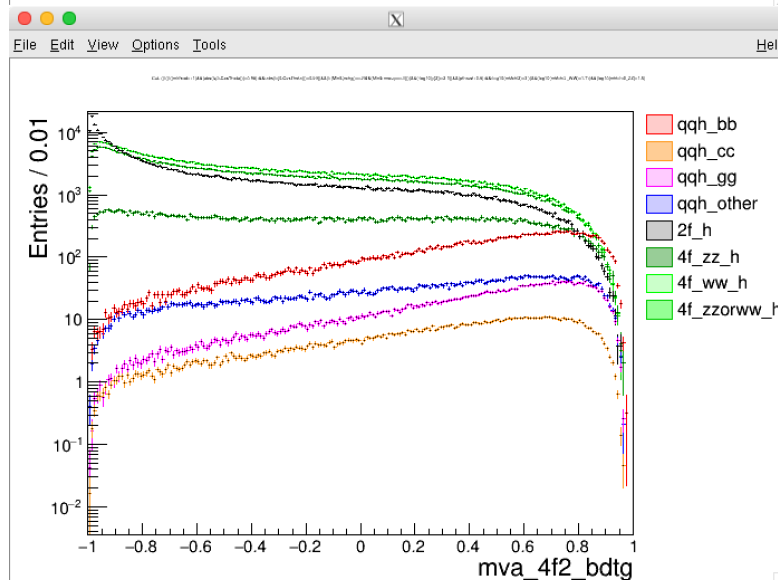


Pol: +1



Note

- MVA is trained with "Pol -1"



# Cut table

Polarization:  $(e^-, e^+) = (-0.8, +0.3)$ , Luminosity = 250/fb

Reduction Table										
Process	:	qqh_other	2f_h	4f_zz_h	4f_ww_h	4f_zzorww_h	all bkg	Signal	efficiency	Signf
Cross Section	:	208.355	77324.4	843.195	8701.64	7255.63	94333.2	144.48		
Generated	:	1e+06	3.0154e+07	316200	2.1488e+06	2.1582e+06		600000		
Expected	:	52088.7	1.93311e+07	210799	2.17541e+06	1.81391e+06	2.35833e+07	36120.1		
Before KF	:	6398.71	438452	140829	1.27387e+06	1.067e+06	2.92654e+06	28689.1	0.794271	16.6887
KF for qqH	:	6384.52	428654	140455	1.26717e+06	1.06116e+06	2.90382e+06	28632.3	0.792698	16.7202
KF for WW	:	5840.76	386061	117513	516916	441552	1.46788e+06	25909.3	0.71731	21.1988
KF for ZZ	:	5401.59	365916	76333.5	462061	388326	1.29804e+06	24408.5	0.675762	21.2252
MVA_4f > 0.49	:	1911.61	19897.9	12430.1	34629	30056.5	98925.1	11693.3	0.323734	35.1579

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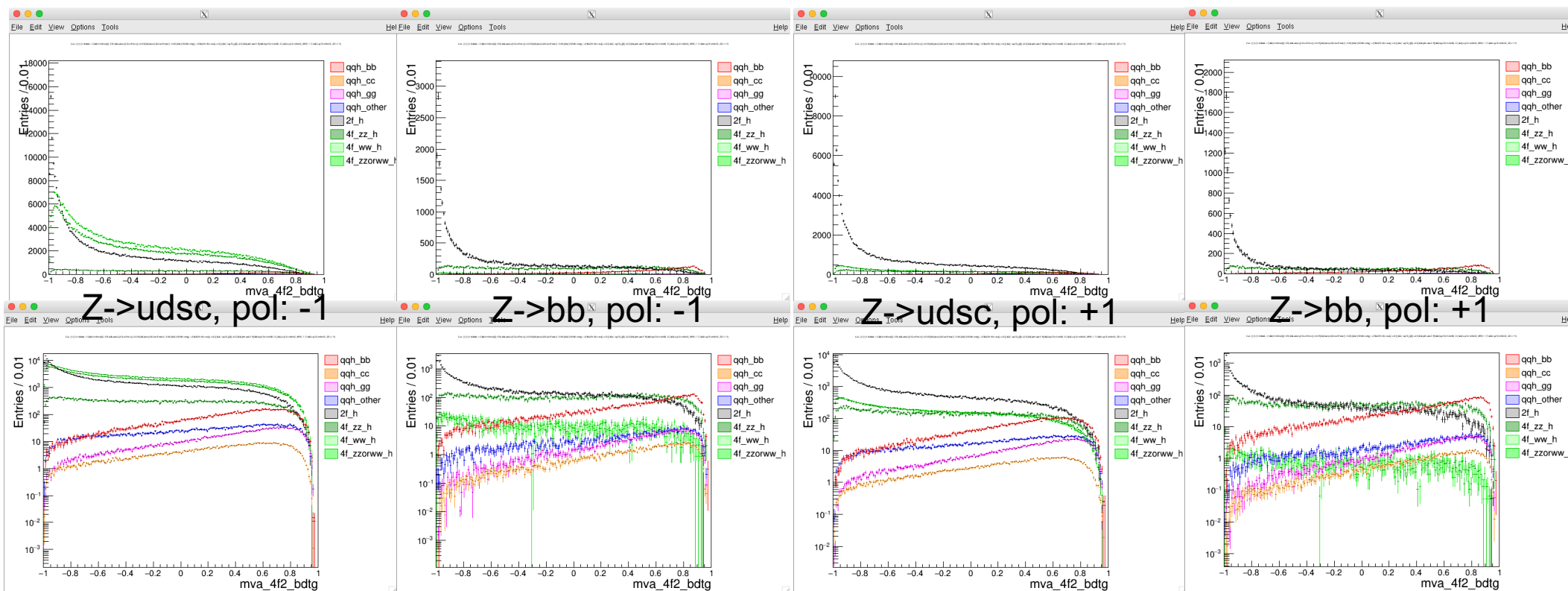
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	Cut names	Condition	Sig.	Bkg.	Condition	Sig.	Bkg.
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$Y_{34}$ value		$-\log(Y_{34}) > 2.7$	25065	1002125	$-\log(Y_{34}) > 2.7$	14543	250995
thrust		thrust < 0.9	24688	935950	thrust < 0.85	13522	144560
thrust angle		$ \cos\theta_{thrust}  < 0.9$	21892	696201	$ \cos\theta_{thrust}  < 0.9$	12523	107025
Higgs jets angle		$105^\circ < \theta_H < 160^\circ$	20062	622143	$70^\circ < \theta_H < 120^\circ$	11185	77659
Z di-jet mass		$80 < M_Z < 100 \text{ GeV}$	16359	411863	$80 < M_Z < 100 \text{ GeV}$	9468	45671
H di-jet mass		$105 < M_H < 130 \text{ GeV}$	16359	411863	$105 < M_H < 130 \text{ GeV}$	9451	44399
Likelihood ratio		$LR > 0.375$	13726	166807	$LR > 0.15$	8686	25393
Significance (Efficiency)		$S/\sqrt{S+B}$	32.3 (26.1 %)		$S/\sqrt{S+B}$	47.1 (24.1 %)	

# Categorization for template fit

Z , Pol	mva_4f cut	Signal: bb/cc/gg	S/N
Z->udsc, -1	0.35	nS = 9339, nB = 149303	0.06
Z->bb, -1	0.24	nS = 5821, nB = 13865	0.42
Z->all, -1	0.49	nS = 11693, nB = 98925	0.12
Z->udsc, +1	0.37	nS = 7267, nB = 36631	0.20
Z->bb, +1	0.03	nS = 4509, nB = 6897	0.65
Z->all, +1	0.29	nS = 10525, nB = 35560	0.30

Note

- MVA is trained with “Pol -1”



# Template fit

- Toy MC to extract the measurement precision of  $H \rightarrow bb, cc, gg$ 
  - From LCFIPlus output, calculate x-likelihood in each event:

$$x - \text{likelihood} = \frac{x_1 x_2}{x_1 x_2 + (1 - x_1)(1 - x_2)} \quad (x = b, c, bc),$$

$x_1, x_2$ : LCFIPlus output( $b, c, bc=c/(b+c)$ )

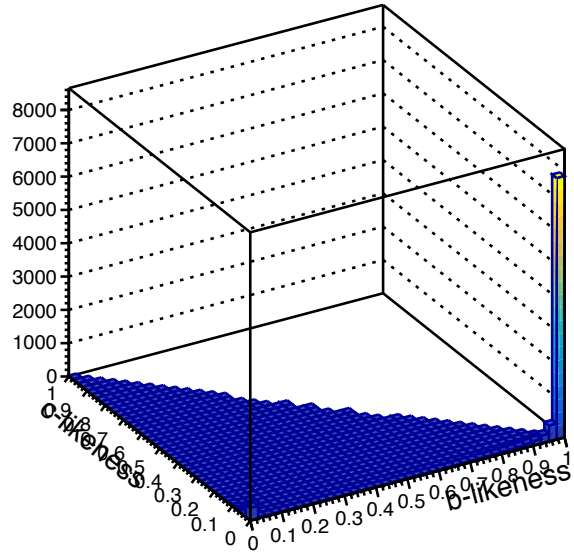
- Create 3-D template with those  $b, c, bc$  likelihood
- Fitting is performed according to Poisson statistics
  - 3 scale factors of signal events are parameters, other fixed:

$$N_{ijk}^{\text{template}} = \sum_{s=bb, cc, gg} r_s \cdot N_{ijk}^s + N_{ijk}^{\text{bkg}},$$

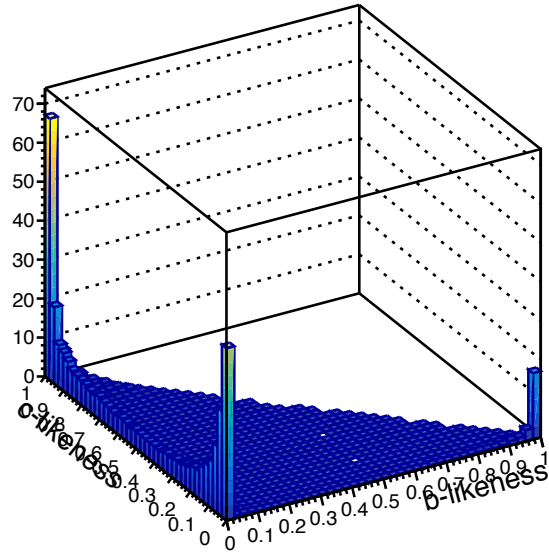
- Do Toy MC
  - 10000 pseudo-experiments performed

# Template\_kato\_nbin40

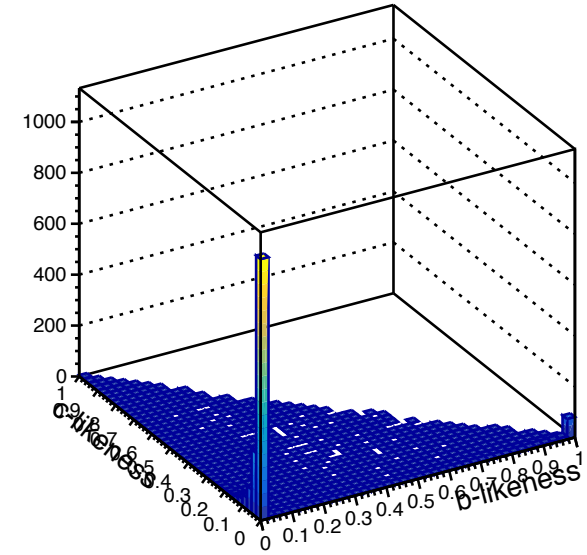
qqh\_bb yx projection



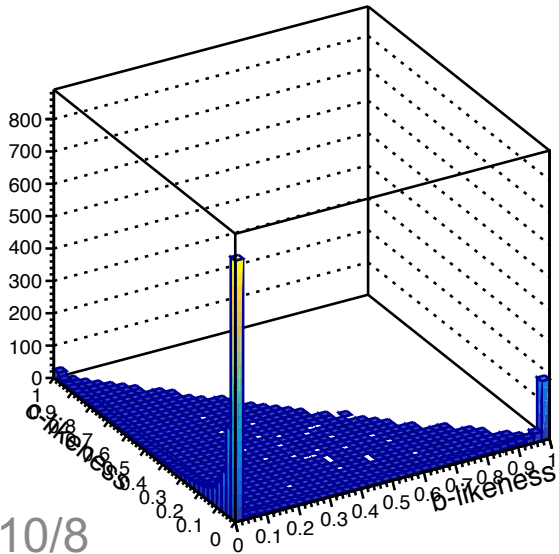
qqh\_cc yx projection



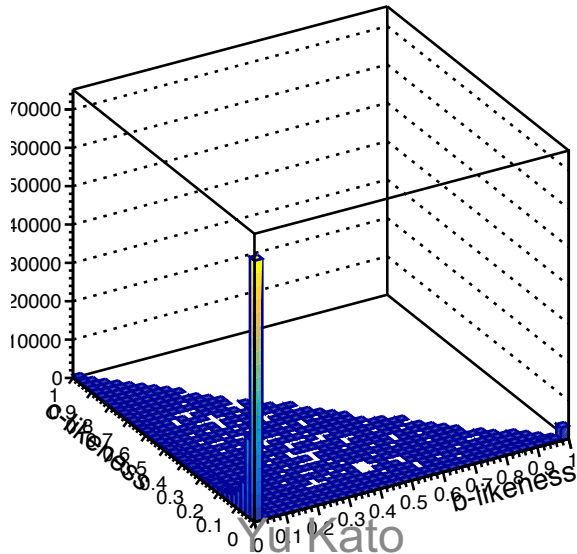
qqh\_gg yx projection



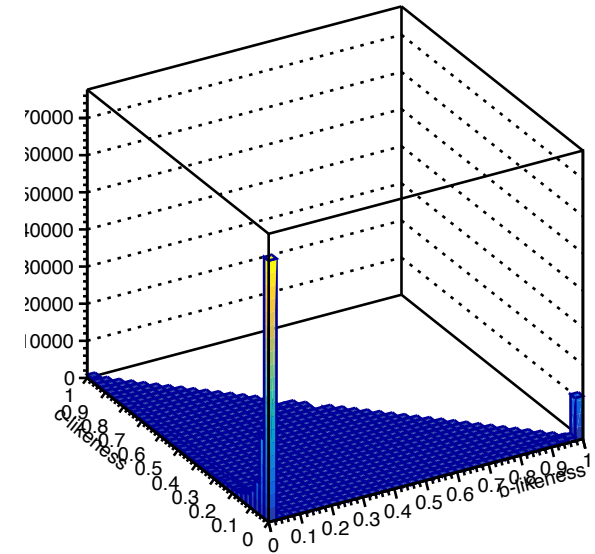
qqh\_other yx projection



qq\_qqqq yx projection



template\_all



# 2D( b-likeness : c-likeness )

• bkg で空のビンのみ除いた

## Pol: -1 (-0.8,+0.3)

result/template2Dv5/Renew/template2D_ pol-1_zdecX_nbin10.root	result/template2Dv5/Renew/template2D_ pol-1_zdecX_nbin20.root	result/template2Dv5/Renew/template2D_ pol-1_zdecX_nbin30.root	result/template2Dv5/Renew/template2D_ pol-1_zdecX_nbin50.root	result/template2Dv5/Renew/template2D_ pol-1_zdecX_nbin80.root	result/template2Dv5/Renew/template2D_ pol-1_zdecX_nbin100.root	result/template2Dv5/Renew/template2D_ pol-1_zdecX_nbin200.root
Z->all: d(rbb) = 1.56e-02 +- 2.64e-04 d(rcc) = 3.83e-01 +- 7.09e-03 d(rgg) = 2.20e-01 +- 3.93e-03	Z->all: d(rbb) = 1.51e-02 +- 2.61e-04 d(rcc) = 3.82e-01 +- 7.22e-03 d(rgg) = 2.23e-01 +- 4.06e-03	Z->all: d(rbb) = 1.54e-02 +- 2.57e-04 d(rcc) = 3.61e-01 +- 6.76e-03 d(rgg) = 2.19e-01 +- 3.75e-03	Z->all: d(rbb) = 1.50e-02 +- 2.50e-04 d(rcc) = 3.66e-01 +- 6.81e-03 d(rgg) = 2.17e-01 +- 3.57e-03	Z->all: d(rbb) = 1.45e-02 +- 2.49e-04 d(rcc) = 3.30e-01 +- 5.69e-03 d(rgg) = 2.12e-01 +- 3.59e-03	Z->all: d(rbb) = 1.41e-02 +- 2.57e-04 d(rcc) = 3.08e-01 +- 5.52e-03 d(rgg) = 2.08e-01 +- 3.67e-03	Z->all: d(rbb) = 1.36e-02 +- 2.34e-04 d(rcc) = 2.64e-01 +- 4.58e-03 d(rgg) = 1.93e-01 +- 3.17e-03
Z->udsc: d(rbb) = 1.77e-02 +- 2.99e-04 d(rcc) = 4.41e-01 +- 9.83e-03 d(rgg) = 2.59e-01 +- 4.45e-03	Z->udsc: d(rbb) = 1.75e-02 +- 2.99e-04 d(rcc) = 4.46e-01 +- 9.86e-03 d(rgg) = 2.61e-01 +- 4.84e-03	Z->udsc: d(rbb) = 1.68e-02 +- 2.66e-04 d(rcc) = 4.39e-01 +- 9.66e-03 d(rgg) = 2.64e-01 +- 4.88e-03	Z->udsc: d(rbb) = 1.69e-02 +- 2.90e-04 d(rcc) = 4.45e-01 +- 1.01e-02 d(rgg) = 2.62e-01 +- 4.71e-03	Z->udsc: d(rbb) = 1.67e-02 +- 3.14e-04 d(rcc) = 3.89e-01 +- 7.94e-03 d(rgg) = 2.42e-01 +- 4.53e-03	Z->udsc: d(rbb) = 1.66e-02 +- 3.17e-04 d(rcc) = 3.77e-01 +- 7.24e-03 d(rgg) = 2.34e-01 +- 3.93e-03	Z->udsc: d(rbb) = 1.55e-02 +- 2.71e-04 d(rcc) = 3.33e-01 +- 6.26e-03 d(rgg) = 2.16e-01 +- 3.61e-03
Z->bb: d(rbb) = 2.71e-02 +- 5.03e-04 d(rcc) = 4.54e-01 +- 1.10e-02 d(rgg) = 3.21e-01 +- 5.56e-03	Z->bb: d(rbb) = 2.52e-02 +- 4.33e-04 d(rcc) = 4.47e-01 +- 9.61e-03 d(rgg) = 3.05e-01 +- 5.26e-03	Z->bb: d(rbb) = 2.43e-02 +- 4.14e-04 d(rcc) = 4.41e-01 +- 9.78e-03 d(rgg) = 2.96e-01 +- 5.51e-03	Z->bb: d(rbb) = 2.30e-02 +- 4.00e-04 d(rcc) = 4.09e-01 +- 8.47e-03 d(rgg) = 2.81e-01 +- 4.99e-03	Z->bb: d(rbb) = 2.23e-02 +- 4.02e-04 d(rcc) = 3.59e-01 +- 6.54e-03 d(rgg) = 2.74e-01 +- 4.52e-03	Z->bb: d(rbb) = 2.17e-02 +- 3.69e-04 d(rcc) = 3.28e-01 +- 5.55e-03 d(rgg) = 2.68e-01 +- 4.78e-03	Z->bb: d(rbb) = 2.05e-02 +- 9.99e-04 d(rcc) = 2.70e-01 +- 4.80e-03 d(rgg) = 2.47e-01 +- 4.50e-03
Combined: d(rbb) = 1.48e-02 d(rcc) = 3.16e-01 d(rgg) = 2.02e-01	Combined: d(rbb) = 1.44e-02 d(rcc) = 3.16e-01 d(rgg) = 1.98e-01	Combined: d(rbb) = 1.38e-02 d(rcc) = 3.11e-01 d(rgg) = 1.97e-01	Combined: d(rbb) = 1.36e-02 d(rcc) = 3.01e-01 d(rgg) = 1.91e-01	Combined: d(rbb) = 1.34e-02 d(rcc) = 2.64e-01 d(rgg) = 1.82e-01	Combined: d(rbb) = 1.32e-02 d(rcc) = 2.48e-01 d(rgg) = 1.76e-01	Combined: d(rbb) = 1.24e-02 d(rcc) = 2.10e-01 d(rgg) = 1.63e-01

## Pol: +1 (+0.8,-0.3)

result/template2Dv5/Renew/template2D_ pol1_zdecX_nbin10.root	result/template2Dv5/Renew/template2D_ pol1_zdecX_nbin20.root	result/template2Dv5/Renew/template2D_ pol1_zdecX_nbin30.root	result/template2Dv5/Renew/template2D_ pol1_zdecX_nbin50.root	result/template2Dv5/Renew/template2D_ pol1_zdecX_nbin80.root	result/template2Dv5/Renew/template2D_ pol1_zdecX_nbin100.root	result/template2Dv5/Renew/template2D_ pol1_zdecX_nbin200.root
Z->all: d(rbb) = 1.54e-02 +- 2.76e-04 d(rcc) = 2.75e-01 +- 4.63e-03 d(rgg) = 1.56e-01 +- 2.68e-03	Z->all: d(rbb) = 1.49e-02 +- 2.55e-04 d(rcc) = 2.79e-01 +- 4.81e-03 d(rgg) = 1.47e-01 +- 2.61e-03	Z->all: d(rbb) = 1.45e-02 +- 2.37e-04 d(rcc) = 2.66e-01 +- 4.15e-03 d(rgg) = 1.49e-01 +- 2.50e-03	Z->all: d(rbb) = 1.48e-02 +- 2.52e-04 d(rcc) = 2.82e-01 +- 4.91e-03 d(rgg) = 1.43e-01 +- 2.31e-03	Z->all: d(rbb) = 1.45e-02 +- 2.30e-04 d(rcc) = 2.61e-01 +- 4.46e-03 d(rgg) = 1.45e-01 +- 2.52e-03	Z->all: d(rbb) = 1.48e-02 +- 2.37e-04 d(rcc) = 2.46e-01 +- 4.10e-03 d(rgg) = 1.44e-01 +- 2.48e-03	Z->all: d(rbb) = 1.41e-02 +- 2.35e-04 d(rcc) = 2.19e-01 +- 3.75e-03 d(rgg) = 1.36e-01 +- 2.36e-03
Z->udsc: d(rbb) = 1.87e-02 +- 3.16e-04 d(rcc) = 3.48e-01 +- 6.50e-03 d(rgg) = 1.74e-01 +- 3.33e-03	Z->udsc: d(rbb) = 1.84e-02 +- 3.08e-04 d(rcc) = 3.42e-01 +- 6.19e-03 d(rgg) = 1.66e-01 +- 2.92e-03	Z->udsc: d(rbb) = 1.92e-02 +- 3.19e-04 d(rcc) = 3.35e-01 +- 5.87e-03 d(rgg) = 1.57e-01 +- 2.80e-03	Z->udsc: d(rbb) = 1.79e-02 +- 3.06e-04 d(rcc) = 3.20e-01 +- 5.62e-03 d(rgg) = 1.62e-01 +- 2.95e-03	Z->udsc: d(rbb) = 1.80e-02 +- 3.28e-04 d(rcc) = 3.02e-01 +- 5.13e-03 d(rgg) = 1.58e-01 +- 2.65e-03	Z->udsc: d(rbb) = 1.79e-02 +- 2.99e-04 d(rcc) = 2.90e-01 +- 5.42e-03 d(rgg) = 1.54e-01 +- 2.61e-03	Z->udsc: d(rbb) = 1.73e-02 +- 3.53e-04 d(rcc) = 2.57e-01 +- 4.22e-03 d(rgg) = 1.49e-01 +- 2.77e-03
Z->bb: d(rbb) = 2.65e-02 +- 4.70e-04 d(rcc) = 4.45e-01 +- 9.86e-03 d(rgg) = 3.15e-01 +- 5.78e-03	Z->bb: d(rbb) = 2.58e-02 +- 4.47e-04 d(rcc) = 4.53e-01 +- 1.09e-02 d(rgg) = 3.04e-01 +- 5.44e-03	Z->bb: d(rbb) = 2.57e-02 +- 4.42e-04 d(rcc) = 4.30e-01 +- 9.71e-03 d(rgg) = 2.96e-01 +- 5.39e-03	Z->bb: d(rbb) = 2.57e-02 +- 4.76e-04 d(rcc) = 4.04e-01 +- 7.76e-03 d(rgg) = 2.86e-01 +- 5.05e-03	Z->bb: d(rbb) = 2.43e-02 +- 4.40e-04 d(rcc) = 3.81e-01 +- 7.43e-03 d(rgg) = 2.71e-01 +- 4.72e-03	Z->bb: d(rbb) = 2.31e-02 +- 4.12e-04 d(rcc) = 3.51e-01 +- 6.88e-03 d(rgg) = 2.67e-01 +- 4.88e-03	Z->bb: d(rbb) = 2.48e-02 +- 1.07e-03 d(rcc) = 2.95e-01 +- 5.27e-03 d(rgg) = 2.45e-01 +- 4.19e-03
Combined: d(rbb) = 1.53e-02 d(rcc) = 2.74e-01 d(rgg) = 1.52e-01	Combined: d(rbb) = 1.50e-02 d(rcc) = 2.73e-01 d(rgg) = 1.46e-01	Combined: d(rbb) = 1.54e-02 d(rcc) = 2.64e-01 d(rgg) = 1.39e-01	Combined: d(rbb) = 1.47e-02 d(rcc) = 2.51e-01 d(rgg) = 1.41e-01	Combined: d(rbb) = 1.45e-02 d(rcc) = 2.37e-01 d(rgg) = 1.37e-01	Combined: d(rbb) = 1.42e-02 d(rcc) = 2.24e-01 d(rgg) = 1.34e-01	Combined: d(rbb) = 1.42e-02 d(rcc) = 1.94e-01 d(rgg) = 1.27e-01

# 2D( c1-probability : c2-probability)

• bkg で空のビンのみ除いた

## Pol: -1 (-0.8,+0.3)

result/Flavor2Dv2/Flavor2D\_xcyc\_pol-1\_zdecX\_nbin10.root

Z->all:  
d(rbb) = 4.90e-02 +- 1.22e-03  
d(rcc) = 3.57e-01 +- 6.44e-03  
d(rgg) = 3.73e-01 +- 7.21e-03

Z->udsc:  
d(rbb) = 6.76e-02 +- 3.14e-03  
d(rcc) = 4.32e-01 +- 1.02e-02  
d(rgg) = 4.47e-01 +- 1.02e-02

Z->bb:  
d(rbb) = 4.54e-02 +- 9.05e-04  
d(rcc) = 4.68e-01 +- 1.11e-02  
d(rgg) = 8.04e-01 +- 5.19e-02

Combined:  
d(rbb) = 3.77e-02  
d(rcc) = 3.17e-01  
d(rgg) = 3.90e-01

result/Flavor2Dv2/Flavor2D\_xcyc\_pol-1\_zdecX\_nbin20.root

Z->all:  
d(rbb) = 1.80e-02 +- 3.01e-04  
d(rcc) = 3.60e-01 +- 6.63e-03  
d(rgg) = 2.24e-01 +- 3.95e-03

Z->udsc:  
d(rbb) = 2.18e-02 +- 3.60e-04  
d(rcc) = 4.24e-01 +- 8.92e-03  
d(rgg) = 2.67e-01 +- 4.71e-03

Z->bb:  
d(rbb) = 2.51e-02 +- 4.67e-04  
d(rcc) = 4.10e-01 +- 8.24e-03  
d(rgg) = 3.33e-01 +- 6.01e-03

Combined:  
d(rbb) = 1.65e-02  
d(rcc) = 2.95e-01  
d(rgg) = 2.08e-01

result/Flavor2Dv2/Flavor2D\_xcyc\_pol-1\_zdecX\_nbin30.root

Z->all:  
d(rbb) = 1.61e-02 +- 2.97e-04  
d(rcc) = 3.49e-01 +- 6.50e-03  
d(rgg) = 2.14e-01 +- 3.71e-03

Z->udsc:  
d(rbb) = 1.84e-02 +- 3.19e-04  
d(rcc) = 4.11e-01 +- 8.25e-03  
d(rgg) = 2.54e-01 +- 4.29e-03

Z->bb:  
d(rbb) = 2.56e-02 +- 4.54e-04  
d(rcc) = 3.51e-01 +- 6.51e-03  
d(rgg) = 3.15e-01 +- 5.84e-03

Combined:  
d(rbb) = 1.50e-02  
d(rcc) = 2.67e-01  
d(rgg) = 1.98e-01

result/Flavor2Dv2/Flavor2D\_xcyc\_pol-1\_zdecX\_nbin50.root

Z->all:  
d(rbb) = 1.65e-02 +- 2.79e-04  
d(rcc) = 2.94e-01 +- 5.07e-03  
d(rgg) = 2.09e-01 +- 3.35e-03

Z->udsc:  
d(rbb) = 1.75e-02 +- 2.90e-04  
d(rcc) = 3.70e-01 +- 7.54e-03  
d(rgg) = 2.56e-01 +- 4.50e-03

Z->bb:  
d(rbb) = 2.38e-02 +- 3.98e-04  
d(rcc) = 2.88e-01 +- 4.98e-03  
d(rgg) = 2.82e-01 +- 5.20e-03

Combined:  
d(rbb) = 1.41e-02  
d(rcc) = 2.27e-01  
d(rgg) = 1.89e-01

result/Flavor2Dv2/Flavor2D\_xcyc\_pol-1\_zdecX\_nbin80.root

Z->all:  
d(rbb) = 1.56e-02 +- 2.63e-04  
d(rcc) = 2.39e-01 +- 4.09e-03  
d(rgg) = 2.04e-01 +- 3.49e-03

Z->udsc:  
d(rbb) = 1.81e-02 +- 2.98e-04  
d(rcc) = 2.96e-01 +- 5.17e-03  
d(rgg) = 2.38e-01 +- 4.23e-03

Z->bb:  
d(rbb) = 2.28e-02 +- 4.11e-04  
d(rcc) = 2.40e-01 +- 3.96e-03  
d(rgg) = 2.53e-01 +- 4.67e-03

Combined:  
d(rbb) = 1.42e-02  
d(rcc) = 1.87e-01  
d(rgg) = 1.73e-01

result/Flavor2Dv2/Flavor2D\_xcyc\_pol-1\_zdecX\_nbin100.root

Z->all:  
d(rbb) = 1.58e-02 +- 2.89e-04  
d(rcc) = 2.08e-01 +- 3.39e-03  
d(rgg) = 1.89e-01 +- 3.23e-03

Z->udsc:  
d(rbb) = 1.80e-02 +- 2.96e-04  
d(rcc) = 2.56e-01 +- 4.54e-03  
d(rgg) = 2.27e-01 +- 4.12e-03

Z->bb:  
d(rbb) = 2.28e-02 +- 5.30e-04  
d(rcc) = 2.18e-01 +- 3.89e-03  
d(rgg) = 2.38e-01 +- 4.15e-03

Combined:  
d(rbb) = 1.41e-02  
d(rcc) = 1.66e-01  
d(rgg) = 1.64e-01

result/Flavor2Dv2/Flavor2D\_xcyc\_pol-1\_zdecX\_nbin200.root

Z->all:  
d(rbb) = 1.40e-02 +- 2.24e-04  
d(rcc) = 1.64e-01 +- 3.02e-03  
d(rgg) = 1.49e-01 +- 2.52e-03

Z->udsc:  
d(rbb) = 1.66e-02 +- 2.72e-04  
d(rcc) = 1.98e-01 +- 3.58e-03  
d(rgg) = 1.84e-01 +- 3.30e-03

Z->bb:  
d(rbb) = 4.34e-02 +- 4.57e-02  
d(rcc) = 1.62e-01 +- 3.68e-03  
d(rgg) = 1.75e-01 +- 2.95e-03

Combined:  
d(rbb) = 1.55e-02  
d(rcc) = 1.25e-01  
d(rgg) = 1.27e-01

## Pol: +1 (+0.8,-0.3)

result/Flavor2Dv2/Flavor2D\_xcyc\_pol1\_zdecX\_nbin10.root

Z->all:  
d(rbb) = 3.70e-02 +- 7.07e-04  
d(rcc) = 2.72e-01 +- 5.01e-03  
d(rgg) = 2.64e-01 +- 4.72e-03

Z->udsc:  
d(rbb) = 4.99e-02 +- 1.29e-03  
d(rcc) = 3.30e-01 +- 6.01e-03  
d(rgg) = 2.84e-01 +- 4.91e-03

Z->bb:  
d(rbb) = 4.57e-02 +- 9.79e-04  
d(rcc) = 4.64e-01 +- 1.08e-02  
d(rgg) = 8.10e-01 +- 5.05e-02

Combined:  
d(rbb) = 3.37e-02  
d(rcc) = 2.69e-01  
d(rgg) = 2.68e-01

result/Flavor2Dv2/Flavor2D\_xcyc\_pol1\_zdecX\_nbin20.root

Z->all:  
d(rbb) = 1.67e-02 +- 2.86e-04  
d(rcc) = 2.67e-01 +- 4.79e-03  
d(rgg) = 1.55e-01 +- 2.65e-03

Z->udsc:  
d(rbb) = 2.11e-02 +- 3.55e-04  
d(rcc) = 3.17e-01 +- 5.90e-03  
d(rgg) = 1.67e-01 +- 2.87e-03

Z->bb:  
d(rbb) = 2.69e-02 +- 4.76e-04  
d(rcc) = 4.24e-01 +- 9.22e-03  
d(rgg) = 3.25e-01 +- 6.15e-03

Combined:  
d(rbb) = 1.66e-02  
d(rcc) = 2.54e-01  
d(rgg) = 1.48e-01

result/Flavor2Dv2/Flavor2D\_xcyc\_pol1\_zdecX\_nbin30.root

Z->all:  
d(rbb) = 1.56e-02 +- 2.57e-04  
d(rcc) = 2.65e-01 +- 4.69e-03  
d(rgg) = 1.54e-01 +- 2.68e-03

Z->udsc:  
d(rbb) = 2.00e-02 +- 3.50e-04  
d(rcc) = 3.00e-01 +- 5.54e-03  
d(rgg) = 1.67e-01 +- 2.84e-03

Z->bb:  
d(rbb) = 2.76e-02 +- 4.94e-04  
d(rcc) = 3.68e-01 +- 7.17e-03  
d(rgg) = 3.10e-01 +- 5.62e-03

Combined:  
d(rbb) = 1.62e-02  
d(rcc) = 2.32e-01  
d(rgg) = 1.47e-01

result/Flavor2Dv2/Flavor2D\_xcyc\_pol1\_zdecX\_nbin50.root

Z->all:  
d(rbb) = 1.54e-02 +- 2.75e-04  
d(rcc) = 2.30e-01 +- 3.96e-03  
d(rgg) = 1.49e-01 +- 2.49e-03

Z->udsc:  
d(rbb) = 1.93e-02 +- 3.32e-04  
d(rcc) = 2.66e-01 +- 4.82e-03  
d(rgg) = 1.57e-01 +- 2.66e-03

Z->bb:  
d(rbb) = 2.45e-02 +- 4.31e-04  
d(rcc) = 3.14e-01 +- 5.64e-03  
d(rgg) = 3.06e-01 +- 5.68e-03

Combined:  
d(rbb) = 1.52e-02  
d(rcc) = 2.03e-01  
d(rgg) = 1.39e-01

result/Flavor2Dv2/Flavor2D\_xcyc\_pol1\_zdecX\_nbin80.root

Z->all:  
d(rbb) = 1.56e-02 +- 2.69e-04  
d(rcc) = 1.94e-01 +- 3.44e-03  
d(rgg) = 1.47e-01 +- 2.52e-03

Z->udsc:  
d(rbb) = 1.94e-02 +- 3.34e-04  
d(rcc) = 2.22e-01 +- 3.72e-03  
d(rgg) = 1.52e-01 +- 2.49e-03

Z->bb:  
d(rbb) = 2.33e-02 +- 3.80e-04  
d(rcc) = 2.68e-01 +- 5.14e-03  
d(rgg) = 2.75e-01 +- 4.99e-03

Combined:  
d(rbb) = 1.49e-02  
d(rcc) = 1.71e-01  
d(rgg) = 1.33e-01

result/Flavor2Dv2/Flavor2D\_xcyc\_pol1\_zdecX\_nbin100.root

Z->all:  
d(rbb) = 1.56e-02 +- 2.73e-04  
d(rcc) = 1.82e-01 +- 3.09e-03  
d(rgg) = 1.38e-01 +- 2.41e-03

Z->udsc:  
d(rbb) = 1.91e-02 +- 3.23e-04  
d(rcc) = 2.12e-01 +- 3.57e-03  
d(rgg) = 1.49e-01 +- 2.52e-03

Z->bb:  
d(rbb) = 2.41e-02 +- 5.02e-04  
d(rcc) = 2.74e-01 +- 5.05e-03  
d(rgg) = 2.45e-01 +- 4.15e-03

Combined:  
d(rbb) = 1.50e-02  
d(rcc) = 1.68e-01  
d(rgg) = 1.27e-01

result/Flavor2Dv2/Flavor2D\_xcyc\_pol1\_zdecX\_nbin200.root

Z->all:  
d(rbb) = 1.41e-02 +- 2.47e-04  
d(rcc) = 1.57e-01 +- 2.64e-03  
d(rgg) = 1.17e-01 +- 1.87e-03

Z->udsc:  
d(rbb) = 1.81e-02 +- 3.11e-04  
d(rcc) = 1.77e-01 +- 3.17e-03  
d(rgg) = 1.28e-01 +- 2.14e-03

Z->bb:  
d(rbb) = 1.74e-02 +- 1.05e-02  
d(rcc) = 2.20e-01 +- 5.32e-03  
d(rgg) = 1.88e-01 +- 3.53e-03

Combined:  
d(rbb) = 1.25e-02  
d(rcc) = 1.38e-01  
d(rgg) = 1.06e-01

backup

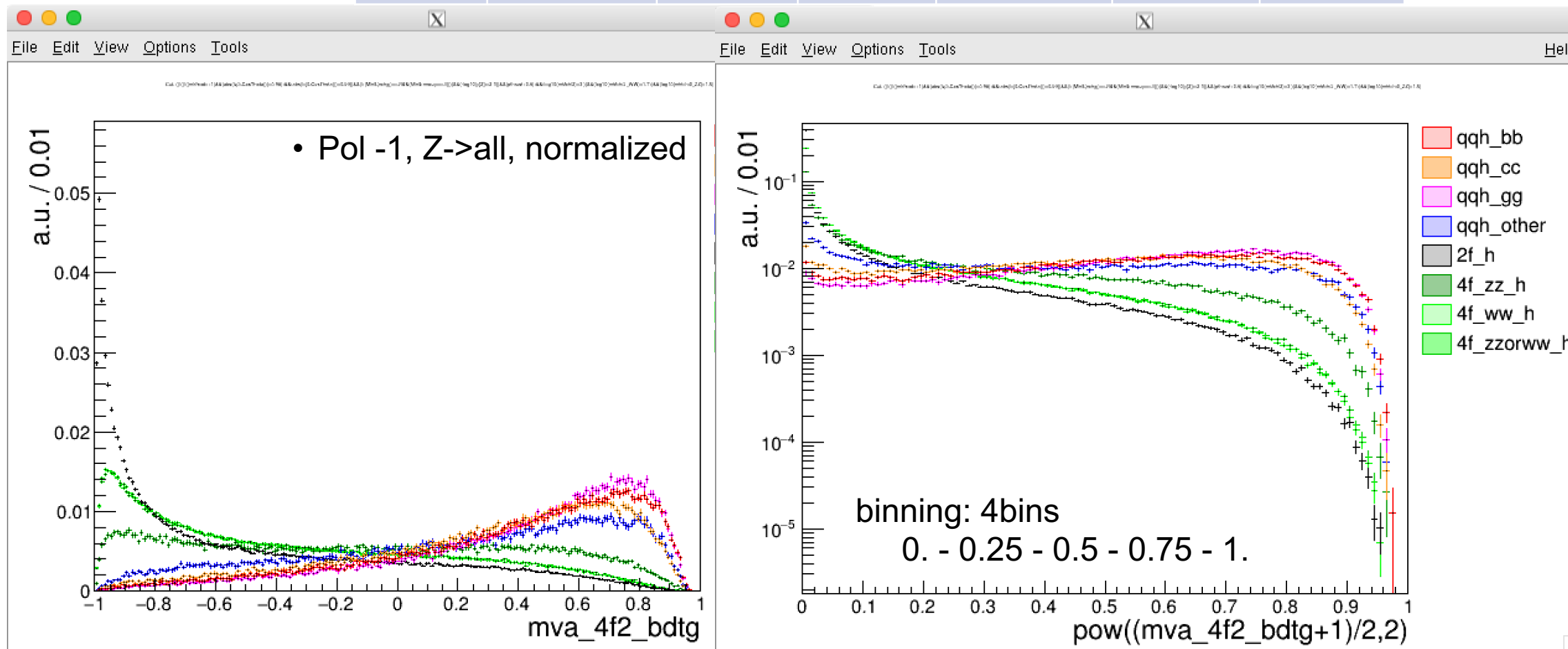


qqh\_bb\_lr: xsec = 200.03, nExp = 29254.4, nGen = 100000, weight = 0.292544, nPass = 67646, eff = 0.67646  
qqh\_bb\_rl: xsec = 127.988, nExp = 1119.9, nGen = 100000, weight = 0.011199, nPass = 67528, eff = 0.67528  
qqh\_cc\_lr: xsec = 9.9616, nExp = 1456.88, nGen = 100000, weight = 0.0145688, nPass = 65009, eff = 0.65009  
qqh\_cc\_rl: xsec = 6.37388, nExp = 55.7714, nGen = 100000, weight = 0.000557714, nPass = 64985, eff = 0.64985  
qqh\_gg\_lr: xsec = 27.8774, nExp = 4077.07, nGen = 100000, weight = 0.0407707, nPass = 68023, eff = 0.68023  
qqh\_gg\_rl: xsec = 17.8372, nExp = 156.076, nGen = 100000, weight = 0.00156076, nPass = 68046, eff = 0.68046  
qqh\_other\_lr: xsec = 343.03, nExp = 50168.2, nGen = 500000, weight = 0.100336, nPass = 51864, eff = 0.103728  
qqh\_other\_rl: xsec = 219.486, nExp = 1920.5, nGen = 500000, weight = 0.00384101, nPass = 51484, eff = 0.102968  
2f\_h\_lr: xsec = 127966, nExp = 1.8715e+07, nGen = 20068800, weight = 0.93254, nPass = 383831, eff = 0.0191258  
2f\_h\_rl: xsec = 70416.7, nExp = 616146, nGen = 10085200, weight = 0.0610941, nPass = 130596, eff = 0.0129493  
4f\_zz\_h\_lr: xsec = 1405.06, nExp = 205490, nGen = 206800, weight = 0.993665, nPass = 74939, eff = 0.362374  
4f\_zz\_h\_rl: xsec = 606.71, nExp = 5308.71, nGen = 109400, weight = 0.0485257, nPass = 38520, eff = 0.352102  
4f\_ww\_h\_lr: xsec = 14866.4, nExp = 2.17421e+06, nGen = 2048200, weight = 1.06152, nPass = 435020, eff = 0.212391  
4f\_ww\_h\_rl: xsec = 136.822, nExp = 1197.19, nGen = 100600, weight = 0.0119005, nPass = 23257, eff = 0.231183  
4f\_zzorww\_h\_lr: xsec = 12389.3, nExp = 1.81193e+06, nGen = 2048200, weight = 0.884647, nPass = 438350, eff = 0.214017  
4f\_zzorww\_h\_rl: xsec = 225.569, nExp = 1973.73, nGen = 110000, weight = 0.017943, nPass = 30145, eff = 0.274045

# c1 vs c2 vs mva\_4f: binning of mva\_4f

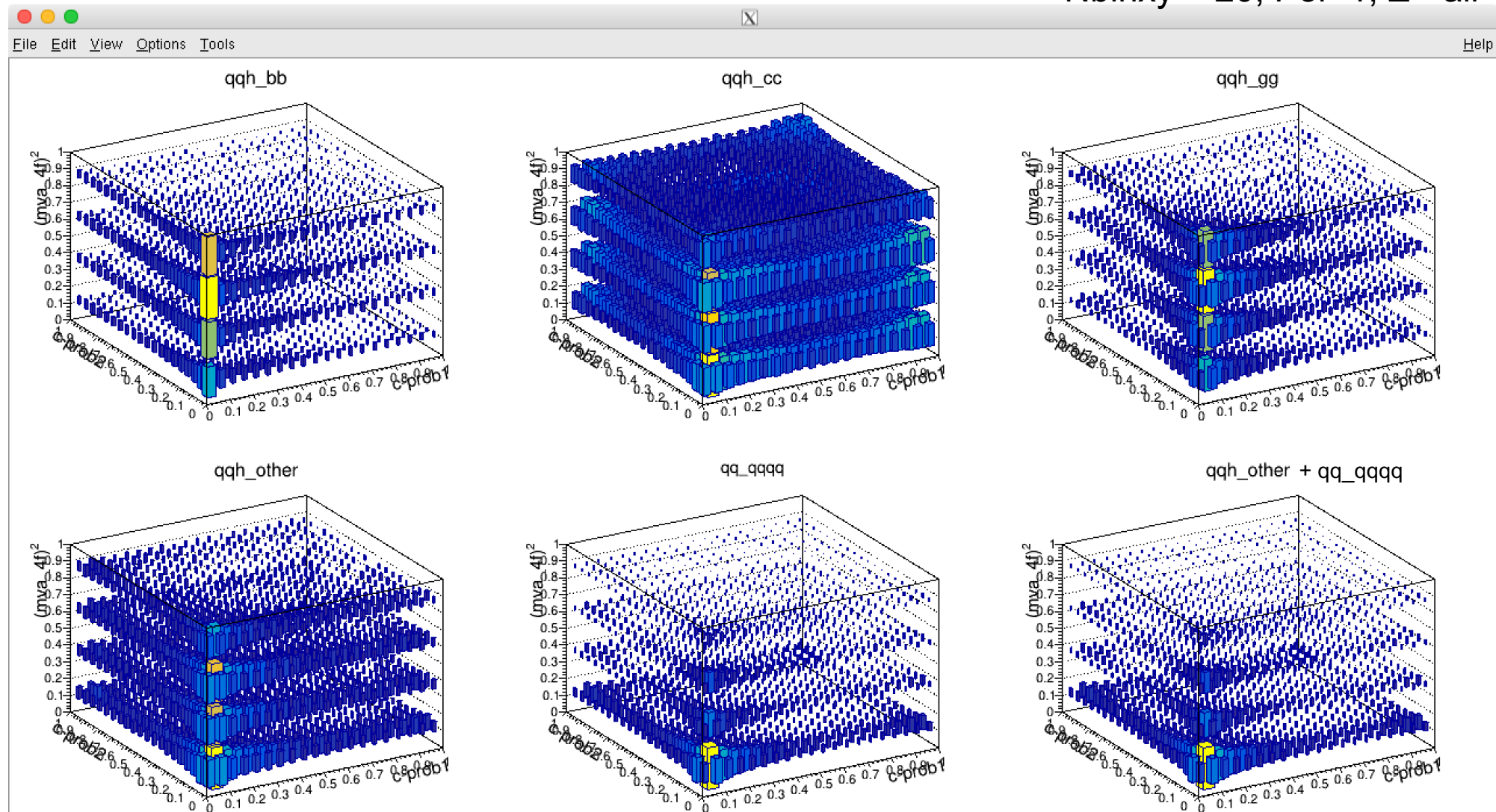
- 従来のカット条件

Z, Pol	Z->udsc, -1	Z->bb, -1	Z->all, -1	Z->udsc, +1	Z->bb, +1	Z->all, +1
Mva_4f4	0.35	0.24	0.49	0.37	0.03	0.29



# c1 vs c2 vs mva\_4f: template

- Nbinxy = 20, Pol -1, Z->all



# 3D( c1-probability : c2-probability : mva\_4f<sup>2</sup> ) • ((mva\_4f+1)/2)<sup>2</sup> 4bins

## Pol: -1 (-0.8,+0.3)

result/flavor3Dmva/flavor3Dmva\_pol-1\_zdecX\_nbin10.root

Z->all:  
d(rbb) = 4.33e-02 +- 9.46e-04  
d(rcc) = 3.65e-01 +- 6.66e-03  
d(rgg) = 3.42e-01 +- 6.10e-03

Z->udsc:  
d(rbb) = 6.62e-02 +- 3.01e-03  
d(rcc) = 4.87e-01 +- 1.19e-02  
d(rgg) = 3.90e-01 +- 7.38e-03

Z->bb:  
d(rbb) = 3.61e-02 +- 6.11e-04  
d(rcc) = 4.08e-01 +- 8.53e-03  
d(rgg) = 5.99e-01 +- 2.15e-02

Combined:  
d(rbb) = 3.17e-02  
d(rcc) = 3.13e-01  
d(rgg) = 3.27e-01

result/flavor3Dmva/flavor3Dmva\_pol-1\_zdecX\_nbin20.root

Z->all:  
d(rbb) = 1.54e-02 +- 2.60e-04  
d(rcc) = 2.97e-01 +- 5.11e-03  
d(rgg) = 1.91e-01 +- 3.14e-03

Z->udsc:  
d(rbb) = 1.88e-02 +- 3.04e-04  
d(rcc) = 3.51e-01 +- 6.31e-03  
d(rgg) = 2.12e-01 +- 3.66e-03

Z->bb:  
d(rbb) = 2.39e-02 +- 4.22e-04  
d(rcc) = 3.50e-01 +- 6.29e-03  
d(rgg) = 2.79e-01 +- 5.41e-03

Combined:  
d(rbb) = 1.48e-02  
d(rcc) = 2.48e-01  
d(rgg) = 1.69e-01

result/flavor3Dmva/flavor3Dmva\_pol-1\_zdecX\_nbin30.root

Z->all:  
d(rbb) = 1.37e-02 +- 2.14e-04  
d(rcc) = 2.74e-01 +- 4.80e-03  
d(rgg) = 1.81e-01 +- 3.29e-03

Z->udsc:  
d(rbb) = 1.62e-02 +- 2.58e-04  
d(rcc) = 3.22e-01 +- 5.91e-03  
d(rgg) = 2.10e-01 +- 3.43e-03

Z->bb:  
d(rbb) = 2.33e-02 +- 4.13e-04  
d(rcc) = 3.04e-01 +- 5.20e-03  
d(rgg) = 2.62e-01 +- 4.72e-03

Combined:  
d(rbb) = 1.33e-02  
d(rcc) = 2.21e-01  
d(rgg) = 1.64e-01

result/flavor3Dmva/flavor3Dmva\_pol-1\_zdecX\_nbin50.root

Z->all:  
d(rbb) = 1.34e-02 +- 2.31e-04  
d(rcc) = 2.31e-01 +- 3.98e-03  
d(rgg) = 1.69e-01 +- 2.97e-03

Z->udsc:  
d(rbb) = 1.59e-02 +- 2.66e-04  
d(rcc) = 2.76e-01 +- 5.03e-03  
d(rgg) = 1.86e-01 +- 3.00e-03

Z->bb:  
d(rbb) = 2.18e-02 +- 3.97e-04  
d(rcc) = 3.07e-01 +- 5.48e-03  
d(rgg) = 2.27e-01 +- 3.88e-03

Combined:  
d(rbb) = 1.28e-02  
d(rcc) = 2.05e-01  
d(rgg) = 1.44e-01

result/flavor3Dmva/flavor3Dmva\_pol-1\_zdecX\_nbin80.root

Z->all:  
d(rbb) = 1.29e-02 +- 2.26e-04  
d(rcc) = 2.05e-01 +- 3.32e-03  
d(rgg) = 1.55e-01 +- 2.66e-03

Z->udsc:  
d(rbb) = 1.50e-02 +- 2.29e-04  
d(rcc) = 2.39e-01 +- 4.24e-03  
d(rgg) = 1.75e-01 +- 2.91e-03

Z->bb:  
d(rbb) = 2.11e-02 +- 3.79e-04  
d(rcc) = 3.66e-01 +- 6.71e-03  
d(rgg) = 2.06e-01 +- 3.72e-03

Combined:  
d(rbb) = 1.22e-02  
d(rcc) = 2.00e-01  
d(rgg) = 1.33e-01

result/flavor3Dmva/flavor3Dmva\_pol-1\_zdecX\_nbin100.root

Z->all:  
d(rbb) = 1.33e-02 +- 2.34e-04  
d(rcc) = 1.93e-01 +- 3.44e-03  
d(rgg) = 1.49e-01 +- 2.67e-03

Z->udsc:  
d(rbb) = 1.53e-02 +- 2.43e-04  
d(rcc) = 2.13e-01 +- 3.46e-03  
d(rgg) = 1.66e-01 +- 2.87e-03

Z->bb:  
d(rbb) = 2.14e-02 +- 3.77e-04  
d(rcc) = 3.74e-01 +- 7.25e-03  
d(rgg) = 1.95e-01 +- 3.40e-03

Combined:  
d(rbb) = 1.25e-02  
d(rcc) = 1.85e-01  
d(rgg) = 1.26e-01

result/flavor3Dmva/flavor3Dmva\_pol-1\_zdecX\_nbin200.root

Z->all:  
d(rbb) = 1.28e-02 +- 2.32e-04  
d(rcc) = 1.88e-01 +- 3.27e-03  
d(rgg) = 1.20e-01 +- 2.05e-03

Z->udsc:  
d(rbb) = 1.56e-02 +- 2.74e-04  
d(rcc) = 2.16e-01 +- 3.70e-03  
d(rgg) = 1.28e-01 +- 1.97e-03

Z->bb:  
d(rbb) = 2.10e-02 +- 3.58e-04  
d(rcc) = 4.83e-01 +- 1.22e-02  
d(rgg) = 1.82e-01 +- 3.17e-03

Combined:  
d(rbb) = 1.25e-02  
d(rcc) = 1.97e-01  
d(rgg) = 1.05e-01

## Pol: +1 (+0.8,-0.3)

result/flavor3Dmva/flavor3Dmva\_pol1\_zdecX\_nbin10.root

Z->all:  
d(rbb) = 3.08e-02 +- 5.63e-04  
d(rcc) = 2.41e-01 +- 4.48e-03  
d(rgg) = 2.14e-01 +- 3.84e-03

Z->udsc:  
d(rbb) = 4.29e-02 +- 8.97e-04  
d(rcc) = 2.84e-01 +- 4.93e-03  
d(rgg) = 2.25e-01 +- 3.81e-03

Z->bb:  
d(rbb) = 3.79e-02 +- 7.31e-04  
d(rcc) = 4.14e-01 +- 8.18e-03  
d(rgg) = 5.74e-01 +- 1.93e-02

Combined:  
d(rbb) = 2.84e-02  
d(rcc) = 2.34e-01  
d(rgg) = 2.09e-01

result/flavor3Dmva/flavor3Dmva\_pol1\_zdecX\_nbin20.root

Z->all:  
d(rbb) = 1.51e-02 +- 2.32e-04  
d(rcc) = 2.27e-01 +- 3.81e-03  
d(rgg) = 1.24e-01 +- 2.07e-03

Z->udsc:  
d(rbb) = 1.86e-02 +- 3.26e-04  
d(rcc) = 2.59e-01 +- 4.56e-03  
d(rgg) = 1.37e-01 +- 2.22e-03

Z->bb:  
d(rbb) = 2.45e-02 +- 4.35e-04  
d(rcc) = 3.61e-01 +- 6.64e-03  
d(rgg) = 2.69e-01 +- 4.75e-03

Combined:  
d(rbb) = 1.48e-02  
d(rcc) = 2.10e-01  
d(rgg) = 1.22e-01

result/flavor3Dmva/flavor3Dmva\_pol1\_zdecX\_nbin30.root

Z->all:  
d(rbb) = 1.43e-02 +- 2.41e-04  
d(rcc) = 2.19e-01 +- 4.06e-03  
d(rgg) = 1.20e-01 +- 1.83e-03

Z->udsc:  
d(rbb) = 1.70e-02 +- 2.78e-04  
d(rcc) = 2.51e-01 +- 4.46e-03  
d(rgg) = 1.34e-01 +- 2.45e-03

Z->bb:  
d(rbb) = 2.23e-02 +- 3.68e-04  
d(rcc) = 3.28e-01 +- 5.95e-03  
d(rgg) = 2.49e-01 +- 4.19e-03

Combined:  
d(rbb) = 1.35e-02  
d(rcc) = 1.99e-01  
d(rgg) = 1.18e-01

result/flavor3Dmva/flavor3Dmva\_pol1\_zdecX\_nbin50.root

Z->all:  
d(rbb) = 1.45e-02 +- 2.68e-04  
d(rcc) = 1.93e-01 +- 3.30e-03  
d(rgg) = 1.18e-01 +- 1.93e-03

Z->udsc:  
d(rbb) = 1.69e-02 +- 2.79e-04  
d(rcc) = 2.11e-01 +- 3.70e-03  
d(rgg) = 1.29e-01 +- 2.26e-03

Z->bb:  
d(rbb) = 2.35e-02 +- 4.47e-04  
d(rcc) = 3.54e-01 +- 6.75e-03  
d(rgg) = 2.24e-01 +- 3.82e-03

Combined:  
d(rbb) = 1.38e-02  
d(rcc) = 1.82e-01  
d(rgg) = 1.12e-01

result/flavor3Dmva/flavor3Dmva\_pol1\_zdecX\_nbin80.root

Z->all:  
d(rbb) = 1.37e-02 +- 2.42e-04  
d(rcc) = 1.68e-01 +- 2.81e-03  
d(rgg) = 1.10e-01 +- 1.86e-03

Z->udsc:  
d(rbb) = 1.66e-02 +- 2.82e-04  
d(rcc) = 1.90e-01 +- 3.01e-03  
d(rgg) = 1.21e-01 +- 2.00e-03

Z->bb:  
d(rbb) = 2.15e-02 +- 3.60e-04  
d(rcc) = 4.20e-01 +- 8.76e-03  
d(rgg) = 2.03e-01 +- 3.64e-03

Combined:  
d(rbb) = 1.31e-02  
d(rcc) = 1.73e-01  
d(rgg) = 1.04e-01

result/flavor3Dmva/flavor3Dmva\_pol1\_zdecX\_nbin100.root

Z->all:  
d(rbb) = 1.38e-02 +- 2.45e-04  
d(rcc) = 1.60e-01 +- 2.73e-03  
d(rgg) = 1.04e-01 +- 1.78e-03

Z->udsc:  
d(rbb) = 1.61e-02 +- 2.90e-04  
d(rcc) = 1.95e-01 +- 3.49e-03  
d(rgg) = 1.13e-01 +- 1.92e-03

Z->bb:  
d(rbb) = 2.21e-02 +- 3.75e-04  
d(rcc) = 4.20e-01 +- 8.53e-03  
d(rgg) = 1.98e-01 +- 3.58e-03

Combined:  
d(rbb) = 1.30e-02  
d(rcc) = 1.77e-01  
d(rgg) = 9.80e-02

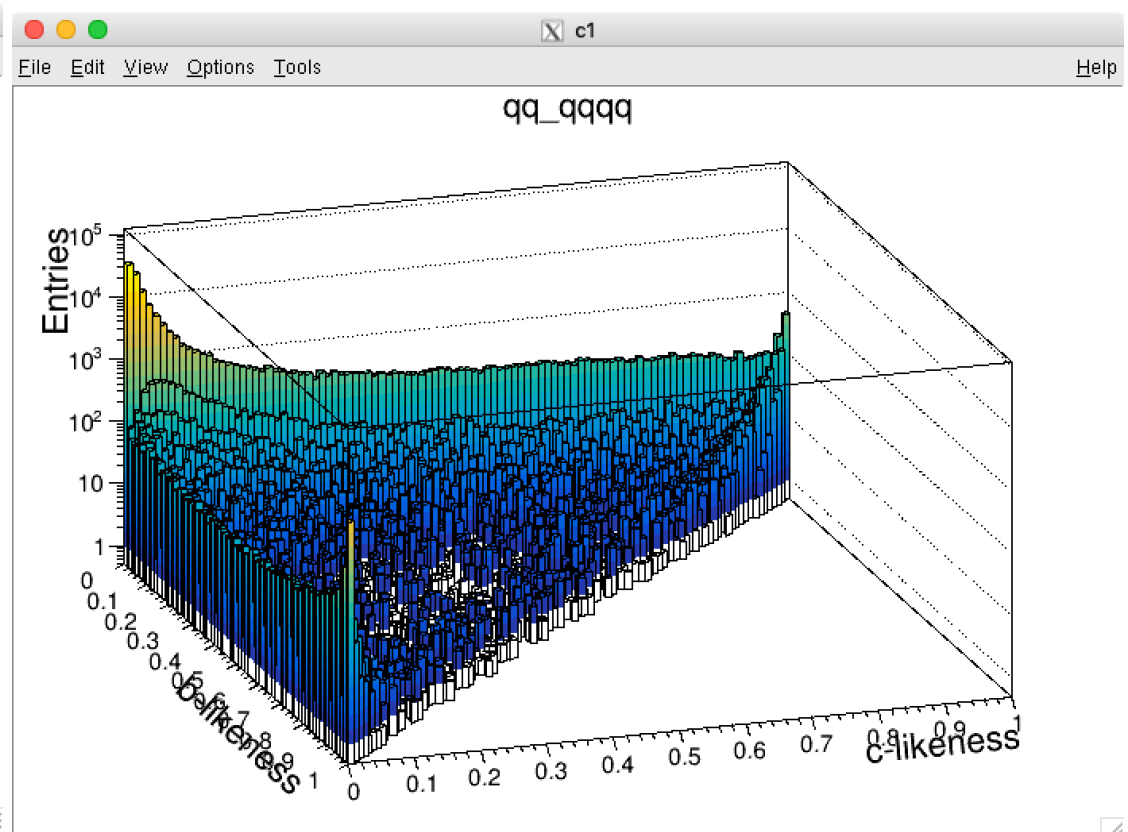
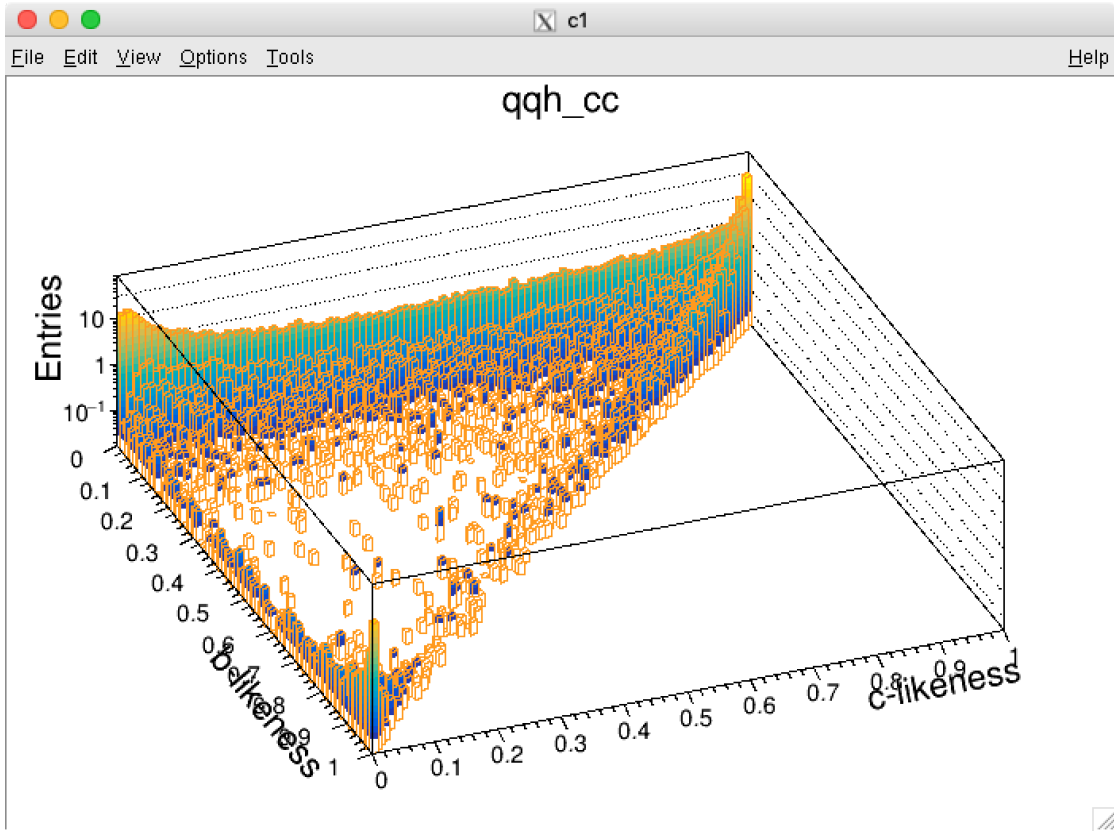
result/flavor3Dmva/flavor3Dmva\_pol1\_zdecX\_nbin200.root

Z->all:  
d(rbb) = 1.26e-02 +- 2.00e-04  
d(rcc) = 1.80e-01 +- 3.20e-03  
d(rgg) = 8.82e-02 +- 1.45e-03

Z->udsc:  
d(rbb) = 1.64e-02 +- 2.54e-04  
d(rcc) = 2.06e-01 +- 3.61e-03  
d(rgg) = 9.79e-02 +- 1.56e-03

Z->bb:  
d(rbb) = 2.15e-02 +- 3.69e-04  
d(rcc) = 5.82e-01 +- 2.01e-02  
d(rgg) = 1.97e-01 +- 3.44e-03

Combined:  
d(rbb) = 1.30e-02  
d(rcc) = 1.94e-01  
d(rgg) = 8.77e-02



# H->bb/cc/gg:Template fit についての打ち合わせ 2021.9.29

- 。 事の起こり
  - 博士論文の題材として新たに開発したkinematic fitterを利用しBR(H->bb/cc/gg)の改善を試みている 250 GeV
  - 独自の解析で先行研究(小野さん)相当のevent selectionを行い、template sampleを用意した
  - Template fit を行ったところ rcc, rgg の測定精度が~30%となり、原因を探っている
- 。 原因の推測
  1. binning の依存性を考慮できていない？
    - binning を細かく(100<sup>3</sup>)したところ、先行研究相当になった!
    - Empty binの影響? 2D/3D?
    - toyMC だと empty bin の影響を受けるはず
      - 特にsignalしかないbinが顕著か?
    - RooFit では empty を使わないようにしている(倉田さん)
  2. rbb/rcc/rgg/roth 間に constraint をかけるべき？
    - 倉田さんはかけていない
  3. cc/gg の significance がよくない？
    - 特に cc/gg に対して
- 。 先行研究との違い
  - Higgs mass (120/125 GeV)
  - overlay の有無
  - Binning, サンプルの統計量
  - Empty bin の取り扱い
  - ツール
    - LCFIVertex → LCFIPlus
      - vvHに対してqqHには影響が大きいのか?(小野さん)
    - RooFit
- 。 今後の方針案
  - 先行研究のtemplateと比較したい
  - overlay removal を tagging 前にやる

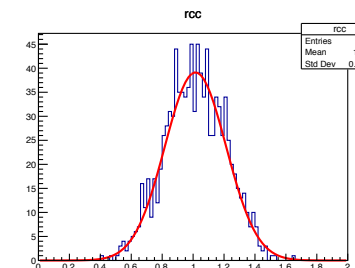
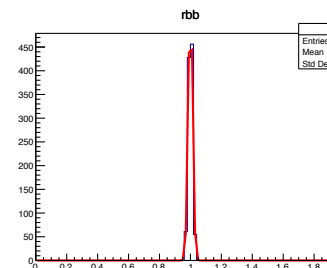
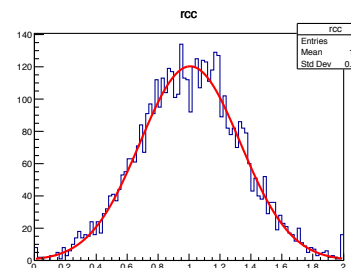
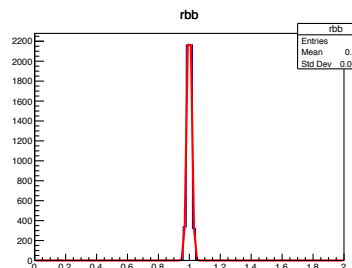
# binning の影響

3D

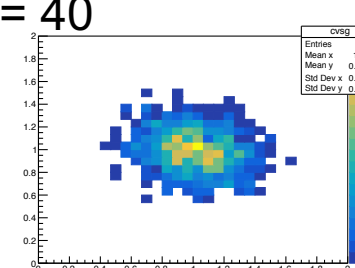
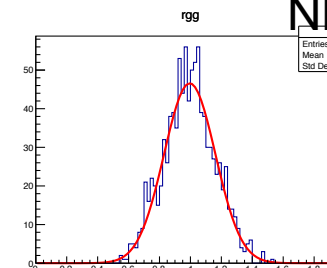
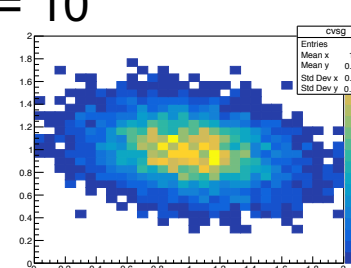
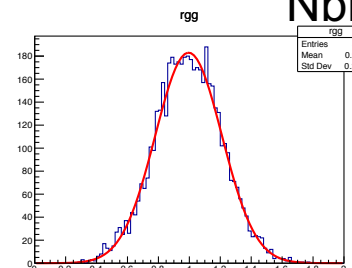
Nbin	10	40	50	100
$\Delta r_{bb}$	0.015	0.014	0.013	0.013
$\Delta r_{cc}$	0.32	0.20	0.17	0.11
$\Delta r_{gg}$	0.22	0.17	0.14	0.10

2D

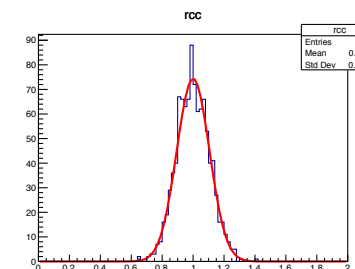
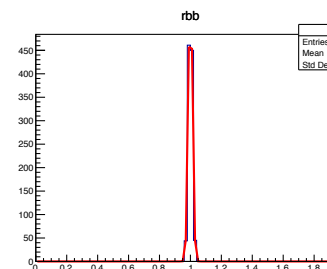
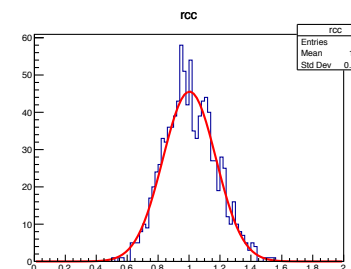
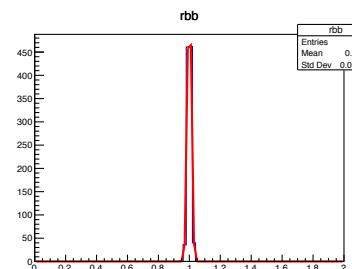
Nbin	10	40	50	100
$\Delta r_{bb}$		0.013		
$\Delta r_{cc}$		0.27		
$\Delta r_{gg}$		0.21		



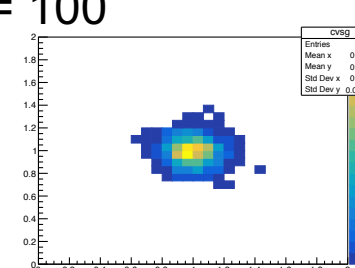
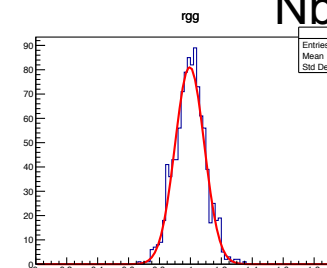
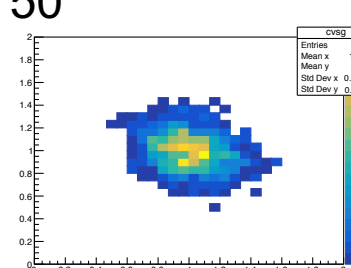
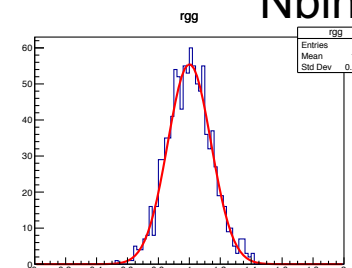
Nbin = 10



Nbin = 40



Nbin = 50



Nbin = 100