

Precise measurement of two-fermion final states in 250 GeV ILC for BSM

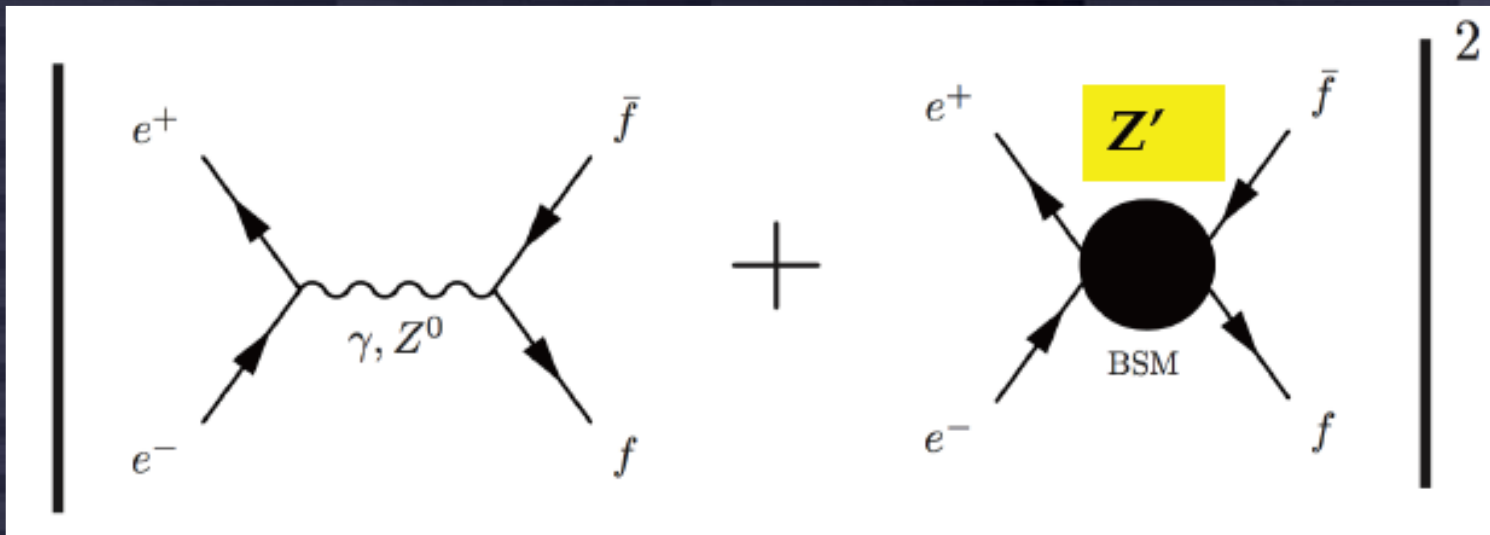
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Topics since LCWS17

- $e^+e^- \rightarrow qq$ channel

- Flavor tagging
- Charge assignment
- Obtaining angular distribution
- Calculation of Z' probability

Z' models
(SSM, ALR, E_6)
General WIMP
GHU Z'



Conditions

- ▶ DBD ILD detector geometry : ild-v1-05 ILCSoft Version : v01-16-02-p1
- ▶ H-20-staged scenario at 250 GeV

Total Luminosity	左巻き偏極($e^-_L e^+_R$)	右巻き偏極($e^-_R e^+_L$)
2000 fb ⁻¹	900 fb ⁻¹	900 fb ⁻¹

- ▶ Polarization : $|P(e^-)| = 80\%$, $|P(e^+)| = 30\%$

signal	Background
$e^+e^- \rightarrow b\bar{b}$	<ul style="list-style-type: none"> • 2f - $q\bar{q}$ ($q = u, d, s, c$) • 4f - Hadronic ,Semi-Leptonic
$e^+e^- \rightarrow c\bar{c}$	<ul style="list-style-type: none"> • 2f - $q\bar{q}$ ($q = u, d, s, b$) • 4f - Hadronic ,Semi-Leptonic

Charge assignment

Jet1	Jet2	条件 1	+	0	-	条件 2	+	0	-
2	2	B	57042	30046	29545	A	14822	7459	7765
2	2	A	63328	24894	28411	B	10369	7459	7066
2	1	B	76748	60794	44257	A	24591	21520	14683
2	1	A	83417	55611	42771	B	18590	21520	15501
2	0	B	19239	67602	9065	A	29456	19469	18677
2	0	A	42781	29199	23926	B	6000	19469	3730
1	1	B	28157	31528	17870	C	15262	4985	11281
1	0	B	35064	39606	23072	C	18700	6355	14551
1	0	C	46805	15357	35580	B	5299	6355	3703
0	0	C	18113	5532	13611	-			

Jet1	Jet2	条件 3	+	0	-	efficiency	purity
2	2	C	3538	1231	2690	64.65%	65.34%
2	2	C	3538	1231	2690	66.22%	66.93%
2	1	C	10310	3542	7668	61.41%	62.63%
2	1	C	10310	3542	7668	61.78%	63.01%
2	0	C	9045	3217	7207	60.20%	62.29%
2	0	C	9045	3217	7207	60.29%	62.39%
1	1	-				55.98%	59.83%
1	0	-				55.01%	58.83%
1	0	-				53.31%	57.01%
0	0	-				48.62%	57.10%

- 2-jet clustering (LCFIPlus)
- B-tagging (LCFIPlus)
- No vertex recovery (yet)
- Select “positive” and “negative” jets
 - A. Charge sum of tracks of 2nd & 3rd vtx
 - B. Charge sum of tracks of 2nd vtx only
 - C. Charge sum of all tracks
- ~60% efficiency obtained

Performance by number of rec. vtx

Selection

$e^+e^- \rightarrow b\bar{b}$	$e_L^- e_R^+$			
	シグナル ($b\bar{b}$)	$qq(q = u, d, s, c)$	$qqqq$	$qq\ell\ell$
全イベント	1.07137×10^7 (1.65745×10^7)	3.69393×10^7	1.307531×10^8	8,813,410
b likeness	6.70713×10^6	86,217	563,988	103,668
$ E_1 - E_2 < 20\text{GeV}$	2.09593×10^6	25,511	138,754	27,071
$\cos\theta_{cc} < -0.99939$	812,351	12,990	40,010	2,290
$E_{\text{sum}} > 230\text{ GeV}$	724,918	12,350	37,491	1,982

$e^+e^- \rightarrow b\bar{b}$	$e_R^- e_L^+$			
	シグナル ($b\bar{b}$)	$qq(q = u, d, s, c)$	$qqqq$	$qq\ell\ell$
全イベント	7.71452×10^6 (7.99098×10^6)	2.76335×10^7	1.17836 ⁶	925,953
b likeness	4.61306×10^6	59,113	101,836	45,122
$ E_1 - E_2 < 20\text{ GeV}$	1.16538×10^6	18,043	23,959	11,864
$\cos\theta_{cc} < -0.99939$	319,136	8,406	6,886	1,164
$E_{\text{sum}} > 230\text{ GeV}$	286,377	8,080	6,423	1,041

$e^+e^- \rightarrow c\bar{c}$	$e_L^- e_R^+$			
	シグナル ($c\bar{c}$)	$qq(q = u, d, s, b)$	$qqqq$	$qq\ell\ell$
全イベント	1.38467×10^7 (1.70212×10^7)	3.58547×10^7	1.30753×10^7	8.81341×10^6
c likeness	3.24113×10^6	55,892	482,204	2.53296×10^6
$\cos\theta_{cc} < -0.99939$	1.02334×10^6	7,141	164,125	3,569
$E_{\text{sum}} > 230\text{ GeV}$	916,279	5,516	159,049	2,531

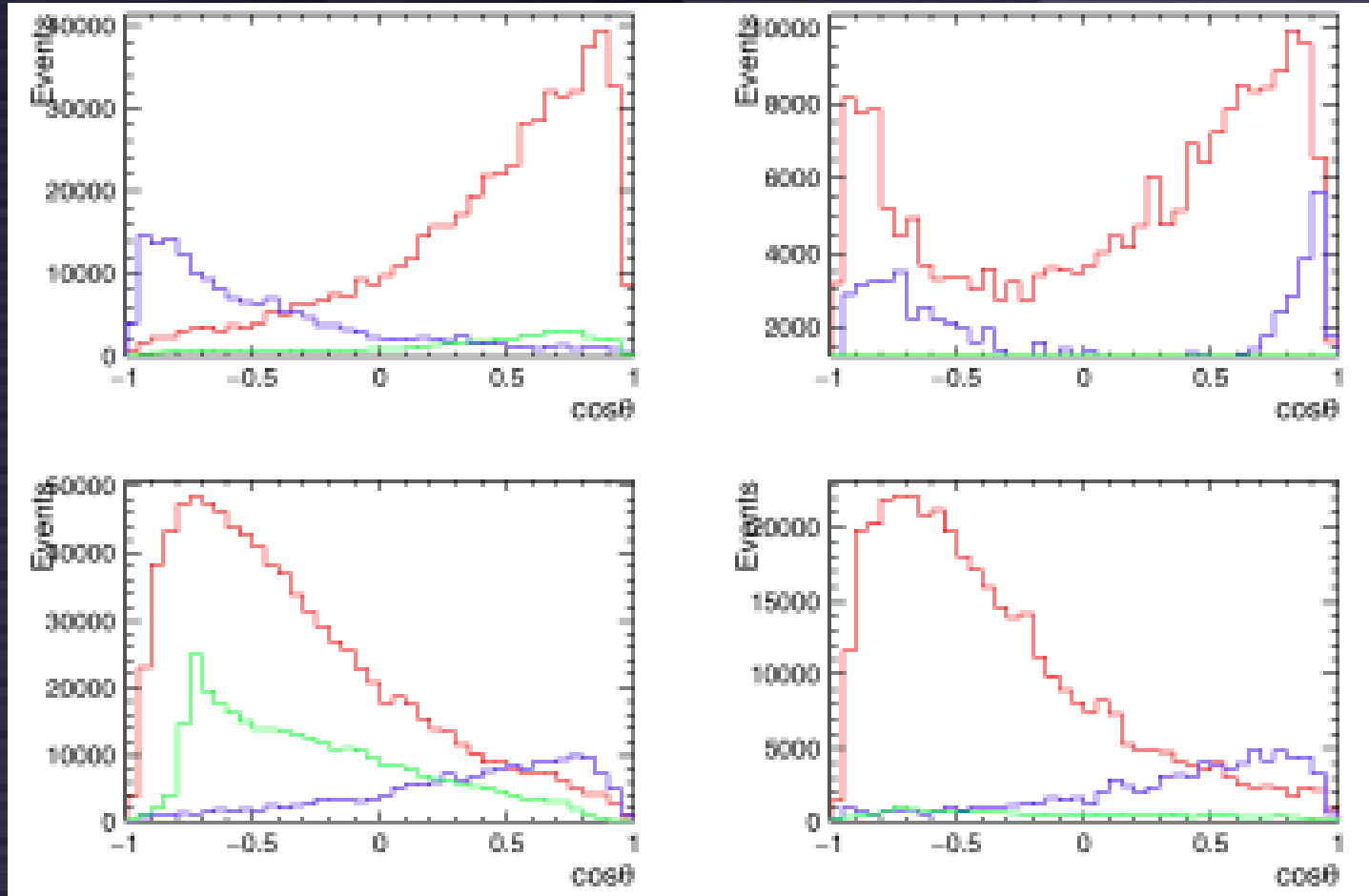
$e^+e^- \rightarrow c\bar{c}$	$e_R^- e_L^+$			
	シグナル ($c\bar{c}$)	$qq(q = u, d, s, b)$	$qqqq$	$qq\ell\ell$
全イベント	8.31734×10^6 (9.57864×10^6)	2.63643×10^7	1.17836×10^6	6.00581×10^6
c likeness	1.84280×10^6	39,052	48,015	36,648
$\cos\theta_{cc} < -0.99939$	533,635	3,337	16,089	1,651
$E_{\text{sum}} > 230\text{ GeV}$	475,578	2,742	15,551	1,293

Angular distribution

eLpR

eRpL

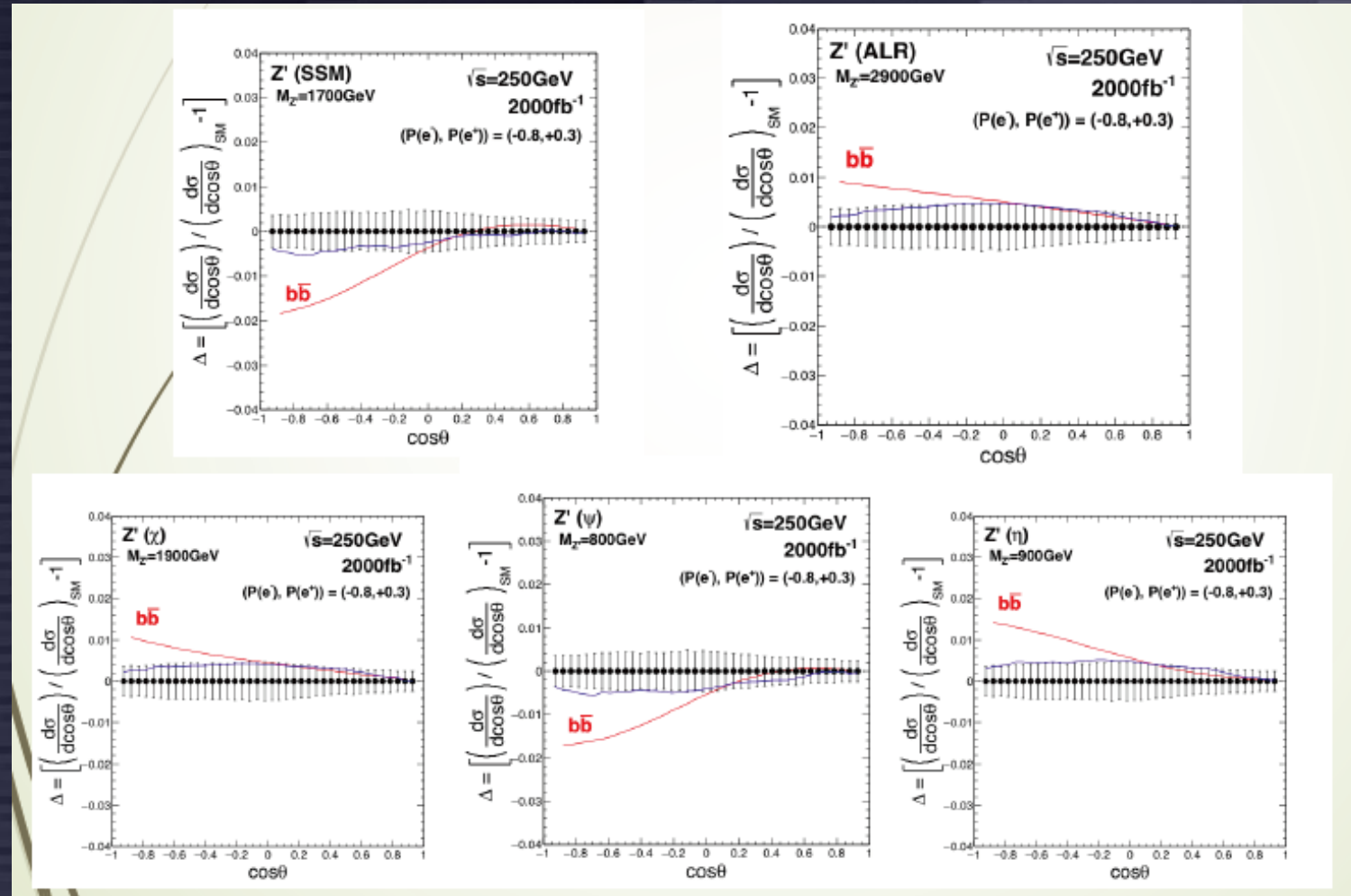
bb



cc

Red: true, blue: wrong sign, green: bkg.

bb for Z' search



Red: true assignment, blue: current assignment

Big degradation due to mis-assignment \rightarrow need to improve

Results on Z'

BSM model	mass reach (lepton)	(b)	(c)
SSM	2.8 TeV	2.7 TeV	2.7 TeV
ALR	4.0 TeV	2.7 TeV	2.8 TeV
χ	2.9 TeV	2.0 TeV	1.4 TeV
ψ	1.4 TeV	1.5 TeV	1.4 TeV
η	1.8 TeV	1.2 TeV	1.4 TeV

No significant gain from leptons

Summary & todo

- Z' mass reach on SSM, ALR \rightarrow several TeV
 - Should be slightly improved, but not 10 TeV
- GHU Z' : Full coverage of favorable region
 - $\theta_H > 0.05$
 - Model identification is the next way
- General WIMP: slightly larger than direct
- Todo
 - Vertex recovery
 - Revisiting method to calculate deviation
(Have to find a manpower...)

	mass reach (3σ)
Higgsino	150 GeV
MDM	330 GeV
Wino	190 GeV