

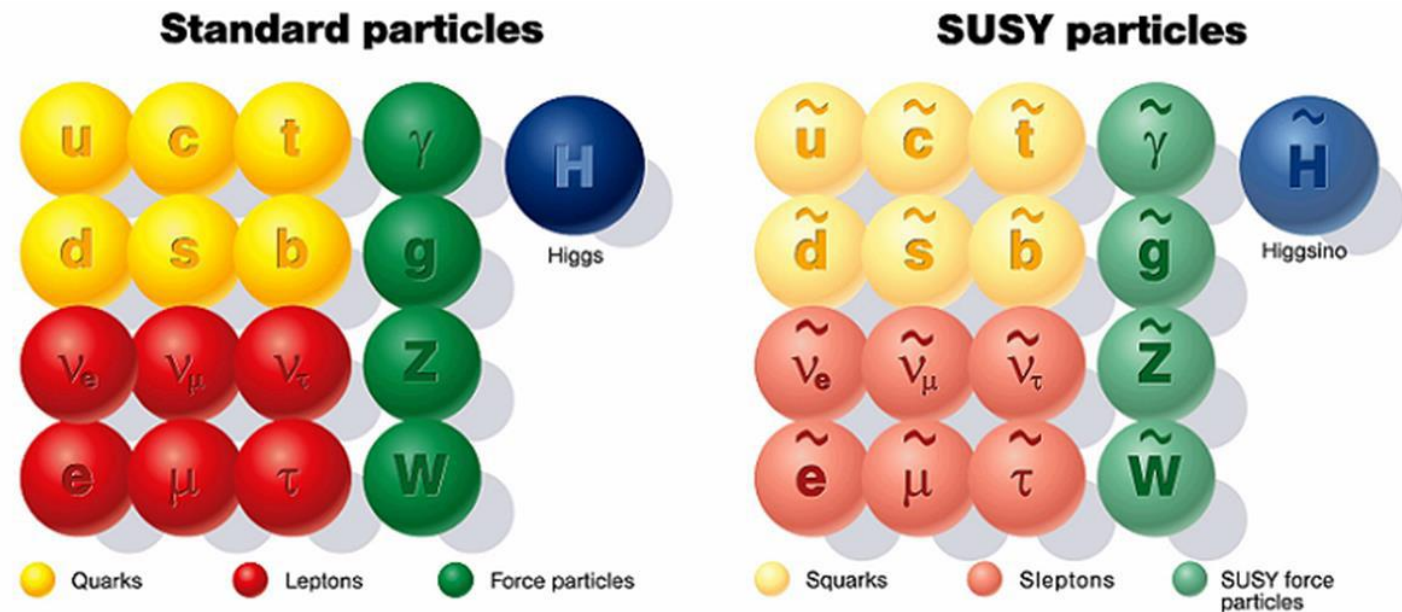
CEPC report: prospect of probing smuon in CEPC

Shiyi Liang

17 August 2026

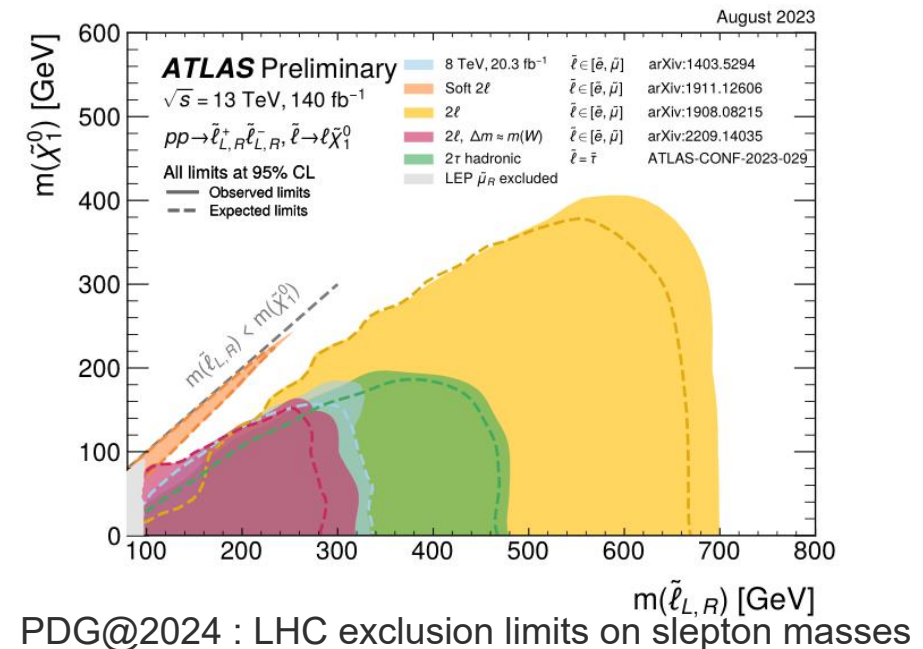
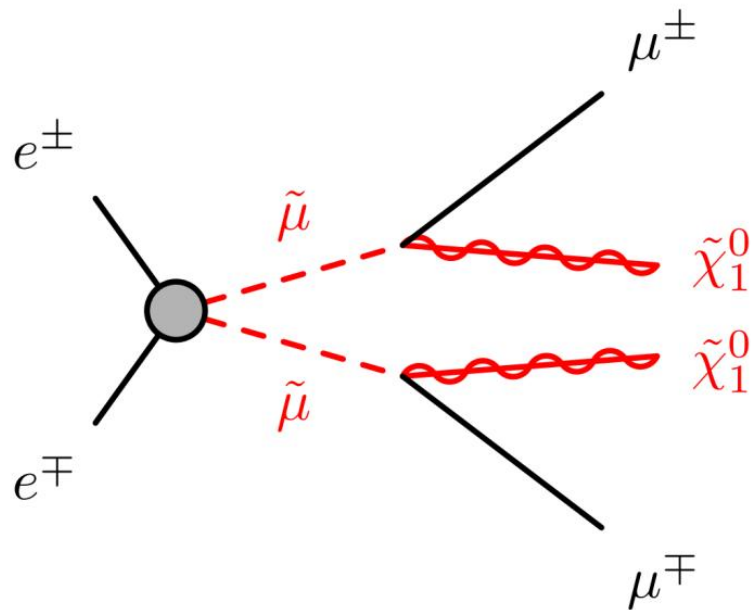
Introduction

- SUSY assume symmetry between fermions and bosons
- SUSY can solve current SM puzzles: dark matter source; dark energy; matter /anti-matter asymmetry; neutrino masses/mixing ; hierarchy problem; gravity in gauge theory and its unification.

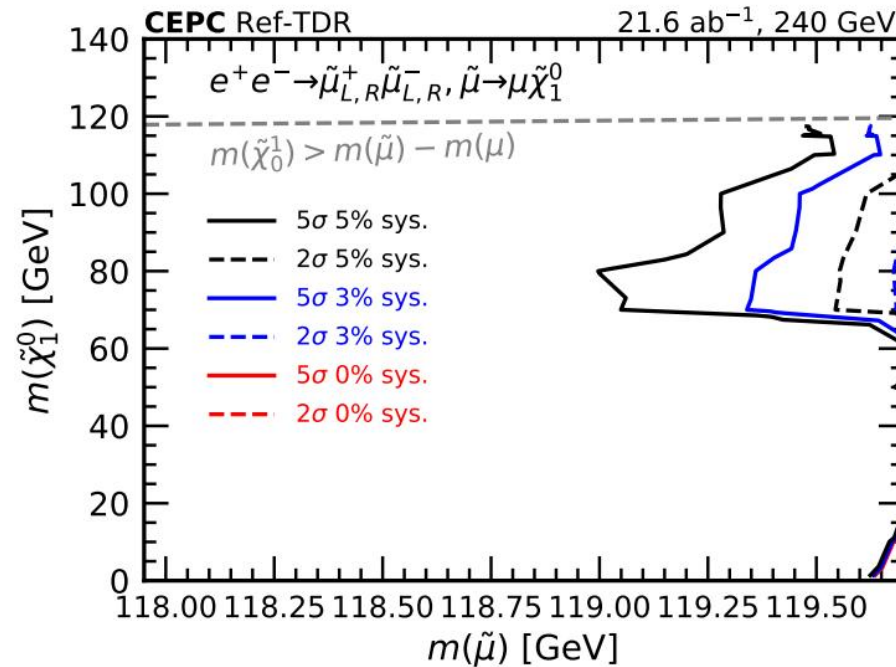


Smuon search at CEPC@240GeV

- CEPC provides good chance to hunt sleptons
- 240 GeV, 20 ab⁻¹ integrated lumi
- Simple final state, clear SM background
- Sensitive to smuon under 120 GeV and in mass-gap-compressed region.



- Preliminary results are in CEPC TDR



The projected exclusion (2σ) and discovery (5σ) contours for the direct $\tilde{\mu}$ production at the CEPC

- Current plan: summarize the study and publish an article.

Status of current study

- Start from reset the background ntuple
- Stdhep background samples were required to pass a tight filter before reconstruction with CEPCSW

Background samples created by GenFilter

Process	X-section (fb)	Sample Tag	20ab ⁻¹ events (k events)	Filter input (k events)	Event Weight
$\tau\tau$	4374.94	e3e3	87498.8	4910	17.82
$\nu\nu H, H \rightarrow \text{anything}$	3.07	nnh_X	61.4	61.4	1.0
$ZZ \text{ or } WW \rightarrow \tau\tau\nu\nu$	211.18*	zzorww_l0tautau	4223.6	963.917	4.38
$ZZ \rightarrow \tau\tau\nu\nu$	9.61*	zz_l0tautau	192.2	184	1.0446
$\nu\nu Z, Z \rightarrow \tau\tau$	14.57*	sznu_l0tautau	291.4	291.4	1.0
$ZZ \text{ or } WW \rightarrow \mu\mu\nu\nu$	221.10*	zzorww_l0mumu	4422	756.97	5.842
$ZZ \rightarrow \mu\mu\nu\nu$	19.38*	zz_l0mumu	387.6	363.4	1.0666
$WW \rightarrow \ell\ell\nu\nu$	403.66*	ww_l0ll	8073.2	2800	2.807
$\nu\nu Z, Z \rightarrow \mu\mu$	43.43*	sznu_l0mumu	868.6	868.6	1.0
$\mu\mu$	4967.58	e2e2	99351.6	17190k	5.78

Table from 2025.3 LvFeng's slides

Status of current study

- Start with repeat old results and validate old codes of filter selection

2025.3 results column is from my local record, somehow for some bkg the filter input events number not matched with those in LvFeng's slides

Input events number of filter from stdhep file for 2025 results and for 2026 results with old codes

Background	2025.3 results	2026 results (set input)	2026 results (actually input)	input dir
nnh_X	61,400	61,400	61,400	higgs/E240.Pnnh_X.e0.p0.whizard195
mumu	11,817,197	99351600	11817197	2fermions_10M/E240.Pe2e2.e0.p0.whizard195/
tautau	4,910,000	87498800	53657901	2fermions_10M/E240.Pe3e3.e0.p0.whizard195/
ww_loll	919,898	919898	919898	4fermions_1M/E240.Pww_l.e0.p0.whizard195/
zzorww: mumu+ tautau	756970+ 963917	4422000+ 4223600	756970+ 963917	4fermions_1M/E240.Pzzorww_l.e0.p0.whizard195
zz_l_zz: mumu+ tautau	363400+ 184000	387600+ 192200	387600+ 192200	4fermions_1M/E240.Pzz_l.e0.p0.whizard195
sznu_l_sznu: mumu+ tautau	758891+ 291400	868600+ 291400	758891+ 291400	4fermions_1M/E240.Psznu_l.e0.p0.whizard195

input dir from kaili: /cefs/higgs/zhangkl/stdhep/E240/

- For tautau and zz_l_zz, the total input events numbers are changed, what cause the difference?

Status of current study

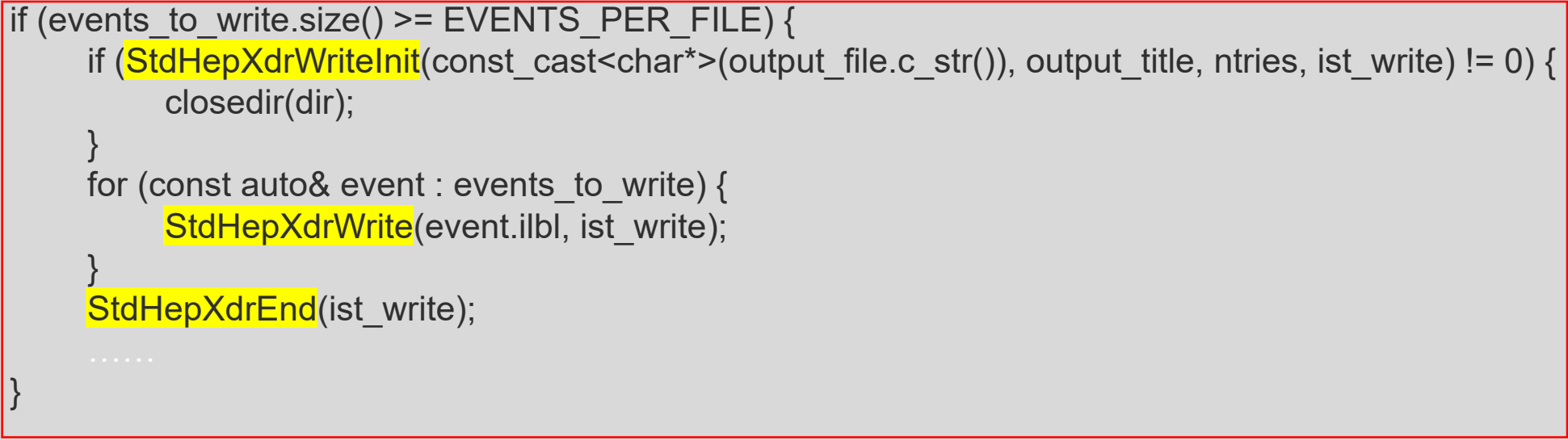
- A bug in filter script: `/lustre/atlascv1/phys/cepc/SUSY/users/liangsy/CEPC/Genfilt/batch_filter_muons.cpp` when read-write file with `StdHepXdrRead*` defined in: `/cefs/higgs/liangh/software3/whizard_deps/stdhep`

```
if (StdHepXdrReadInit(const_cast<char*>(input_file.c_str()), ntries, ist_read) != 0) {
    continue;
}
while (StdHepXdrRead(&ilbl, ist_read) == 0 && total_input_events < needed_input_events) {
    .....read events information.....
    if (.....pass filter.....){
        if (events_to_write.size() >= EVENTS_PER_FILE) {
            if (StdHepXdrWriteInit(const_cast<char*>(output_file.c_str()), output_title, ntries, ist_write) != 0) {
                closedir(dir);
            }
            for (const auto& event : events_to_write) {
                StdHepXdrWrite(event.ilbl, ist_write);
            }
            StdHepXdrEnd(ist_write);
            .....
        }
    }
}
StdHepXdrEnd(ist_read);
```

Status of current study

- A bug in filter script: `/lustrefs/atlas/SUSY/users/liangsy/CEPC/Genfilt/batch_filter_muons.cpp`
when read-write file with: `/cefs/higgs/liangh/software3/whizard_deps/stdhep`

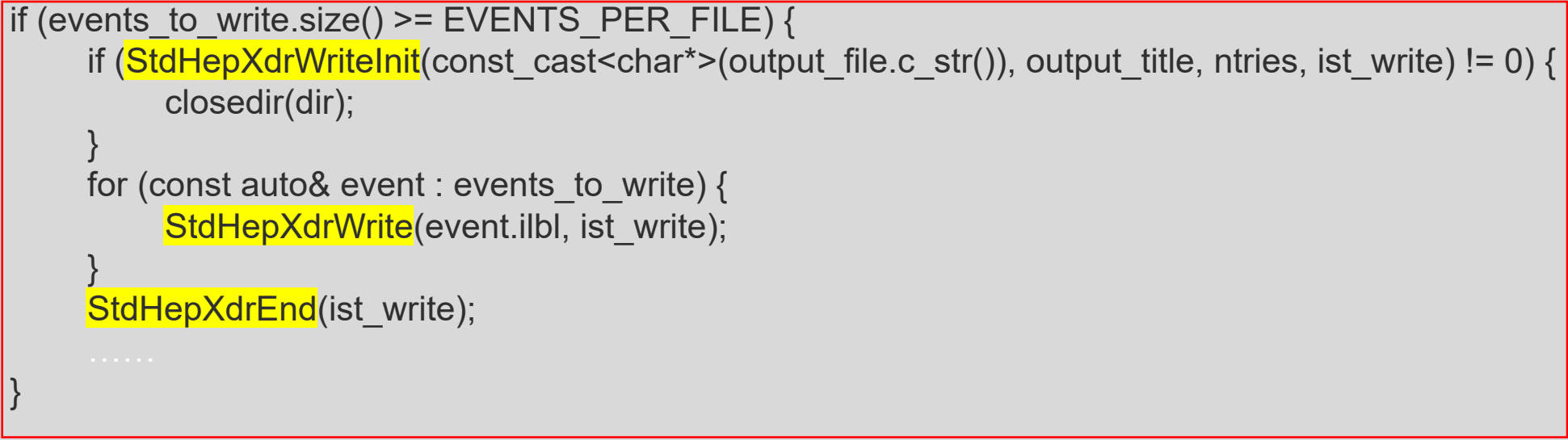
```
if (StdHepXdrReadInit(const_cast<char*>(input_file.c_str()), ntries, ist_read) != 0) {
    continue;
}
while (StdHepXdrRead(&ilbl, ist_read) == 0 && total_input_events < needed_input_events) {
    .....read events information.....
    if (.....pass filter.....){
        if (events_to_write.size() >= EVENTS_PER_FILE) {
            if (StdHepXdrWriteInit(const_cast<char*>(output_file.c_str()), output_title, ntries, ist_write) != 0) {
                closedir(dir);
            }
            for (const auto& event : events_to_write) {
                StdHepXdrWrite(event.ilbl, ist_write);
            }
            StdHepXdrEnd(ist_write);
            .....
        }
    }
}
StdHepXdrEnd(ist_read);
```



Status of current study

- A bug in filter script: `/lustrefs/atlas/SUSY/users/liangsy/CEPC/Genfilt/batch_filter_muons.cpp`
when read-write file with: `/cefs/higgs/liangh/software3/whizard_deps/stdhep`

```
if (StdHepXdrReadInit(const_cast<char*>(input_file.c_str()), ntries, ist_read) != 0) {
    continue;
}
while (StdHepXdrRead(&ilbl, ist_read) == 0 && total_input_events < needed_iutput_events) {
    .....read events information.....
    if (.....pass filter.....){
        if (events_to_write.size() >= EVENTS_PER_FILE) {
            if (StdHepXdrWriteInit(const_cast<char*>(output_file.c_str()), output_title, ntries, ist_write) != 0) {
                closedir(dir);
            }
            for (const auto& event : events_to_write) {
                StdHepXdrWrite(event.ilbl, ist_write);
            }
            StdHepXdrEnd(ist_write);
            .....
        }
    }
}
StdHepXdrEnd(ist_read);
```



break

Status of current study

- A bug in filter script: `/lustrefs/atlas/SUSY/users/liangsy/CEPC/Genfilt/batch_filter_muons.cpp`
when read-write file with: `/cefs/higgs/liangh/software3/whizard_deps/stdhep` , fix in
`/lustrefs/atlas/SUSY/users/liangsy/CEPC/stdhep`

```
if (McfStreamPtrList == NULL) {  
    McfStreamPtrList = (mcfStream **)  
        malloc(sizeof(mcfStream *) * MCF_STREAM_NUM_MAX);  
    for (i=0; i< MCF_STREAM_NUM_MAX; i++) McfStreamPtrList[i] = NULL;  
    return;  
}  
for (i=0; i< MCF_STREAM_NUM_MAX; i++) McfStreamPtrList[i] = NULL;  
mcfioC_Close(0);  
McfNumOfStreamActive=0;
```



```
if (McfStreamPtrList == NULL){  
    McfStreamPtrList =(mcfStream **)malloc(sizeof(mcfStream *) * MCF_STREAM_NUM_MAX);  
    for(i=0;i<MCF_STREAM_NUM_MAX;i++)  
        McfStreamPtrList[i]=NULL;  
}
```

Status of current study

- A bug in filter script: `/lustrefs/atlas/SUSY/users/liangsy/CEPC/Genfilt/batch_filter_muons.cpp` when read-write file with: `/cefs/higgs/liangh/software3/whizard_deps/stdhep` , fix in `/lustrefs/atlas/SUSY/users/liangsy/CEPC/stdhep`
 - **Problem:** After writing the first 1,000 selected events, the input stream became inactive, preventing further events from the same input file from being read.
 - **Cause:** Repeated `mcfioC_Init()` calls reset the global stream list and closed all active streams via `mcfioC_Close(0)`.
 - **Solution:** Initialize `McfStreamPtrList` only once and avoid resetting or closing existing streams during subsequent initializations.
 - **Result:** Input and output streams remain independent, allowing all selected events to be processed and split into multiple output files of 1,000 events each.

Summary

- Can not repeat the passing-filter results with exact the same event number.
- Found a bug in `/cefs/higgs/liangh/software3/whizard_deps/stdhep` and fix locally.
- Todo:
 - continue to prepare the paper.

Backup