EF08: Model Specific Explorations

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Snowmass Timeline

7/1/21 Restart of activities	7/12-14/21 **DPF Meeting** Snowmass Townhall	**EF workshop** Aug-Sep ‘21 + Additional workshops (Dec 21 - Mar 22)	3/15/22 Deadline **Contributed Papers**	5/31/22 Preliminary **TG Reports**	6/30/22 Preliminary **Frontier Reports**	7/22 **Community Summer Study** (UW-Seattle)	9/30/22 **Final Reports**	10/31/22 Snowmass Book & online archive docs

Upcoming events

- Energy Frontier Restart Workshop, Aug 30th - Sept 3rd (virtual)
  - EF08 parallel session currently planned for Thursday 10am-12pm EDT
  - But of course the point of the workshop is to thinking across the sub-groups
- Expect a “status/progress” workshop in ~December
- Expect a TG report workshop late March (to assess what to include in the topical group report)

Collider Configuration and Energies Planned

Circular colliders merged

- put all others left ~as is

Machine	Energy						
Circular ee	m_Z	$2m_W$	240	$2m_t$			GeV
ILC	250	350	500	1000			
CLIC					1500	3000	
HL-LHC/FCC-hh	14	75	100	150			TeV
LHeC/FCC-eh	1.3	3.5					
μμ	3	10	14	30			

Delphes cards for all configurations on EF MC page

- No full simulation (left up to collaborations)

Preliminary Accelerator List

From:https://indico.fnal.gov/event/44870/contributions/198445/attachments/135764/168821/EFintro_CPM_Oct2020.pdf

Accelerator Benchmark Parameters

Snowmass 2021 Energy Frontier Collider Study Scenarios

Collider	Type	$\sqrt{s}$	P [%] e^-/e^+	L_{int} ab^{-1}
HL-LHC	pp	14 TeV		6
ILC	ee	250 GeV	$\pm 80/\pm 30$	2
		350 GeV	$\pm 80/\pm 30$	0.2
		500 GeV	$\pm 80/\pm 30$	4
		1 TeV	$\pm 80/\pm 20$	8
CLIC	ee	380 GeV	$\pm 80/0$	1
		1.5 TeV	$\pm 80/0$	2.5
		3.0 TeV	$\pm 80/0$	5
CEPC	ee	M_Z		16
		$2M_W$		2.6
		240 GeV		5.6
FCC-ee	ee	M_Z		150
		$2M_W$		10
		240 GeV		5
		$2\ M_{top}$		1.5

Snowmass 2021 Energy Frontier Collider Study Scenarios

Collider	Type	$\sqrt{s}$	P [%] e^-/e^+	L_{int} ab^{-1}
FCC-hh	pp	100 TeV		30
LHeC	ep	1.3 TeV		1
FCC-eh	ep	3.5 TeV		2
muon-collider (higgs)	$\mu\mu$	125 GeV		0.02
High energy muon-collider	$\mu\mu$	3 TeV		1
		10 TeV		10
		14 TeV		20
		30 TeV		90

Note for muon-collider: It is important to note that the plan is not to run subsequently at the various c.o.m etc. These are reference points to explore and assess the physics potential and technology. The luminosity can be varied to determine how best to exploit the physics potential.

Other options to explore:

- Muon collider at a very high energy (>30 TeV?)
- FCC pp >150 TeV? and ~75 TeV documenting sensitivity loss
- Very high energy e+e- collider
- gamma-gamma collider

More Detailed Discussion (slides 20-38):
https://indico.fnal.gov/event/43963/contributions/190477/attachments/131609/161205/Snowmass2021-EF-July2020-MN-final.pdf

Hope to have more discussion at EF restart workshop

Summary

Restart of Snowmass Energy Frontier Officially July 1st

- Contributed paper deadline 3/15/22

Plan your MC needs

- This is key to making the deadlines and avoiding a scramble
- Let us know either way in our form, we don't want groups getting stuck
- Technical questions on the EF08 slack channel are encouraged

Making sure your work gets in the EF08 report

- Fill in the form so we know how you are doing and what you plan to deliver: https://forms.gle/qdgJ5k35rqu9gusw9

Help make sure the EF08 report has a broad view that is useful for scenario comparison

- Think about the plots and tables let us know what you think

Backup

Hadron Collider Background Samples Planned

Follows 2013 list

- https://arxiv.org/pdf/1309.1057.pdf
- There is a request form on the MC page if you need others

Dataset name	Physics process	Number of recoil jets
B-4p	γ or on-shell W, Z	0
Bj-4p	γ or on-shell W, Z	1-3
Bjj-vbf-4p	γ or off-shell W, Z, H in VBF topology	2-3
BB-4p	Diboson (γ, W, Z) processes	0-2
BBB-4p	Tri-boson (γ, W, Z) processes including BH	0-1
LL-4p	Non-resonant dileptons (including neutrinos) with $m_{ll} > 20$ GeV	0-2
LLB-4p	Non-resonant dileptons with an on-shell boson, $m_{ll} > 20$ GeV	0-1
H-4p	Higgs	0-3
tj-4p	Single top (s- and t-channel)	0-2
tB-4p	Single top associated with a boson	0-2
tt-4p	$t\bar{t}$ pair production	0-2
ttB-4p	$t\bar{t}$ associated with γ, W, Z, H	0-1

Table 1-2. *Table of background processes. All processes include the particles in the dataset name plus additional recoil jets up to four generated particles. On-shell vector bosons, off-shell dileptons, Higgs bosons, top quarks, and jets are denoted B, LL, H, t, and j, respectively. In the Bjj-vbf-4p case, B includes Higgs. In the BBB-4p case, BBB includes BH. Samples are generated in bins of H_{T}^{*} for $\sqrt{s}$ = 14, 33, and 100 TeV.*

MC: my understanding

Energy Frontier MC group is active and is preparing a lot of resources for use by the topical groups

- But if we don't give them input it's our fault if we don't get what we need
- https://snowmass21.org/montecarlo/energy has getting started and info on plans (see here also: https://indico.fnal.gov/event/44870/contributions/198448/attachments/136004/168905/Stupak_100720_SnowmassEFMCTF.pdf)
- Not everything is easy to find yet, so here is my understanding

MC strategy

- MC group will make large hadron collider bkg samples "proactively"
  - I.e. they will use past needs to build a list of likely requests (later slide) and make large samples
- MC group will make other collider samples "reactively"
  - Smaller CPU requirements means less planning needed
- Groups need make their own signal samples, but can use OSG resources see https://snowmass21.org/montecarlo/energy to generate and share
  - We might want to try to coordinate mode choices and samples in EF08 … discuss?