

# Measurement of $V_{cb}$ from $WW \rightarrow \mu\nu qq$ at the CEPC

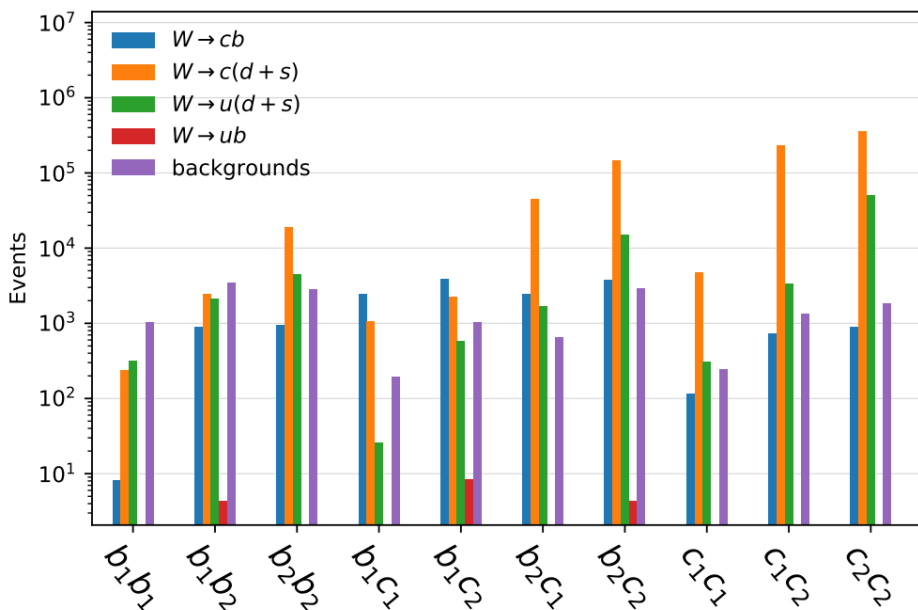
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# Only mirror changes

- Previous:  
<https://indico.ihep.ac.cn/event/18498/>
- Luminosity is normalized to 201ab from beginning (Snowmass 2021)
- Some cuts are tight to further reduce the risk of systematics



	$\mu\nu W, W \rightarrow$				$\tau(\mu 2\nu)\nu_\tau W, W \rightarrow$			$\tau\nu_\tau qq, \tau \rightarrow$		$\tau\tau qq, \mu\mu qq$ Higgs others			
	<i>cb</i>	<i>ub</i>	<i>c(d/s)</i>	<i>u(d/s)</i>	<i>cb</i>	<i>c(d/s)</i>	<i>u(d/s)</i>	<i>e2\nu</i>	<i>had.\nu_\tau</i>	$\tau\tau qq$	$\mu\mu qq$	Higgs	others
w/o selections	40.3K	358	24.2M	24.2M	7.79K	4.2M	4.2M	8.66M	31.4M	2.18M	4.47M	4.07M	1.3G
$E_{L\mu} > 12\text{GeV}$	37.8K	333	22.6M	22.6M	5.43K	2.98M	2.97M	133K	688K	422K	2.82M	649K	48.2M
$R_{L\mu} > 0.85$	35.2K	311	21.1M	21.1M	4.77K	2.73M	2.74M	2.21K	45.3K	266K	1.82M	309K	146K
$\cos(\theta_{L\mu})$	35.2K	311	21.1M	21.1M	4.77K	2.73M	2.74M	2.21K	45.3K	266K	1.82M	309K	146K
2nd isolation $\ell$ veto	34.7K	307	21.0M	21.1M	4.71K	2.73M	2.73M	2.21K	45.2K	261K	761K	206K	146K
Missing $P_T > 9.5 \text{ GeV}/c$	33.5K	294	20.2M	20.3M	4.41K	2.56M	2.57M	2.1K	42.6K	231K	187K	178K	33.1K
multiplicity $\geq 27$	33.5K	294	20.2M	20.2M	4.41K	2.56M	2.56M	2.07K	42.4K	230K	185K	149K	32.8K
$M_{\text{jets}} > 60\text{GeV}$	32.5K	285	19.8M	19.9M	4.31K	2.52M	2.53M	1.74K	41.3K	225K	177K	136K	26.7K
$M_{\text{jets}} < 86\text{GeV}$	23.4K	203	13.6M	13.2M	3.17K	1.77M	1.71M	1.14K	24.6K	9.07K	16.7K	9.65K	3.54K
efficiency	0.581	0.566	0.564	0.543	0.407	0.421	0.407	0.000	0.001	0.004	0.004	0.002	0.000
	(8)	(83)	(0)	(0)	(15)	(1)	(1)	(0)	(0)	(0)	(0)	(0)	(0)
$b_1c_{1,2}$	5.54K	4	2.91K	540	715	419	63	12	33	191	763	111	0

# Numbers summarized

$V_{cb}$ relative <b>statistical</b> uncertainty	$V_{uds}$ or $V_{c ds}$ relative <b>statistical</b> uncertainty	detector	channels	luminosity	comments
0.73%	0.018%	baseline	$\mu\nu qq+$ $\tau(\mu 2\nu)\nu qq$	Snowmass 2021 20 iab	Cuts unchanged. we found optimal cuts not changed with changs of lumi. (2)
0.46%	0.011%	baseline	$lvqq$	Snowmass 2021	(1)+(2)
0.36%	0.0092%	<b>Vin-B</b>	$lvqq$	Snowmass 2021	Improved by 20% for $V_{cb}$ and by 8% for $V_{uds}/V_{c ds}$
2%			Inc. and exc. B decay respectively		PDG2020/PDG2022

$$V_{cd/s} = \sqrt{|V_{cs}|^2 + |V_{cd}|^2}$$

$V_{ud/s}$  is similar

# Work plan

- Some ideas from Lingfeng is interesting, and I didn't investigate before:
  - Investigate the inv. mass:
    - Leading muon + subleading muon (opposite charge)
    - Leading muon + leading electron (opposite charge)
    - leading muon + invisible
  - Including  $evqq$
- I get stuck in running samples for a long time, sorry!