Muon Collider R&D Coordination Group meeting

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March 17th, 2023

Snowmass activities

- Proposal for a US national accelerator R&D program on Future Colliders
- Presentation of the MuC Forum report: a coherent vision for Muon Colliders (MuC) from the US side
  - The forum goal was to build a strong collaboration between the AF+EF+TF frontiers for MuC research and make a strong physics case
  - Monthly meetings and dedicated workshops for 18+ months before Snowmass
  - 160 e-mail subscribers, 50-100 regular participants
- MuC Forum report is now public
  - 180+ authors, 50% are early career scientists

What the Muon Collider Forum asks

- Enable opportunity for US institutions to join and participate in the International Muon Collider Collaboration (IMCC)
- Participate in the global MuC R&D efforts
  - Accelerator R&D in the areas of US expertise and interests
  - Physics and detector design studies
  - Integrate MuC accelerator and detector needs into current R&D programs
- Support the Snowmass US national collider initiative
- Identify and explore synergies with other projects/proposals
- Study options for hosting a Muon Collider in the US

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 notional 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 including and beyond Fermilab, to join this effort
- Asked Sridhara Dasu to join us and represent User community in organizing these efforts

R&D Coordination Group formation

- Keep Accelerator + Detector + Theory united
- Focus on key elements of **10 TeV accelerator and detector design**
  - Break work into individual areas
  - Keep tight connection with International Muon Collider Collaboration (IMCC)

Physics Case Development:
Patrick Meade (Stony Brook), Nathaniel Craig (UCSB)

Accelerator R&D focus areas:

1. **Muon source**
   Mary Convery (FNAL), Jeff Eldred (FNAL), Sergei Nagaitsev (JLAB), Eric Prebys (UC Davis)
2. **Machine design**
   Scott Berg (BNL), Frederique Pellemoine (FNAL), Katsuya Yonehara (FNAL)
3. **Magnet systems**
   Giorgio Apollinari (FNAL), Steve Gourlay (FNAL), Soren Prestemon (LBNL)
4. **RF systems**
   Sergey Belomestnykh (FNAL), Spencer Gressner (SLAC) -TBC, Tianhuan Luo (LBNL)

Detector R&D Focus Areas:
Tracking Detectors:
Tova Holmes (Tennessee), TBC

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 Begel (BNL)

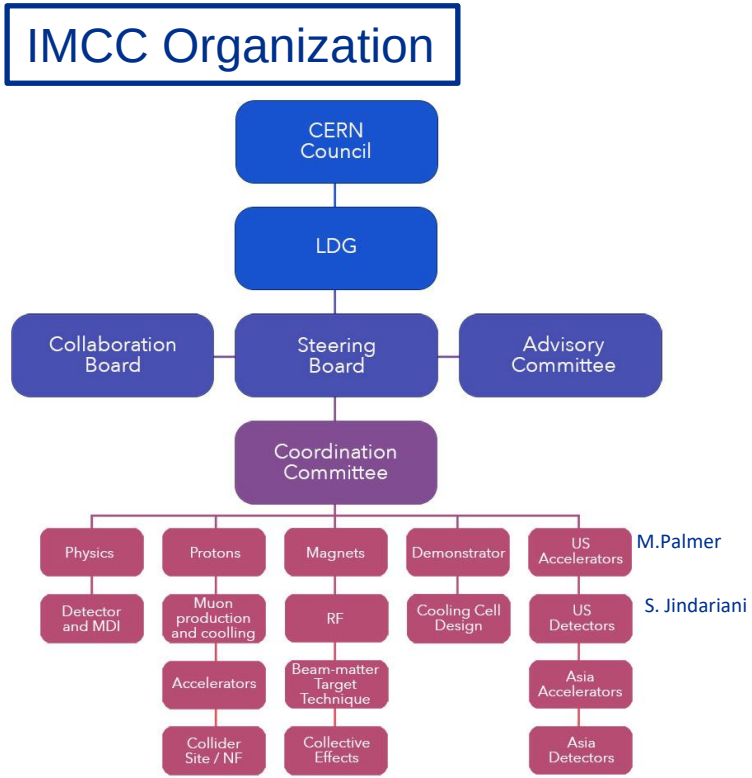
MDI+Forward Detectors:
Kevin Black (Wisconsin), Karri DiPetrillo (Chicago), Nikolai Mokhov (Fermilab)

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)

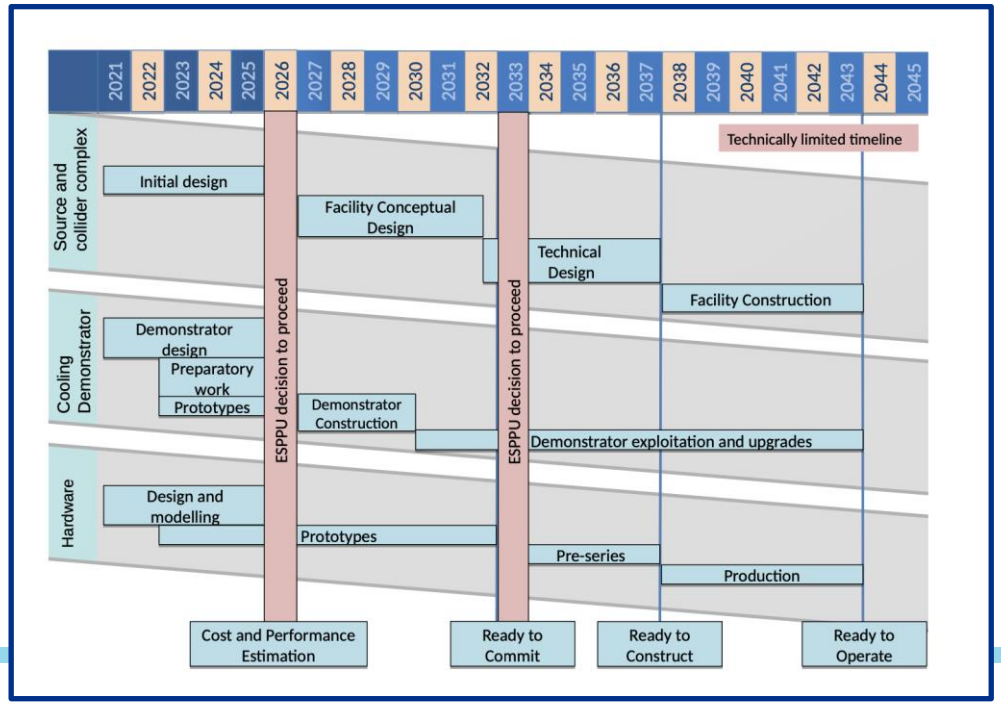
International Muon Collider Collaboration

- Following the 2018 European Strategy process, European LDG initiated a Muon Collider (MuC) feasibility study
- International MuC 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

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



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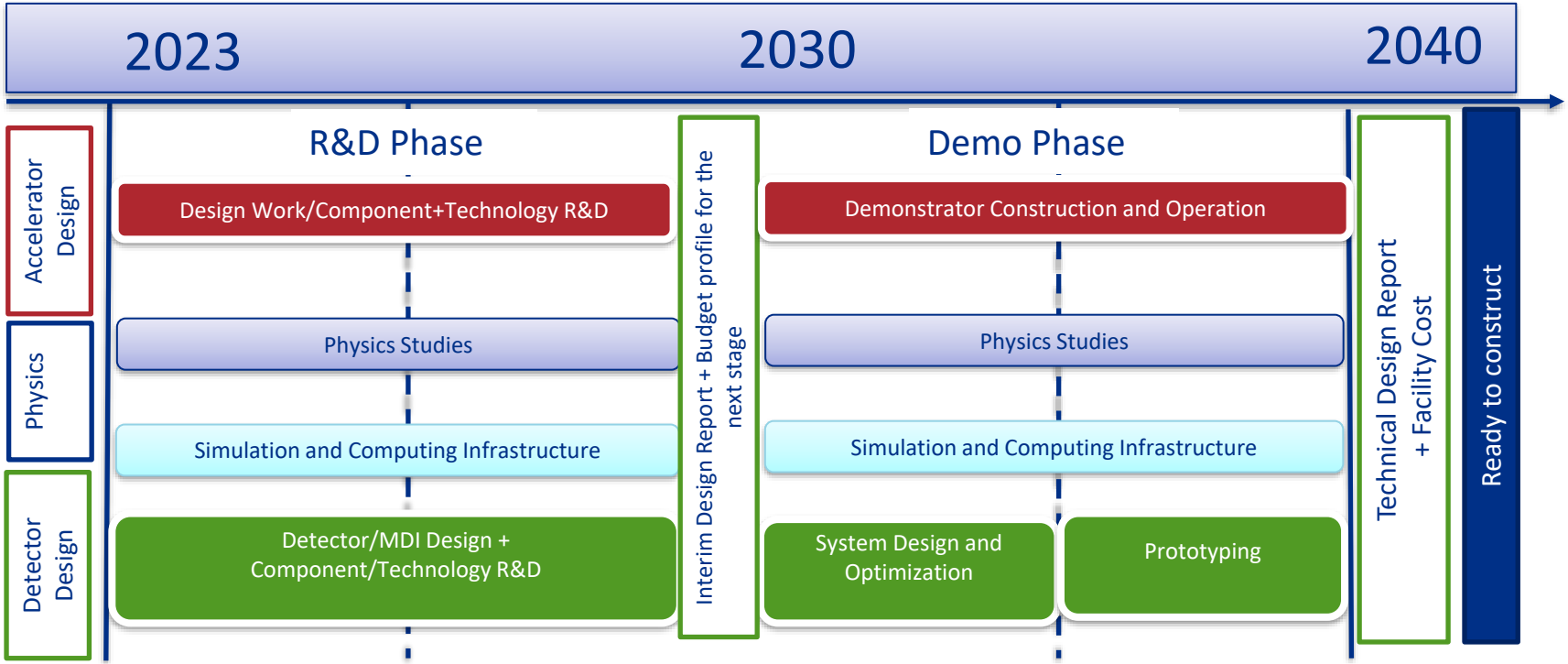
Sketch of US Timeline



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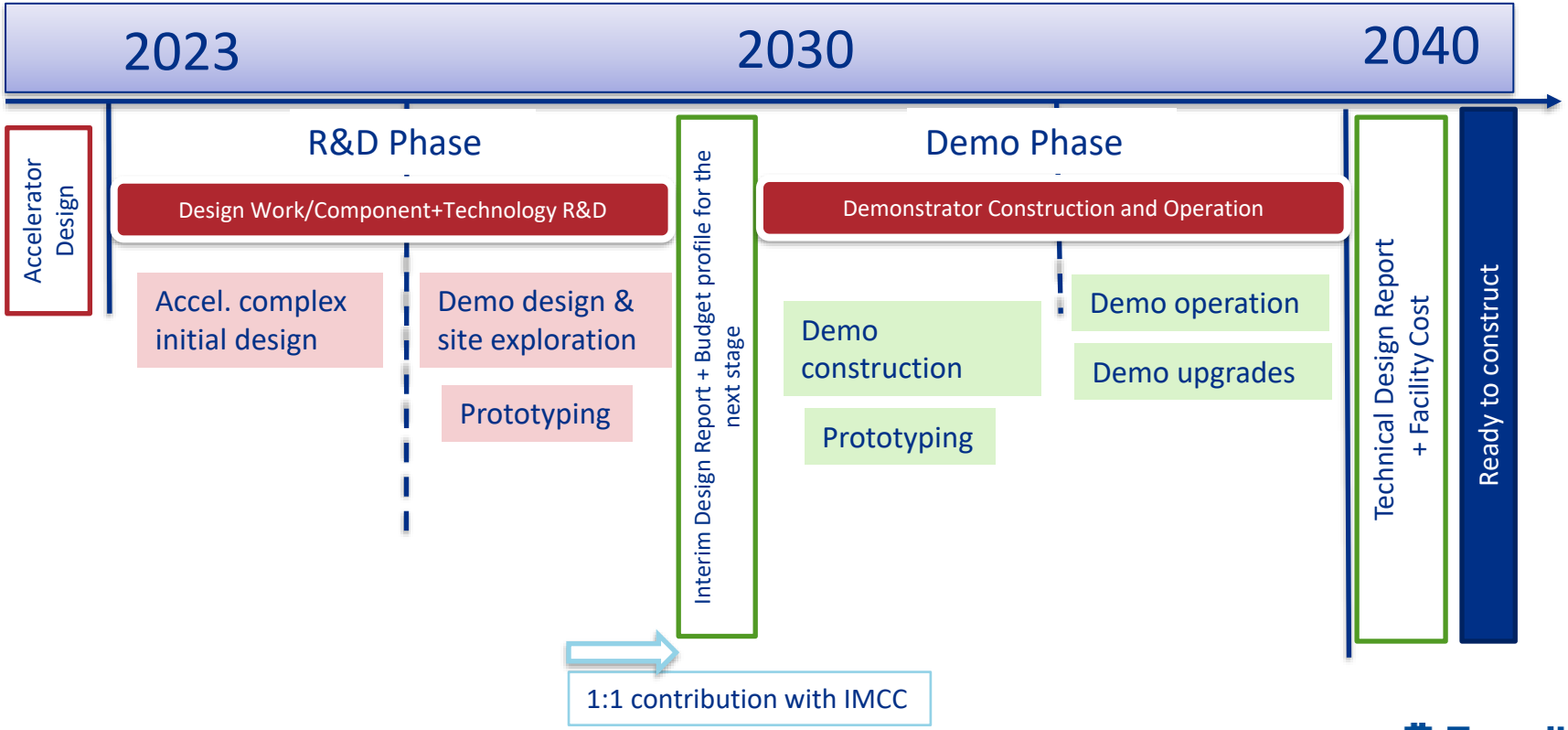
Sketch of US Timeline (accelerator)



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Areas of focus

Muon source group

- High power proton driver development (2-4 MW, 5-15 GeV, 5-15 Hz rep. rate)
- Bunch accumulation concept to "pack" ~10^{14} protons
- Bunch compressor concept for ~ 2 ns proton bunches

Machine design group

- Target system capable of managing large instant power
- Shielding system for capture magnet & target surrounds protection
- Cooling design to deliver the baseline emittance goal
- Accelerator design for TeV-scale energies

RF systems group

- High-gradient NC RF cavities within multi-T B-fields
- High-gradient SC cavities robust to beam loading

Magnets group

- Large bore, high field magnet for muon capture
- High field (30+ T) magnets for cooling
- Fast ramping magnets (few T on a ms scale) for acceleration
- Large bore dipole magnets at high-fields (16 T) for collider
- High-field (16+ T) final focus quadrupoles

ALL groups

- Think about what expertise and capabilities the US have in order to address the MuC needs
- Use your experience and expertise to define what work is required and how it get accomplished among interested US national labs/universities
- Think about synergies with other programs
- What scope of international participation (IMCC) is required, and what is the status of these arrangements?

What are we asking (1):

- Each Focus Area to provide budget profile for 2024-2030:
  - What is the scope and deliverable? What is the schedule?
  - Line up a plan on how this can get accomplished among interested US institutions
  - Profile of FTE needs per year
  - Profile of M&S needs per year
  - Note synergies with e+e-, pp, any other experiment
- How do you anticipate international participation to develop over time?

Focus Group	Topic	Deliverable	Define plan	Synergies	2024 FTE	2024 M&S	2025 FTE	2025 M&S
Muon Source	1.1							
	1.2							
	1.3							
Design	2.1							
	2.2							
	2.3							
Magnets	3.1							
	3.2							
	3.3							
RF systems	4.1							
	4.2							
	4.3							

Shared link for the document will be provided

What are we asking (2):

- Each Focus Area to provide envelope for 2031-2035 period 2036-2040:
  - List of to-do items and deliverables
  - An envelope of total FTE and M&S

Focus Group	Topic	Deliverable	2031-2035 Total FTE	2031-2035 M&S	2036-2040 Total FTE	2036-2040 M&S
Muon Source	1.1					
	1.2					
	1.3					
Design	2.1					
	2.2					
	2.3					
Magnets	3.1					
	3.2					
	3.3					
RF systems	4.1					
	4.2					
	4.3					

Shared link for the document will be provided

Timeline:

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

Proposed Timeline:

- Now – Apr 7th : Focus area coordinators contact interested groups and solicit input from Snowmass/Muon Collider Forum/ IMCC communities
- April 10th: Initial drafts of the tables to Diktys, Sergo and Sridhara
- **April 12-13th : Presentation to P5 (detector)**
- April 17th: Meeting to discuss and make necessary adjustments
- April 24th: Meeting to discuss and make necessary adjustments
- **May 3rd: Presentation to P5 (accelerator)**

Useful References

- Useful references for the accelerator effort:
  - MAP JINST paper collection: Link
  - High level accelerator subsystems overview: Link
  - Facility overview white paper: Link
  - Latest Muon Forum MuC accelerator workshop: Link
  - Muon Collider Forum Report: Link