Z Mass Measurement at CEPC

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Outline

- The selection efficiencies of signal sample added anti-c-tagging
- Results after event selections
 - Without b- & c-tagging
 - With b-tagging score < 0.5 for two jets</p>
 - With b-tagging score < 0.5 & c-tagging score < 0.6 for two jets
- Comparison between these three categories

(Signal)Select the Final State($ZZ - \mu\mu q\overline{q}$) in V1

V1(WW→µ∨qq̄)	# of event	Efficiency	Efficiency w.r.t. previous
Tot # of event	1051200	—	-
Muon Selection	416754	39.6%	—
Detector acceptance Icos(θμ)I < 0.995	416754	39.6%	100%
Visible mass > 0.85*√s	382248	36.6%	91.7%
Two jets b-tag score < 0.5	273881	26.0%	71.6%
Two jets c-tag score < 0.6	231686	22.0%	84.5%

These selection are following Maarten's suggestions and then add one more category with c-tagging.

- Muon selections: ID=13 & R0 < 0.01mm & Eµ>= 10 (GeV).
- Jet reconstruction: force all events to two jets
- There are three categories, without anti- b- & c-tagging, with anti-b-tagging, with anti-b-& anti-c-tagging.
- Since the efficiencies is too low, I switch to vvqq final state to measure Z-boson mass.

$$R0 = \sqrt{D0^2 + Z0^2}$$
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V1(WW→µvqq)	# of event	Efficiency	Efficiency w.r.t. previo	ous	
Tot # of event	1764775	—	_		
MET > 35 GeV	1234062	69.9%	—		
Visible mass > 0.2*√s	1179441	66.8%	95.5%		
Two jets b-tag score < 0.5	891385	50.5%	75.5%	¥	
Two jets c-tag score < 0.6	690386	39.2%	77.4%	/	

These selection are following Maarten's suggestions and then add one more category with c-tagging.

- The efficient luminosity is 1 ab⁻¹.
- Muon selections: ID=13 & R0 < 0.01mm & E μ >= 10 (GeV).
- Jet reconstruction: force all events to two jets
- There are three categories, without anti- b- & c-tagging, with anti- b-tagging, with anti- b- & anti-c-tagging.

$$R0 = \sqrt{D0^2 + Z0^2}$$
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 $C \mathcal{E} \mathcal{P}$

Results(without anti- b- & c-tagging) $ZZ -> \nu \nu q \overline{q}$

Results(without anti- b- & c-tagging)



Results(without anti- b- & c-tagging)

Combined four categories (uu, dd, cc, ss, bb)



Results(without anti- b- & c-tagging)

V1(ZZ→ <i>νν</i> qą̄)	uu	dd	CC	SS	bb	Combined
μ_{BW}	92.511 ± 0.0200	92.402 ± 0.0172	91.523 ± 0.0185	92.152 ± 0.0170	90.785 ± 0.0040	92.004 ± 0.0028
Орвсв	2.978 ± 0.0198	3.094 ± 0.0178	4.221 ± 0.0229	3.482 ± 0.0191	4.570 ± 0.0163	3.836 ± 0.0031
Entries	212120	257057	208379	256095	2545790	1179441
RMS	11.569	9.900	11.754	9.976	11.447	11.064
RMS/√N _w	0.0065	0.0061	0.0092	0.0069	0.0092	0.0035

• The categories with c- & b-quark would have less μ_{BW} and lower jet energy resolution.

Results(with anit- b- tagging) $ZZ \rightarrow \nu \nu q \overline{q}$

Results(with anti-b-tagging)





Results(with anti-b-tagging)

Combined four categories (uu, dd, cc, ss, bb)



Results(with anti-b-tagging)

V1(ZZ→vvqq)	uu	dd	CC	SS	bb	Combined
µ вw	92.513 ± 0.0200	92.403 ± 0.0173	91.475 ± 0.0201	92.152 ± 0.0172	89.000 ± 0.0359	92.241 ± 0.0088
Орвсв	2.974 ± 0.0199	3.089 ± 0.0180	4.227 ± 0.0249	3.483 ± 0.0193	4.758 ± 0.1631	3.453 ± 0.0100
Entries	208190	252154	173285	250233	7523	891385
RMS	11.575	9.896	11.714	9.980	12.324	10.778
RMS/√N _w	0.0065	0.0062	0.0102	0.0070	0.0549	0.0037

• The categories with c- & b-quark would have less μ_{BW} and lower jet energy resolution.

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Results(with anit-c- & anti-b- tagging) $ZZ \rightarrow \nu \nu q \overline{q}$

Results(with anti-b and anti-c- tagging)



Example 7 CEPC Results(with anti-b and anti-c- tagging)

Combined four categories (uu, dd, cc, ss, bb)



CEPO Results(with anti-b and anti-c- tagging)

V1(ZZ→ <i>νν</i> qq̄)	uu	dd	СС	SS	bb	Combined
μ_{BW}	92.514 ± 0.0210	92.395 ± 0.0179	91.088 ± 0.0548	92.131 ± 0.0179	89.000 ± 0.0637	92.319 ± 0.0103
Орвсв	2.986 ± 0.0207	3.087 ± 0.0186	4.336 ± 0.0703	3.480 ± 0.0201	4.751 ± 0.1707	3.273 ± 0.0112
Entries	193079	234244	28657	232360	2046	690386
RMS	11.599	9.923	12.317	9.999	12.559	10.581
RMS/√N _W	0.0068	0.0064	0.0256	0.0072	0.1051	0.0039

• The categories with c- & b-quark would have less μ_{BW} and lower jet energy resolution.

Mass window (80,110), without b-tagging

V1(ZZ→vvqą)	uu	dd	СС	SS	bb	Combined		
µ вw	92.511 ± 0.0200	92.402 ± 0.0172	91.523 ± 0.0185	92.152 ± 0.0170	90.785 ± 0.0040	92.004 ± 0.0028		
Орвсв	2.978 ± 0.0198	3.094 ± 0.0178	4.221 ± 0.0229	3.482 ± 0.0191	4.570 ± 0.0163	3.836 ± 0.0031		
Entries	212120	257057	208379	256095	2545790	1179441		
RMS	11.569	9.900	11.754	9.976	11.447	11.064		
RMS/√Nw	0.0065	0.0061	0.0092	0.0069	0.0092	0.0035		
	Mass window (80,110), with b-tagging < 0.5							
V1(ZZ→ <i>νν</i> qą̄)	uu	dd	СС	SS	bb	Combined		
µ вw	92.513 ± 0.0200	92.403 ± 0.0173	91.475 ± 0.0201	92.152 ± 0.0172	89.000 ± 0.0359	92.241 ± 0.0088		
σdbcb	2.974 ± 0.0199	3.089 ± 0.0180	4.227 ± 0.0249	3.483 ± 0.0193	4.758 ± 0.1631	3.453 ± 0.0100		
σ _{DBCB}	2.974 ± 0.0199 208190	3.089 ± 0.0180 252154	4.227 ± 0.0249 173285	3.483 ± 0.0193 250233	4.758 ± 0.1631 7523	3.453 ± 0.0100 891385		
σ _{DBCB} Entries RMS	2.974 ± 0.0199 208190 11.575	3.089 ± 0.0180 252154 9.896	4.227 ± 0.0249 173285 11.714	3.483 ± 0.0193 250233 9.980	4.758 ± 0.1631 7523 12.324	3.453 ± 0.0100 891385 10.778		
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Mass window (80,110), with b-tagging < 0.5 & c-tagging < 0.6

V1(ZZ→vvqq)	uu	dd	СС	SS	bb	Combined
µ вw	92.514 ± 0.0210	92.395 ± 0.0179	91.088 ± 0.0548	92.131 ± 0.0179	89.000 ± 0.0637	92.319 ± 0.0103
Орвсв	2.986 ± 0.0207	3.087 ± 0.0186	4.336 ± 0.0703	3.480 ± 0.0201	4.751 ± 0.1707	3.273 ± 0.0112
Entries	193079	234244	28657	232360	2046	690386
RMS	11.599	9.923	12.317	9.999	12.559	10.581
RMS/√N _W	0.0068	0.0064	0.0256	0.0072	0.1051	0.0039