Discussion

Danning Liu
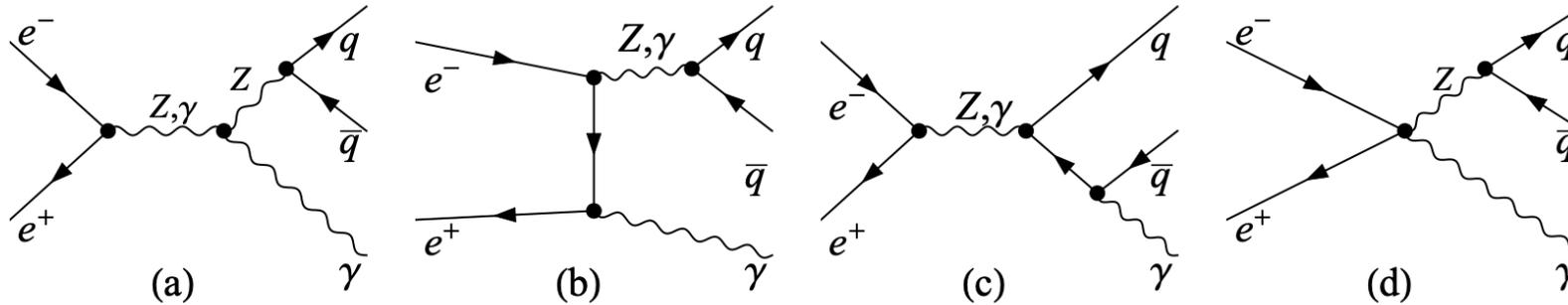
2022.06.01

- Background Estimation in theory side :

  - Only consider Standard Model $Z\gamma$ process

- Technique preparation

  - README to customize the generation can be found here : /besfs/groups/higgs/users/moxin/slcio/wz_project/generator — empty

  - Guidance to customize generation using WHIZARD, need validations

  - Also can email to Gang Li, to help finish the production

Official samples

- Information of Official samples
  - Generator : MC generator WHIZARD, version 1.95
  - Classification : according to the final states
    - Unified luminosity of 5 ab^{-1}
    - Center-of-mass energy : 240 GeV
  - All samples are fed to CEPC full simulation and reconstruction chain, work as official samples for physics analysis and detector simulation
  - Categories
    - Higgs signal
    - 2 fermions
    - 4 fermions
    - If users want to customize the generation, all necessary materials are located : /besfs/groups/higgs/users/moxin/slcio/wz_project/generator

2-fermion background

- Existing 2-fermion samples

  - Bhabha scattering — sub-dominant

  - Quark final states — dominant

  - Lepton final states

    - Muons

    - Taus

    - Neutrinos

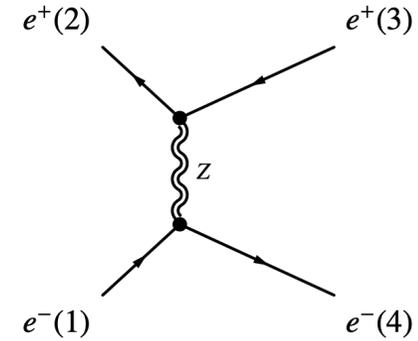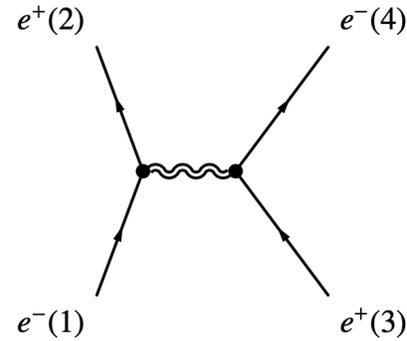- No background samples with photon, may need to generate later

Table 6: The cross section for the 2 fermions background

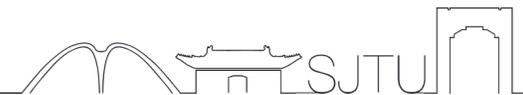| Process	Cross section [fb]	Error [fb]	ILC result [fb]
uu	9995.35	23.2	10110.43
dd	9808.71	25.7	10010.07
cc	9974.20	28.9	10102.75
ss	9805.39	74.7	9924.40
bb	9803.04	25.5	9957.70
qq	49561.30	120.0	50105.35
e2e2	4967.58	35.0	4991.91
e3e3	4374.94	10.5	4432.18
bhabha	24992.21	41.50	24937.95
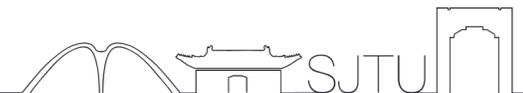
- Also need to consider — since only leading and sub-leading leptons are chosen, but not requiring lepton number to be exactly 2
  - Grouped together as "hadronic", "leptonic" and "semi-leptonic"
  - 4 fermions cab be combined into 2 bosons : Z or W (ZZ, WZ, single Z or single W)

sw_l0mu	5 ab $^{-1}$
sw_l0tau	5 ab $^{-1}$
sw_sl0qq	5 ab $^{-1}$
sze_l0e	5 ab $^{-1}$
sze_l0mu	5 ab $^{-1}$
sze_l0nunu	5 ab $^{-1}$
sze_l0tau	5 ab $^{-1}$
sze_sl0dd	5 ab $^{-1}$
sze_sl0uu	5 ab $^{-1}$
szeorsw_l0l	5 ab $^{-1}$
sznu_l0mumu	5 ab $^{-1}$
sznu_l0tautau	5 ab $^{-1}$
sznu_sl0nu_down	5 ab $^{-1}$
sznu_sl0nu_up	5 ab $^{-1}$
ww_h0ccbs	5 ab $^{-1}$
ww_h0ccds	5 ab $^{-1}$
ww_h0cuxx	5 ab $^{-1}$

ww_h0uubd	5 ab $^{-1}$
ww_h0uusd	5 ab $^{-1}$
ww_l0ll	5 ab $^{-1}$
ww_sl0muq	5 ab $^{-1}$
ww_sl0tauq	5 ab $^{-1}$
wwbosons	5 ab $^{-1}$
zz_h0cc_nots	5 ab $^{-1}$
zz_h0dtdt	5 ab $^{-1}$
zz_h0utut	5 ab $^{-1}$
zz_h0uu_notd	5 ab $^{-1}$
zz_l04mu	5 ab $^{-1}$
zz_l04tau	5 ab $^{-1}$
zz_l0mumu	5 ab $^{-1}$
zz_l0taumu	5 ab $^{-1}$
zz_l0tautau	5 ab $^{-1}$

zz_sl0mu_down	5 ab $^{-1}$
zz_sl0mu_up	5 ab $^{-1}$
zz_sl0nu_down	5 ab $^{-1}$
zz_sl0nu_up	5 ab $^{-1}$
zz_sl0tau_down	5 ab $^{-1}$
zz_sl0tau_up	5 ab $^{-1}$
zzbosons	5 ab $^{-1}$
zzorww_h0cscs	5 ab $^{-1}$
zzorww_h0udud	5 ab $^{-1}$
zzorww_l0mumu	5 ab $^{-1}$
zzorww_l0tautau	5 ab $^{-1}$

up-type : u, c quarks

down-type : d, s, b quarks

- Summarize all backgrounds
  - Including 2-fermion backgrounds (lepton final-state process)
  - Including 4-fermion backgrounds (lepton and semi-lepton final-state process, at least has 2 leptons)
  - Request new background samples
    - With photon final state

- Study the usage of WHIZARD generators
  - Try to produce some validation sample at the first stage (make sure right configuration)
  - Then start to produce needed backgrounds (with photon)

- Signal samples are produced already, doing binning study now