AF Implementation Task Force

Thomas Roser for the Implementation Task Force

BROOKHAVEN NATIONAL LABORATORY

U.S. DEPARTMENT OF ENERGY

Snowmass Community Planning Meeting

October 7, 2020

AF Implementation Task Force

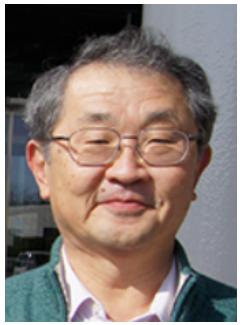
- One of the key goals of the Snowmass'21 Accelerator Frontier is to address the question "…What are the time and cost scales of the R&D and associated test facilities as well as the time and cost scale of the facility?"
- A large number of accelerator projects are being considered and/or developed as part of the Snowmass'21 effort. Examples include: ILC, a Muon Collider, gamma-gamma and ERL options, a large circumference electron ring, and a large circumference hadron ring amongst others.
- One of the challenges for the Accelerator Topical groups will be to compare the expected cost scales, schedule, and R&D status for the projects as they will be at varied stages of development and possibly proposed using different accounting rules.
- The Accelerator Implementation Task Force is charged with developing metrics and processes to facilitate such a comparison between projects.

Steve Gourlay (LBNL)

Philippe Lebrun (CERN)

Thomas Roser (BNL, Chair)

Tor Raubenheimer (SLAC)



Katsunobu Oide (KEK)

Jim Strait (FNAL)

Vladimir Shiltsev (FNAL)

Reinhard Brinkmann (DESY)

John Seeman (SLAC)

Charge items

1. Develop the metrics to compare projects' cost, schedule/timeline, technical risks (readiness), operating cost and environmental impact, and R&D status and plans;
2. Select the accelerator projects to be evaluated (provided by the AF topical groups);
3. Work with the proponents of the selected accelerator projects to evaluate them against the metrics from item 1;
4. Consider the ultimate limits of various types of colliders: e+/e-, p/p, mu+/mu-;
5. Consider limits and timescales due to accelerator technology for various types of colliders: e+/e-, p/p, mu+/mu-;
6. Lead the evaluation of the different HEP accelerator proposals and inform and communicate with the Snowmass'21 AF, EF, NF and TF;
7. Document the metrics, processes, and conclusions for the Snowmass'21 meeting in the Summer 2021; write and submit a corresponding White Paper.

AF-EF Initial workshop on future facilities

- June 24, 2020: https://indico.fnal.gov/event/43871/

9:00 AM → 9:10 AM **Introduction: goals, format, etc**

9:10 AM → 9:25 AM **FCCee**
Speaker: Katsunobu Oide (KEK)

9:25 AM → 9:40 AM **CepC**
Speaker: Yu Chenghui

9:40 AM → 9:55 AM **ILC**
Speaker: Shinichiro MICHIZONO (KEK)

9:55 AM → 10:10 AM **CLIC**
Speaker: Steinar Stapnes (FNAL)

10:10 AM → 10:25 AM **EIC**
Speaker: Christoph Montag (BNL)

10:25 AM → 10:40 AM **LHeC**
Speaker: Oliver Bruning (CERN)

10:40 AM → 10:55 AM **HE-LHC**
Speaker: Frank Zimmermann (CERN)

10:55 AM → 11:10 AM **SppC**
Speaker: Jingyu Tang (Institute of High Energy Physics)

11:10 AM → 11:25 AM **FCChh**
Speaker: Michael Benedikt

- July 1, 2020: https://indico.fnal.gov/event/43872/

9:00 AM → 9:10 AM **Introduction: gioals, format, etc**

9:10 AM → 9:30 AM **Cold NC-Linear Collider**
Speaker: Emilio Nanni (SLAC National Accelerator Laboratory)

9:30 AM → 9:50 AM **ERL based FCCee**
Speaker: Thomas Roser (BNL)

9:50 AM → 10:10 AM **Gamma-Gamma Higgs factories**
Speaker: Frank Zimmermann (CERN)

10:10 AM → 10:30 AM **Plasma-Laser WFA 1 TeV +**
Speaker: Carl Schroeder (Lawrence Berkeley National Laboratory)

10:30 AM → 10:50 AM **Plasma-Beam WFA 1 TeV +**
Speaker: Spencer Gessner

10:50 AM → 11:10 AM **Structure-beam WFA 1 Tev +**
Speaker: John Power (Argonne National Lab)

11:10 AM → 11:30 AM **Muon Coliders: Higgs Factory and 3-14 TeV**
Speaker: Daniel Schulte (CERN)

11:30 AM → 12:10 PM **Discussion/ Q&A**

Example of an existing comparison table

- V. Shiltsev and F. Zimmermann (arXiv:2003.09084v1 [physics.acc-ph] 20 Mar 2020)

Project	**Type**	**Energy** (TeV, c.m.e.)	$N_{\rm det}$	$\mathcal{L}_{\rm int}$ ($\rm ab^{-1}$)	**Time** (years)	**Power** (MW)	**Cost**	**Cost/$\mathcal{L}_{\rm int}$** (BCHF/$\rm ab^{-1}$)	**$\mathcal{L}_{\rm int}$/Power** ($\rm ab^{-1}$/TWh)
ILC	e^+e^-	0.25	1	2	11	129	4.8-5.3BILCU	2.7	0.24
		0.5	1	4	10	163(204)	8.0 BILCU	1.3	0.4
		1	1			300	+(n/a)		
CLIC	e^+e^-	0.38	1	1	8	168	5.9 BCHF	5.9	0.12
		1.5	1	2.5	7	370	+ 5.1 BCHF	3.1	0.16
		3	1	5	8	590	+7.3 BCHF	2.0	0.18
CEPC	e^+e^-	0.091&0.16	2	16+2.6	2+1	149	5 B USD	0.27	7.0
		0.24	2	5.6	7	266	+(n/a)	0.21	0.5
FCC-ee	e^+e^-	0.091&0.16	2	150+10	4+1	259	10.5 BCHF	0.065	20.5
		0.24	2	5	3	282		0.064	0.9
		0.365 & 0.35	2	1.5+0.2	4+1	340	+1.1 BCHF	0.07	0.15
LHeC	ep	1.3	1	1	12	(+100)	1.75* BCHF	1.75	0.14
HE-LHC	pp	27	2	20	20	220	7.2 BCHF	0.36	0.75
FCC-hh	pp	100	2	30	25	580	17(+7) BCHF	0.8	0.35
FCC-eh	ep	3.5	1	2	25	(+100)	1.75 BCHF	0.9	0.13
Muon Collider	$\mu\mu$	14	2	50	15	290	10.7* BCHF	0.21	1.9

Next steps

- To begin with, the ITF will focus on collider facilities.
- AF topical groups (AF3,4,6) provide initial lists of proposals and concepts for evaluation to the ITF. Additional proposals and concepts can be added later. Four categories:
  1. Existing facilities for references (Tevatron, RHIC, LEP, LHC, Super KEKB, XFEL, LCLS II ...)
  2. Proposals with TDR and/or CDR
  3. Proposal without TDR or CDR but reasonably well thought through and mostly based on existing technologies
  4. Future concepts and ideas
- The ITF will develop a set of metrics that will be used to evaluate the proposals and concepts. Input is welcome.
  - Possible list of metrics:
    - *Performance (ab^{-1}/TWh?, Higgs/ TWh?, Luminosity/MW?, …)*
    - *Physics reach (parton collision energy?, vs. cost?, vs. MW?) (need input from EF topical groups)*
    - *construction cost (accounting rules?, number of components and length tunnel, …)*
    - *schedule/timeline*
    - *technical risks and R&D status and plans (readiness, required demonstration, …)*
    - *operating cost and environmental impact (power consumption (MW, TWh). …)*
    - *life cycle cost ?*
- Proponents of proposals and concepts are asked to provide the information of their proposal and concept for each metric item by the end of 2020
- ITF will assemble and evaluate all this information and prepare an overall comparison of all the proposals and concepts. This will be presented to the AF topical groups at a workshop, probably during spring 2021, for comments and feedback.
- ITF will prepare a White Paper with the metrics, processes and conclusions for Smowmass'21 in summer 2021.