https://snowmass21.org/accelerator/start

Accelerator Frontier

Panel 3

Large Accelerator Facilities

Community Summer Study – Seattle, July 26 2022

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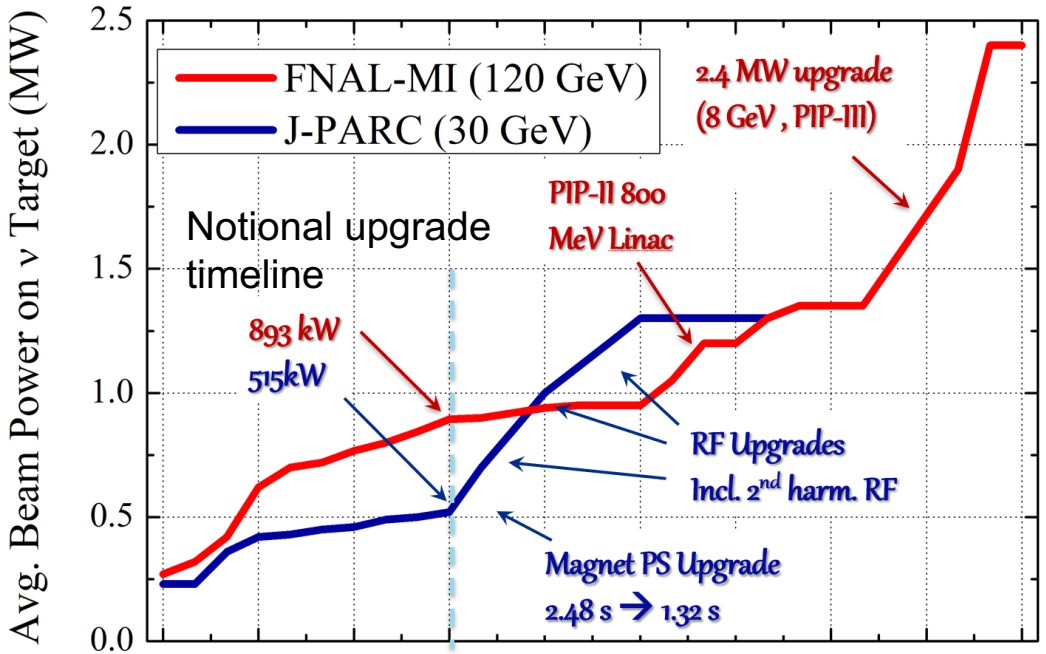
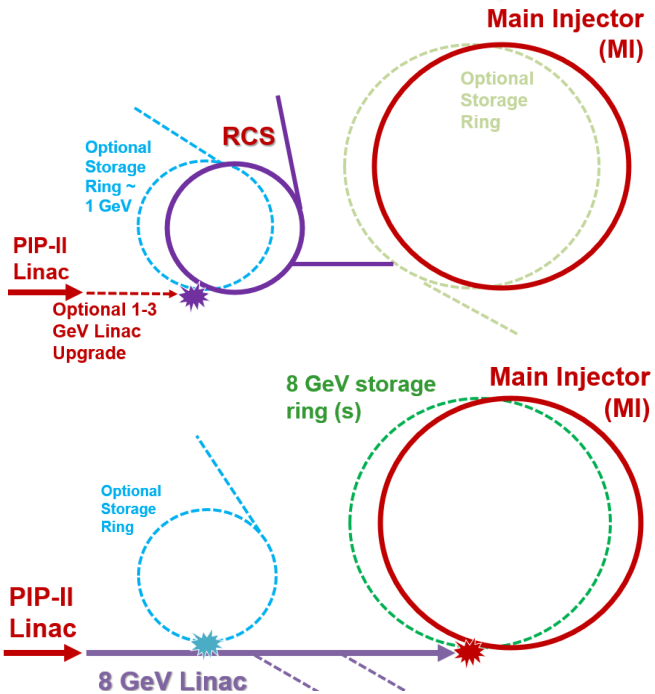
(Snowmass'21 AF Conveners*)*

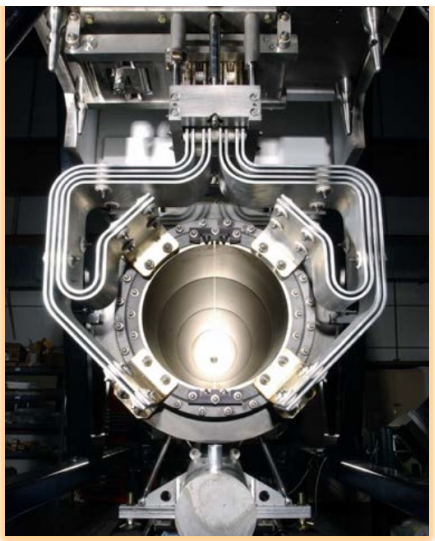
Captions here please

LBNF/DUNE Upgrade Options

- Phase II 2.4 MW upgrade options: RCS vs SRF
  - Need to understand other proton utilization, e.g. Rare/Precision, MC R&D, …
- Short timeline for design and resolving cost challenges
  - Impact on rest of field and the R&D focus







NUMI horn 0.9MW

Higgs Factory Options

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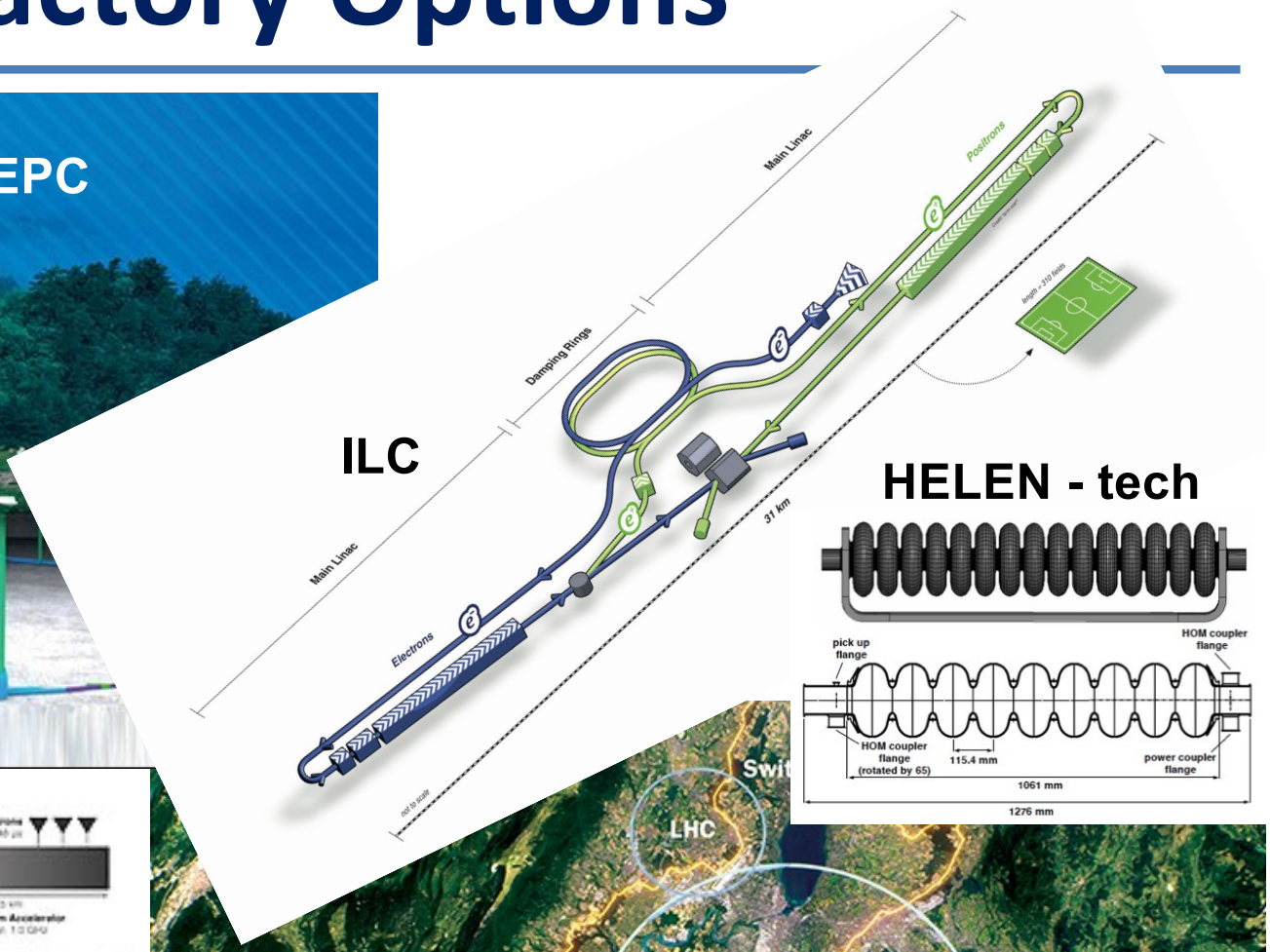
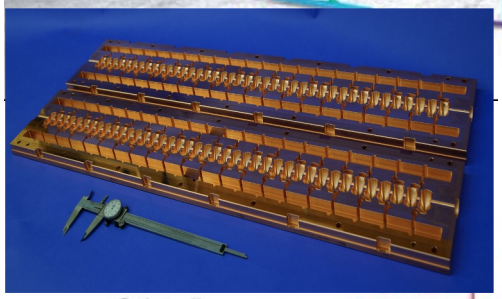
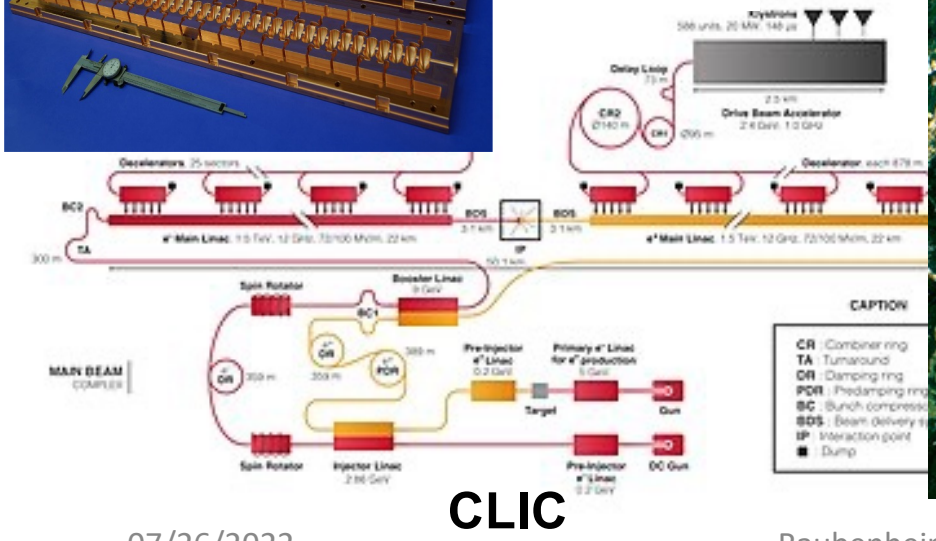
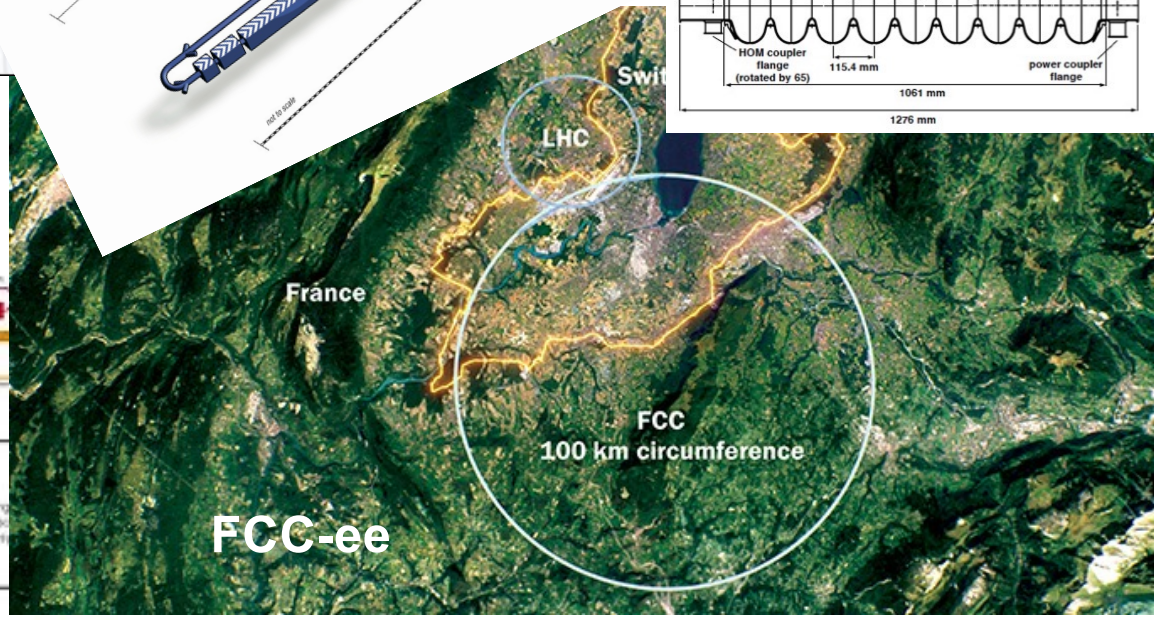




C^3 - tech



CLIC



AF Message #1 for Large-Scale Facilities

- #1: We have a broad array of accelerator technologies and expertise to design and construct near-term prioritized HEP accelerator projects, e.g Neutrino Frontier – 2.4MW, Energy Frontier – spectrum of design options.

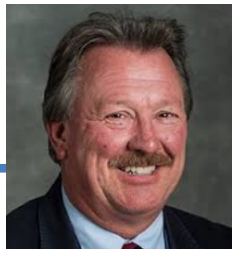
  → Expect P5 to tell us “what” and we can help say how.

Implementation Task Force

- The Accelerator Implementation Task Force (ITF) is charged with developing metrics and processes to facilitate a comparison between collider projects.
- 10 int'l experts, 2 *Snowmass Young's*, 3 liaisons to Energy & Theory Frontiers
- ITF addressed (four subgroups):
  - Physics reach (impact), beam parameters
  - Size, complexity, power, environment
  - Technical risk, technical readiness, validation and R&D required
  - Cost and schedule


Thomas Roser (BNL, Chair)


Philippe Lebrun (CERN)


Steve Gourlay (LBNL)


Tor Raubenheimer (SLAC)


Katsunobu Oide (KEK)

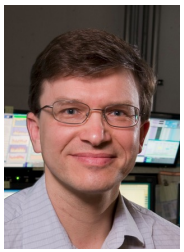

Jim Strait (FNAL)


Vladimir Shiltsev (FNAL)


Reinhard Brinkmann (DESY)


John Seeman (SLAC)

DRAFT REPORT

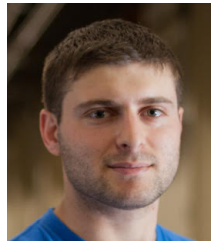

Dmitry Denisov (BNL)


Meenakshi Narain (Brown U.)


Liantao Wang (U.Chicago)


Sarah Cousineau (ORNL)


Marlene Turner (LBNL)


Spencer Gessner (SLAC)

AF Message #1' for Large-Scale Facilities

- #1': We can contribute to HEP prioritization and international project consideration by providing top-down metrics for expected cost-scales and technology / timeline evaluations, e.g. Implementation Task Force (ITF).
  - The ITF did not review luminosity and power estimates and some parameter sets were not self-consistent. The study could/should be taken further with additional effort.

From the ITF Report Draft: Tables 1-3, 5

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	CME (TeV)	Lumi per IP (10^34)	Years, pre-project R&D	Years to 1st physics	Cost range (2021 B$)	Electric Power (MW)
FCCee-0.24	0.24	8.5	0-2	13-18	12-18	280
ILC-0.25	0.25	2.7	0-2	<12	7-12	140
CLIC-0.38	0.38	2.3	0-2	13-18	7-12	110
HELEN-0.25	0.25	1.4	5-10	13-18	7-12	110
CCC-0.25	0.25	1.3	3-5	13-18	7-12	150
CERC(ERL)	0.24	78	5-10	19-24	12-30	90
CLIC-3	3	5.9	3-5	19-24	18-30	~550
ILC-3	3	6.1	5-10	19-24	18-30	~400
MC-3	3	2.3	>10	19-24	7-12	~230
MC-FNAL	6-10	20	>10	19-24	12-18	O(300)
MC-IMCC	10-14	20	>10	>25	12-18	O(300)
FCChh-100	100	30	>10	>25	30-50	~560

State of Large-Scale Facilities

- Work is needed to understand the optimal path for the accelerator upgrades to LBNF / DUNE
- Multiple global options exist for Higgs factories that could be constructed: (ILC, FCC-ee, CEPC, CLIC)
  - Technology development is providing potential improvements, e.g. C^3, HELEN, High Q_0 SRF, High η RF, … but need to understand the full accelerator designs
- Options are being considered for 10+ TeV colliders but R&D is needed to develop technology and understand costs and timescales
- Technology and physics R&D is progressing and will provide options for accelerators in future decades

AF Messages #2-4 for Large-Scale Facilities

- #2: We need an integrated future collider R&D program (a focused R&D program in OHEP) to engage in the design and to coordinate the development of next generation collider projects such as: ILC, CLIC, FCCee, CCC/HELEN, multi-TeV Muon Collider. We (the US) have few new proposals ready for P5 evaluation.
- #3 & #4 We have an active R&D program in labs and universities aimed at general accelerator R&D that is critical in developing technologies and options for future HEP accelerators (but does not develop accelerator proposals).

Opportunities in AF

- The development of collider designs requires:
  - Knowledge of the experimental physics to help optimize parameters
  - Development of the Machine-Detector Interface to understand collider backgrounds
  - Technology development and experimental verification
  - Systems integration and optimization (inc. ML)
  - Project implementation
- Many opportunities for early career members to join efforts tailored to their interests
- Need support for Universities to maintain pipeline for accelerator workforce

AF Message #5 for Large-Scale Facilities

#5 Accelerator development should be part of P5: Planning of integrated accelerator development and accelerator R&D should be aligned with the strategic planning for particle physics and should be part of the P5 prioritization process.

Thanks to AF TG Convenors

Topical Group		Co-Conveners			
AF1	Beam Physics & Acc. Education	Mei Bai (SLAC)	Zhirong Huang (SLAC)	Steve Lund (MSU)	
AF2	Accelerators for Neutrinos	John Galambos (ORNL)	Bob Zwaska (FNAL)	Gianluigi Arduini (CERN)	
AF3	Accelerators for EW/Higgs	Goerg Hoffstaetter (Cornell)	Qing Qin (IHEP)	Frank Zimmermann (CERN)	Angeles Faus-Golfe (IN2P3)
AF4	Multi-TeV Colliders	Mark Palmer (BNL)	Nadia Pastrone (INFN)	Jingyu Tang (IHEP)	Alexander Valishev (FNAL)
AF5	Accelerators for PBC & Rare Processes	Mike Lamont (CERN)	Richard Milner (MIT)	Eric Prebys (UC Davis)	
AF6	Advanced Acc. Concepts	Ralph Assmann (DESY)	Cameron Geddes (LBNL)	Mark Hogan (SLAC)	Pietro Musumeci (UCLA)
AF7	Accelerator Technology				
	RF	Emilio Nanni (SLAC)	Sergey Belomestnykh (FNAL)	Hans Weise (DESY)	
	Magnets	Susana Bermudez (CERN)	Gianluca Sabbi (LBNL)	Sasha Zlobin (FNAL)	
	Targets/Sources	Charlotte Barbier (ORNL)	Frederique Pellemoine (FNAL)	Yin-E Sun (ANL)	
ITF	Implementation Task Force	Thomas Roser (BNL)			