



Muon Collider R&D Coordination Group meeting

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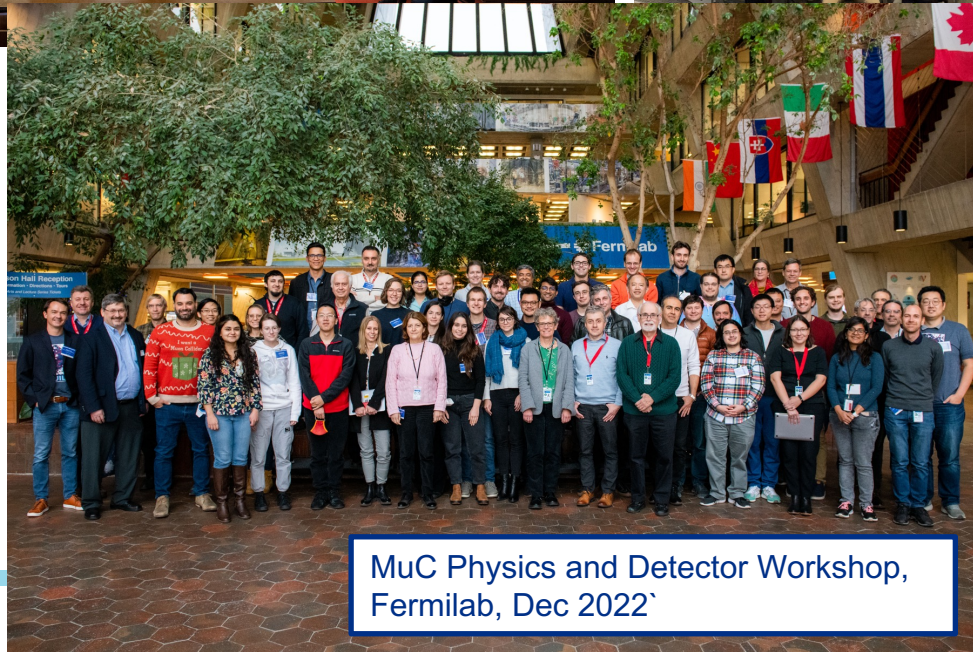
Mar 17th, 2023

Muon Collider Community

IMCC Annual Meeting,
CERN Oct 2022



KITP MuC Workshop,
Santa Barbara, March 2023



MuC Physics and Detector Workshop,
Fermilab, Dec 2022

Muon Collider in Snowmass

- Overwhelming enthusiasm
- Cross-frontier AF+EF+TF Muon Collider Forum :
 - Many meetings, with 50-100 participants in each
 - Final report with 150+ authors ([arxiv:2209.01318](https://arxiv.org/abs/2209.01318))
- 40+ dedicated White Papers, Smasher's Guide, etc...

7 Path Forward

The Forum asks:

7.1	Engagement in IMCC	67
7.2	Contributions to Physics Studies	67
7.3	Contributions to Detector R&D	67
7.4	Contributions to Accelerator R&D	68
7.5	Explore US options	68

Request for P5 input

- On March 1st, Fermilab directorate asked Diktys and Sergo to prepare and organize input to the P5 committee on the US Muon Collider efforts
- Serve as points of contact for a broader, national effort, beginning to organize input for P5
- Develop a national budget profile for a Muon Collider R&D program to be able to present to P5
- Reach out to other relevant experts from the community to join this effort
- Asked Sridhara Dasu to join us and represent User community in organizing these efforts

R&D Coordination Group

- Keep Accelerator+Detector+Theory united
- Build a diverse and inclusive group
- Focus on key elements of **10 TeV accelerator and detector design**
- Support Theory, Software and Simulation
- Maintain tight connection with IMCC

Physics Case Development:

Patrick Meade (Stony Brook), Nathaniel Craig (UCSB)

Accelerator R&D Focus Areas:

Muon source:

Mary Convery (Fermilab), Jeff Eldred (Fermilab), Sergei Nagaitsev (JLAB), Eric Prebys (UC Dav

Machine design:

Frederique Pellemoine (Fermilab), Scott Berg (BNL), Katsuya Yonehara (Fermilab)

Magnet systems:

Steve Gourlay (Fermilab), Giorgio Apollinari (Fermilab), Soren Prestemon (LBNL)

RF systems:

Sergey Belomestnykh (Fermilab), Spencer Gessner (SLAC, TBC), Tianhuan Luo (LBNL)

Detector R&D Focus Areas:

Tracking Detectors:

Maurice Garcia-Sciveres (LBNL, TBC), Tova Holmes (Tennessee)

Calorimeter Systems

Chris Tully (Princeton), Rachel Yohay (FSU)

Muon Detectors

Melissa Franklin (Harvard), Darien Wood (Northeastern)

Electronics/TDAQ

Darin Acosta (Rice), Isobel Ojalvo (Princeton), Michael Biegel (BNL)

MDI+Forward Detectors:

Kevin Black (Wisconsin), Karri DiPetrillo (Chicago), Nikolai Mokhov (Fermilab)

Detector Software and Simulations:

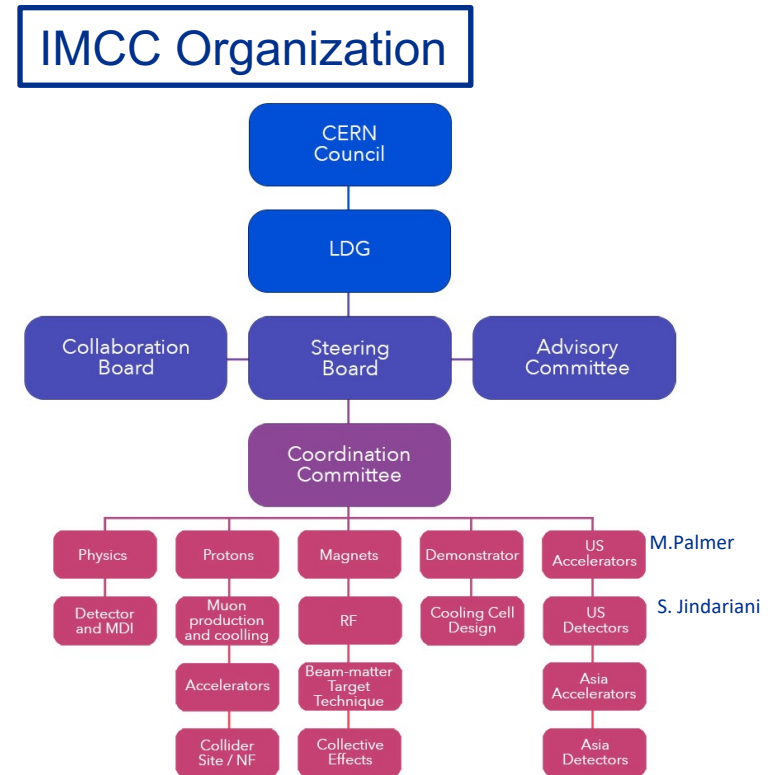
Liz Sexton-Kennedy (Fermilab), Simone Pagan Griso (LBNL)

International Liaisons:

Daniel Schulte (CERN), Chris Rogers (RAL), Donatella Lucchesi (INFN), Federico Meloni (DESY)

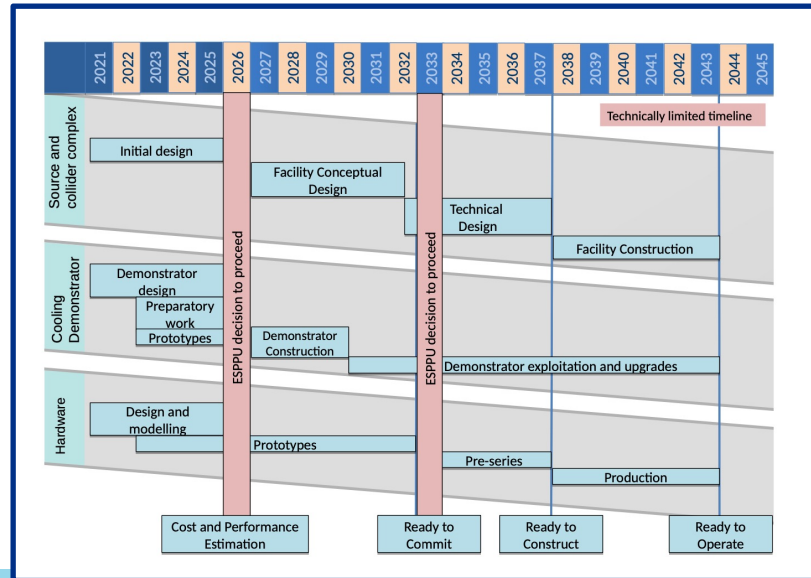
International Landscape

- Following the 2018 European Strategy process, European LDG initiated a Muon Collider feasibility study
- International Muon Collider Collaboration was formed and is initially hosted at CERN
- IMCC organized three community meetings to establish R&D plan and timeline (US was well represented in these efforts)
- Many universities and national labs expressed interest in officially joining IMCC



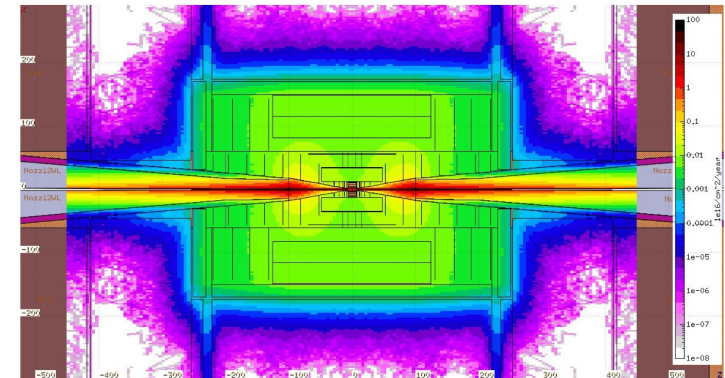
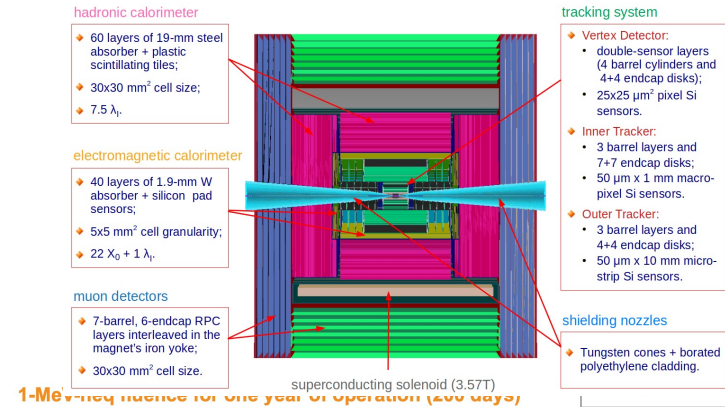
IMCC Timeline

- Technically limited timeline
- Driven by accelerator technology and demonstration requirements
- We should be reasonably aligned with it (some differences are OK at this stage)
- The timelines will be re-aligned when US officially joins the effort



IMCC Detector Concept and Requirements

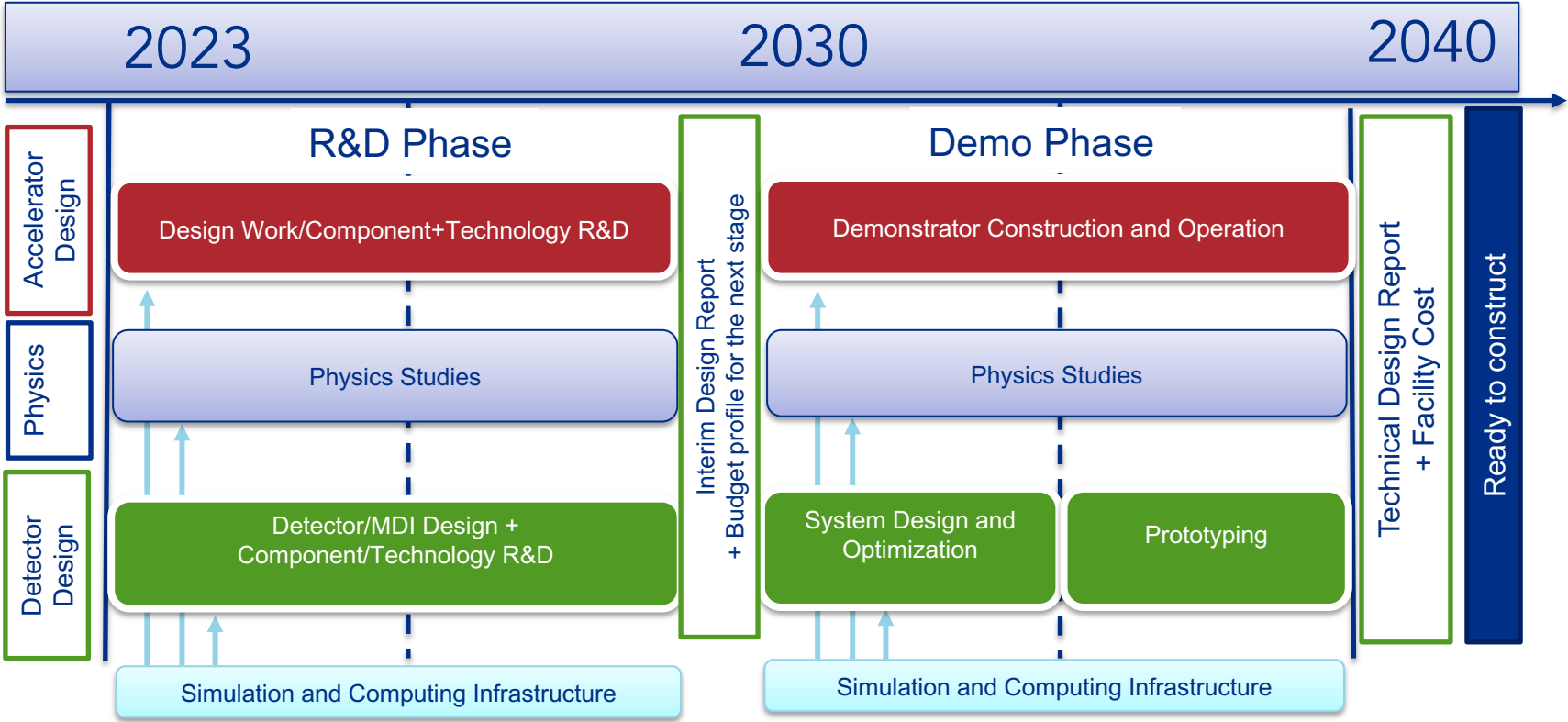
- ◆ **3 TeV detector design is relatively mature. 10 TeV concept is at its infancy**
- ◆ **Beam induced background evolution studied:**
 - The BIB in detector volume is approximately constant with COM energy
- ◆ **Fluence and Integrated Dose simulated:**
 - similar to HL-LHC and much smaller than FCC-hh
- ◆ **Trackers:**
 - Pixel sizes smaller than HL-LHC detectors
 - 30-60ps timing per hit
- ◆ **Calorimeter:**
 - SiW PF calorimeter with good timing
 - Segmented Crystals (+ dual readout) concept is interesting
- ◆ **Some on-detector intelligence, rad-rad high speed links**



Useful References

- Useful references for this Effort:
 - Muon Smasher's Guide: [Link](#)
 - Facility overview white paper: [Link](#)
 - Simulated Performance white paper: [Link](#)
 - Promising Detector Technologies white paper: [Link](#)
 - Muon Collider Forum Report: [Link](#)

Sketch of US Timeline



What are we asking (1):

- Bottom-up estimate!
 - Focus on critical Muon Collider needs and what expertise and capabilities US can provide to address those needs
 - Solicit input from Snowmass/Muon Collider Forum community, but also rely on your expertise and judgement
 - For now, ignore potential overlaps with international efforts
- Each Focus Area to provide budget profile for 2024-2030:
 - List of activities and deliverables
 - FTE and M&S needs per year
 - Note synergies with e+e-, pp, any other experiments
- For 2031-2035 and 2036-2040
 - List of activities and deliverables
 - Envelope of total FTE and M&S

What are we asking (2):

Link to the google doc will be shared

	A	B	C	D	E	F	G	H
1	Focus Group	Activity	Deliverable	Possible Synergies (e.g. e+e-, pp)	2024 FTE	2024 M&S	2025 FTE	2025 M&S
2	Tracking	Activity 1						
3		Activity 2						
4		Activity 3						
5								
6	Calorimeter	Activity 1						
7		Activity 2						
8		Activity 3						

	A	B	C	D	E	F
1	Focus Group	Activity	2031-2035 FTE	2031-2035 M&S	2036-2040 FTE	2036-2040 M&S
2	Tracking	Activity 1				
3		Activity 2				
4		Activity 3				
5						
6	Calorimeter	Activity 1				
7		Activity 2				
8		Activity 3				
α						

Timeline:

- BNL townhall – Apr 12-14th : expect one or two talks on Muon Colliders (physics and detectors)
- SLAC townhall – May 3-5th: expect one talk on Muon Colliders (accelerator)

Proposed Timeline:

- Now – Mar 31st : Focus area coordinators contact interested groups and solicit input from Snowmass/Muon Collider Forum communities
- April 3rd: Initial drafts of the tables to Diktys, Sergo and Sridhara
- April 7th: Meeting to discuss and make necessary adjustments
- April 12-13th : Presentation to P5 at BNL (physics and detector)
- May 3-4th: Presentation to P5 at SLAC (accelerator)

Beyond the townhalls:

- Identify possible overlaps with generic accelerator and detector R&D
- Identify overlaps with ongoing IMCC efforts
- Revise the budget profile as necessary
- Continue to provide interfaces with IMCC and P5/EPP until a US Muon Collider organization is formed