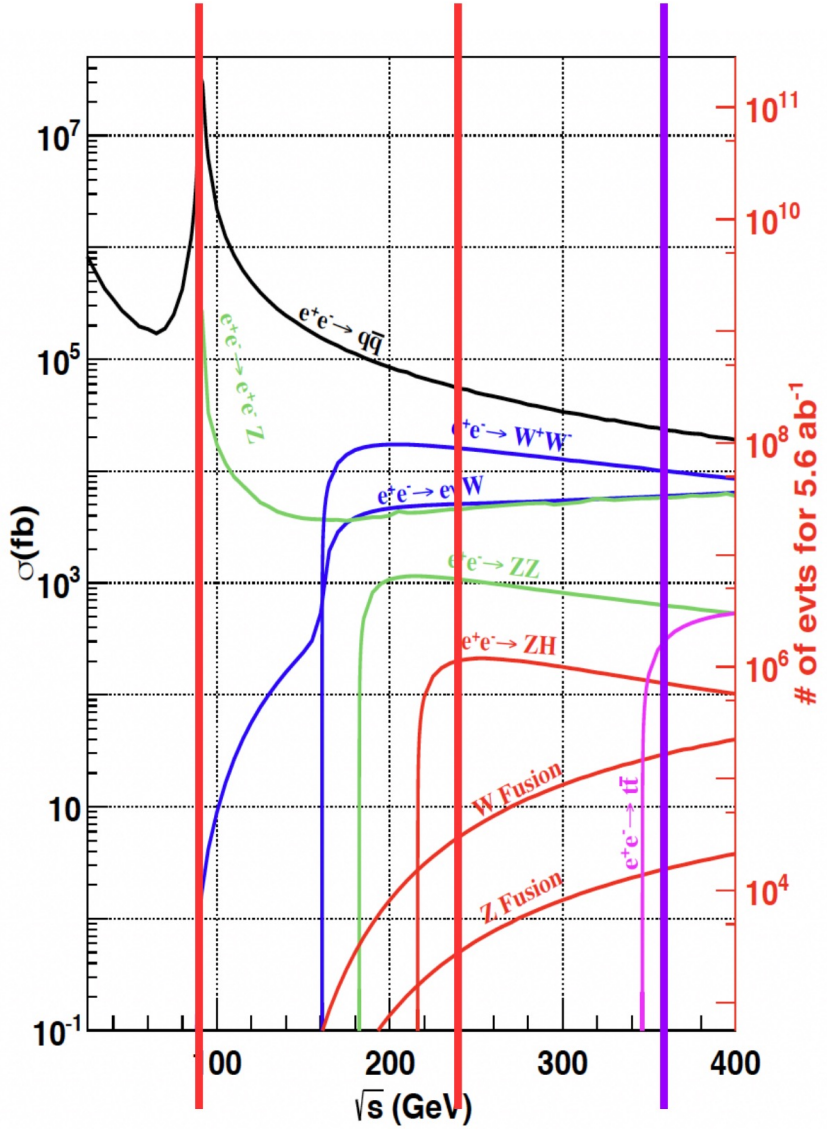
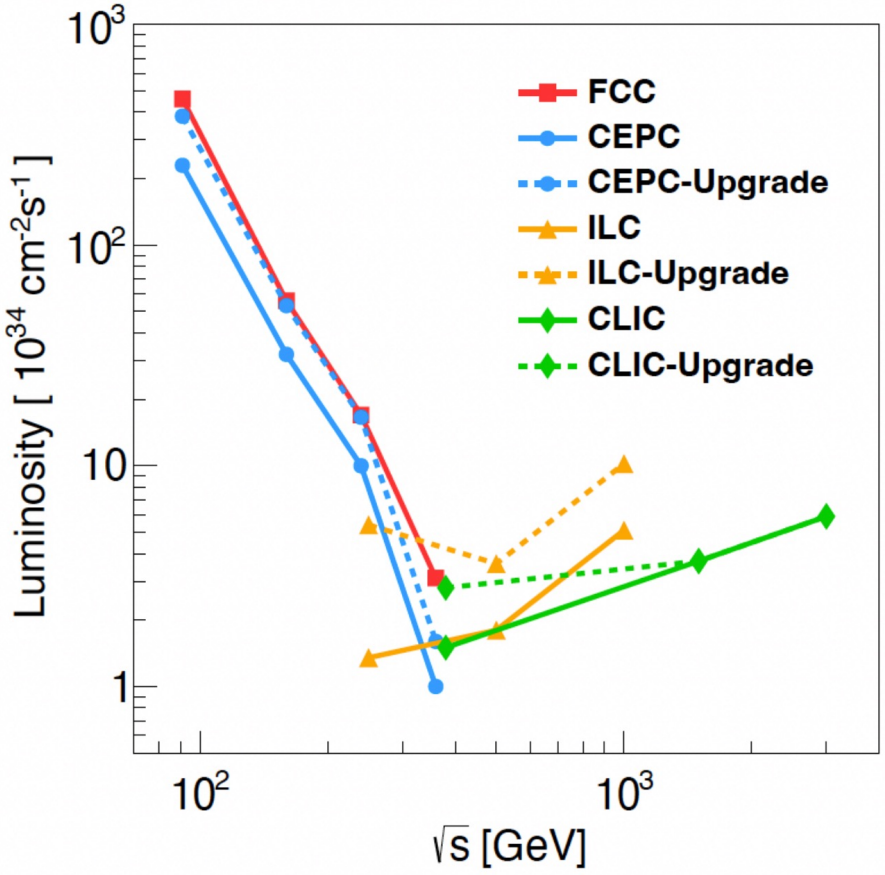
Introduction

- CEPC Detector Ref-TDR timeline
  - October 21-23, 2024: First IDRC Review Meeting
  - By the end of 2024: Ref-TDR draft (with a dedicated chapter on physics performance)
  - Early 2025: International Review
  - Mid-2025: Release of the Ref-TDR
- CEPC Physics Study for RefTDR weekly meeting
  - 2pm-3pm Monday
  - https://indico.ihep.ac.cn/category/1043/
- Main tasks of the working group
  - Complete a few physics benchmark analyses that have undergone TDR detector simulation and reconstruction, according to the schedule of the RefTDR
    - if needed, fast simulation (validated by the full simulation) could be employed
      - object level, event level, distributions, etc
  - Deliver physics performance chapter in Ref-TDR

Expected Data at CEPC





- 4 Million Higgs (10 years)
- ~ 1 Giga W (1 year) + 4 Tera Z (2 years)
- Upgradable: Top factory (500 k ttbar)

Physics Benchmarks for Ref-TDR

	Processes @ c.m.s.	Domain	Relevant Det. Performance
H→ss/cc/sb	vvH @ 240 GeV	Higgs	PFA + Jet Origin Id (JoI)
H→inv	qqH	Higgs/NP	PFA
Vcb	WW→lvqq @ 240/160 GeV	Flavor	JoI + Pid (Lepton, tau)
W fusion Xsec	vvH @ 360 GeV	Higgs	PFA + JoI
α_s	Z→tautau @ 91.2 GeV	QCD	PFA: Tau & Tau final state id
CKM angle $\gamma - 2\beta$	Z→bb, B→DK @ 91.2 GeV	Flavor	PFA + JoI + Pid (Kaon)
Weak mixing angle	Z@ 91.2 GeV	EW	JoI
Higgs recoil	llH	Higgs	Pid (Lepton), track dP/P
H→bb, gg	vvH + qqH	Higgs	PFA + JoI + Color Singlet id
H→di muon	qqH	Higgs	PFA, Leptons id, Tracking
H→di photon	qqH	Higgs	PFA, Photons id, EM resolution
W mass & Width	W threshold scan @160 GeV	EW	Beam energy
Top mass & Width	Top threshold scan @360 GeV	EW	Beam energy
Bs→ $\nu\nu\phi$	91.2 GeV	Flavor	Object (ϕ) in jets; MET
Bc→ $\tau\nu$	91.2 GeV	Flavor	Object (τ) in jets; MET
B0→ $2\pi^0$	91.2 GeV	Flavor	π^0 in jets; EM resolution

must cover

optional

Need to identify persons to cover each benchmark, and contacts for some technical work:

- MC production
- PFA
- JoI
- Object validation
- ....

Please volunteer for the tasks. More ideas are welcome

Next plan

- Start conducting physical analysis, beginning with identifying suitable generators to produce MC samples, and then GEN-SIM-DIGI-RECO-ANA
  - e.g. find out Generator status for sample production, ZH, Z, WW, ttbar, backgrounds
  - Identify and (help) solve problems in the software/analysis
  - Any requirements on computing resources: CPU, storage, etc.
- Training sessions on CEPCSW software in the coming Thursday and Friday, thanks to Software group
  - https://indico.ihep.ac.cn/event/23539/
  - https://code.ihep.ac.cn/cepc/CEPCSW
- Analysis documentation to be put in DocDB (will be upgraded with SSO integrated)

backup

Preliminary estimates on physics performance

	Processes @ c.m.s.	Domain	Anticipated relative accuracies/up limit with CDR baseline detector + TDR Luminosity, with JoI	@Ref TDR
H→cc	vvH @ 240 GeV	Higgs	1.7%	1.6%
H→ss [1]			95% up limit of 0.75E-3	95% up limit of 0.70E-3
H→sb [1]			95% up limit of 0.22E-3	95% up limit of 0.20E-3
H→inv [2]	qqH	Higgs/NP	95% up limit of 0.13%	Same
Vcb [3]	WW→lvqq @ 240/160 GeV	Flavor	0.4%	0.36%
W fusion Xsec [2]	vvH @ 360 GeV	Higgs	1.1%	Same
α_s	Z→tautau @ 91.2 GeV	QCD	NAN	Theoretical Uncertainty Dominant
CKM angle $\gamma - 2\beta$	Z→bb, B→DK @ 91.2 GeV	Flavor	NAN	~o(0.1 - 1) degree
Weak mixing angle [4]	Z@ 91.2 GeV	EW	2.4E-6 using 1 month data (~ 2E11 Z)	~ tiny improvement due to VTX
Higgs recoil [5]	llH	Higgs	δm = 2.5 MeV $\delta\sigma/\sigma$ = 0.25%/0.4% (wi/wo qqH)	Same
H→bb, gg [2]	vvH + qqH	Higgs	bb: 0.14% -> 0.13% gg: 0.81% -> 0.65% (wi/wo JoI)	bb: 0.12% gg: 0.62%
H→di muon [2]	qqH	Higgs	6.4%	Same
H→di photon [2]	qqH	Higgs	3%	1.8%
W mass & Width [6]	W threshold scan @160 GeV	EW	0.7 MeV & 2.4 MeV @ 6 iab	Same
Top mass & Width [7]	Top threshold scan @360 GeV	EW	9 MeV & 26 MeV @ 100 ifb	Same
Bs→ $\nu\nu\phi$ [8]	91.2 GeV	Flavor	0.9% (1.8%@Tera-Z)	Same, if object recon. ~ CDR
Bc→ $\tau\nu$ [9]	91.2 GeV	Flavor	0.35% (0.7%@Tera-Z)	Same, if object recon. ~ CDR
B0→ $2\pi^0$ [10]	91.2 GeV	Flavor	NAN	0.3%, need to validate photons finding

- Higgs to di photon precisions improves significantly, if low mass tail tamed.
- Physics measurements using JoI, etc, benefit from better VTX and has 5-10% improvements
- Here we assume the TDR BMR could eventually reach ~ CDR
- If BMR of 3% achieved, precisions of most benchmarks could be further improved for 5-10%
- The Pattern reco. capability of Xbar ECAL is still a concern. Need further development & validations.