Status of MC tools and samples at CEPC

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Outline

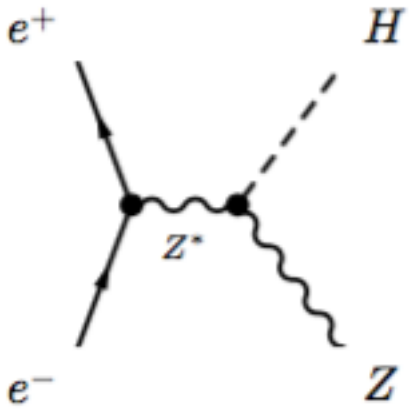
- Sample information
  - Signal and SM background
  - Gamma-gamma background
- MC tools
  - Whizard 1.95 & 2.3.x
  - ProMC
  - Delphes

General samples

Signal part

Background part

- 2 fermions
- 4 fermions



Sample information	
Luminosity	5050fb^{-1}
Polarization	unpolarized
ISR	on
Beamstrahlung	off

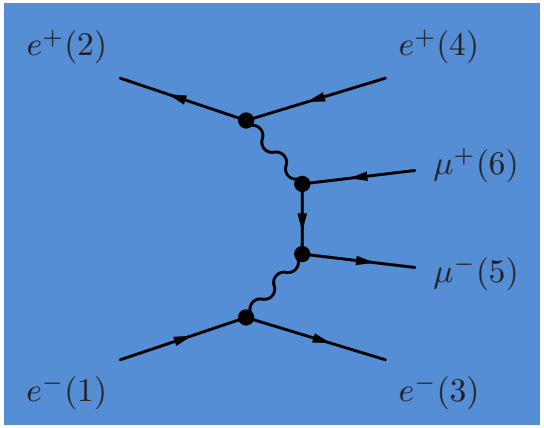
➢ References

- "Physics cross sections and event generation of e+e− annihilations at the CEPC ", Chin.Phys.C 40(2016)033001
- CEPC_TLS_GEN_2015_001 from CEPC docdb

Gamma-gamma BKG

Weizsacker-Williams approximation

```
&beam_input
particle_name = 'e1'
polarization = 0 0
USER_spectrum_on = F
USER_spectrum_mode = 22
ISR_on = F
ISR_alpha = 0.0072993
ISR_m_in = 0.000511
EPA_on = T
EPA_alpha = 0.0072993
EPA_m_in = 0.000511
EPA_mX = 4.
EPA_Q_max = 4.
/
```



Unkown photon spectral, real photon bkg still absent

Whizard 2.3

```
model = SM_CKM
```

Claim of model

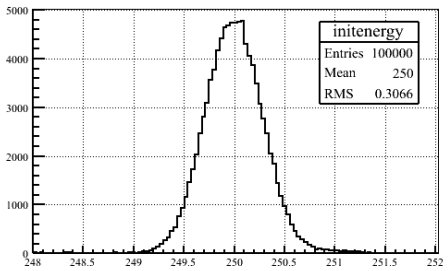
```
me  = 0
mmu = 0.10566
ms  = 0
mc  = 0
mb  = 0

# Define the alias
alias f = u:d:s:c:b:e1:e2:e3:n1:n2:n3
alias F = U:D:S:C:B:E1:E2:E3:N1:N2:N3
alias q = u:d:s:c:b
alias Q = U:D:S:C:B
alias l = e1:e2:e3
alias L = E1:E2:E3
alias n = n1:n2:n3
alias N = N1:N2:N3

# Define the process
process e2e2h = e1,E1 => em, ep, h
```

Particle alias

Process definition




```
# Compile the process into library
compile
?rebuild_library = true
?rebuild_grids = true

# Define the beams and event count (for simulation)
sqrts = 250 GeV
n_events = 10000
luminosity = 5000
beams = e1,E1 => isr, isr

$circe2_file = "cepc250.circe"
$circe2_design = "CEPC"
?circe2_polarized = false
isr_alpha = 0.0072993
isr_mass = 0.000511

?ps_isr_active = true
?ps_fsr_active = true
$shower_method = "PYTHIA6"
?hadronization_active = true

?write_raw = false

# Integrate the process
iterations = 1:100000, 10:100000, 1:500000
integrate(e2e2h)
simulate(e2e2h){ sample_format = stdhep $extension_stdhep = "stdhep"}
```

Configurations

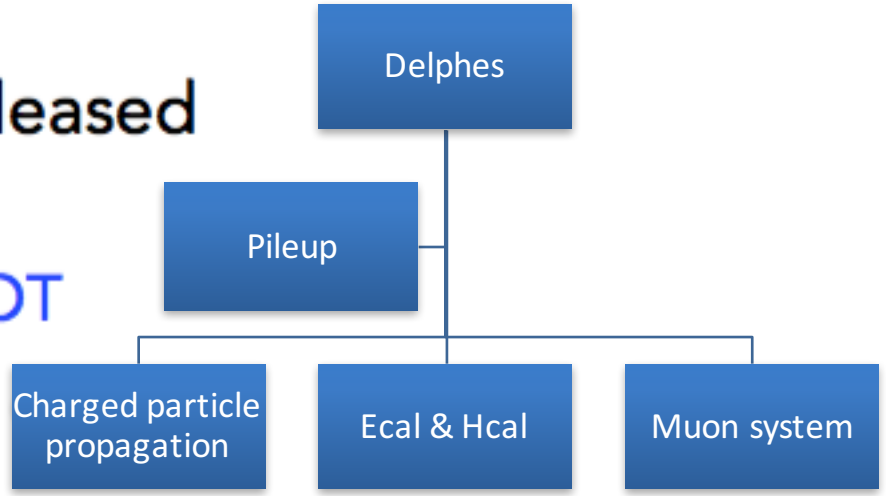
Beam setup, default CEPC setting

Hadronization & fragmentation

Integration & simulation

Delphes

- In 2013, DELPHES 3 was released
  - C++ modular software
  - Dependencies: gcc, tcl, ROOT
  - is shipped with FastJet



- Run Delphes:

```
./DelphesSTDHEP [detector_card] [output] [input]
./DelphesHepMC [detector_card] [output] [input]
```

- Input formats: HepMC, StdHep, ProMC, LHE
- Output: browsable ROOT tree

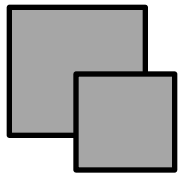
Delphes

Tracking Efficiency		
Charged hadron		
	$0.1 < pt \leq 1.0$	$pt > 1.0$
$\eta \leq 1.5$	0.75	0.95
$1.5 < \eta \leq 4.0$	0.60	0.90
Electron		
	$0.1 < pt \leq 1.0$	$pt > 1.0$
$\eta \leq 1.5$	0.75	0.99
$1.5 < \eta \leq 4.0$	0.70	0.98
Muon		
	$0.1 < pt \leq 1.0$	$pt > 1.0$
$\eta \leq 1.5$	0.75	0.99
$1.5 < \eta \leq 4.0$	0.70	0.98

Need further tuning and check consistency with full simulation

Smearing			
Charged hadron momentum			
		$pt > 0.1$	
$\eta \leq 1.5$		0.01	
$1.5 < \eta \leq 4.0$		0.02	
Electron energy			
	$0.1 < En \leq 20$	$En > 20$	
$\eta \leq 4.0$	0.007	$0.005 \oplus 0.02$	
Muon momentum			
		$pt > 0.1$	
$\eta \leq 1.5$		0.01	
$1.5 < \eta \leq 4.0$		0.02	
Angular		Impact parameter	
ϕ	0.001	$0.1 < pt \leq 5.0$	$pt > 5.0$
η	0.001	0.01	0.005

ProMC



ProMC

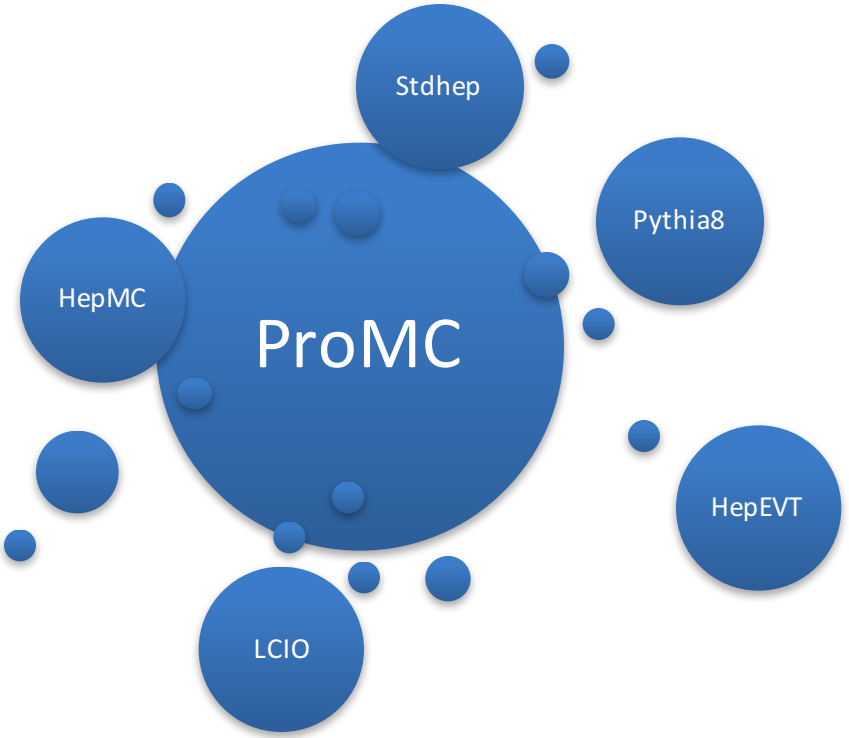
Next generation input-output file format

ProMC is a library for Monte Carlo event records or any structural data, including experimental data, in very compact binary form. The main features are:

- Streams data into a binary form and *dynamically* writes less interesting numeric information with reduced precision compared to more interesting records. Such *content-dependent* "compression" can substentially reduce file size.
- Fast. No CPU overhead due to decompression.
- Self-describing data format based on a template approach to encode complicated data structures. One can generate C++, Java and Python analysis code for reading and writing data from the ProMC file itself.
- Multiplatform. Data records can be written and read in C++, Java and Python.
- Forwards-compatible and backwards-compatible binary format.
- Metadata for each event can easily be encoded.
- Random access. Events (and metadata) can be read starting at any index.
- No external dependence. The library is small and self-contained.

ProMC

- ProMC file is necessary.
- Browser is not available due to memory requiment.



ProMC Browser

File MetaData Data layout Help

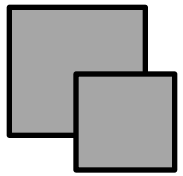
	Description	Value
1		
2	ProMC Version	1
3	Description	PYTHIA8 event record
4	Last modified	2013-05-09 22:28:00
5	Attached logfile	logfile.txt
6	Requested events	1000
7	eCM	-1.0
8	S	-1.0
9	Process	
10	Code	-1
11	Momentum unit (GeV*unit)	100000
12	Length unit (cm*unit)	1000
13	id1	-1
14	id2	-1
15	pdf_id1	-1
16	pdf_id2	-1
17	x1	-1.0
18	x2	-1.0
19	ScalePDF	-1.0
20	pdf1	-1
21	pdf2	-1
	Cross section (pb)	9.882293022981601E8

Ver=1 Nr=1000 Info=PYTHIA8 event record 6/15Mb

Summary

- Gamma-gamma background is taken into account, real photon emittion still needs to be studied.
- Delphes is available, need our own parameters.
- General intermediate format.

Thanks



Thanks for attention!