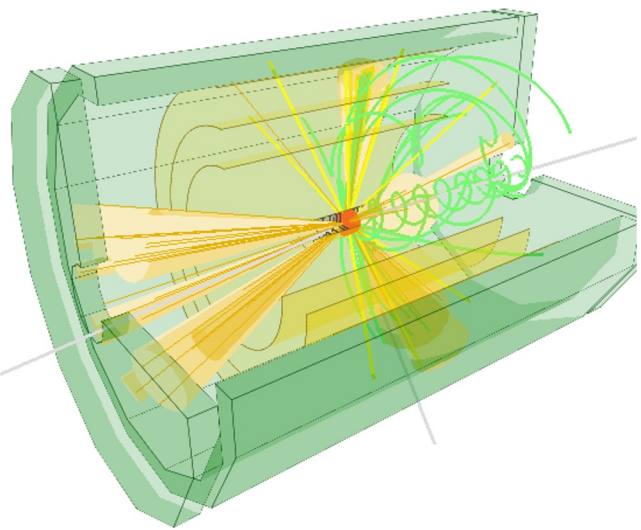
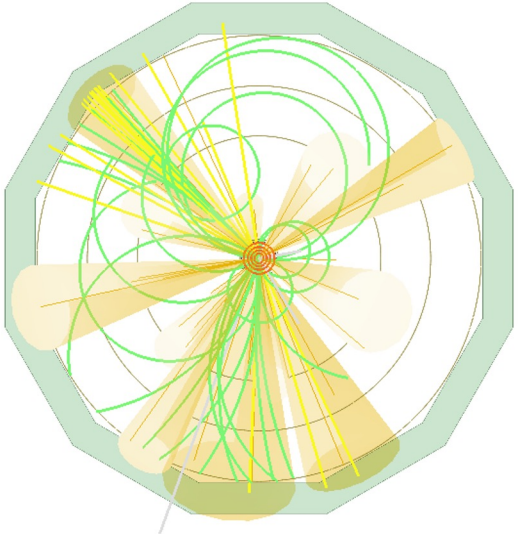
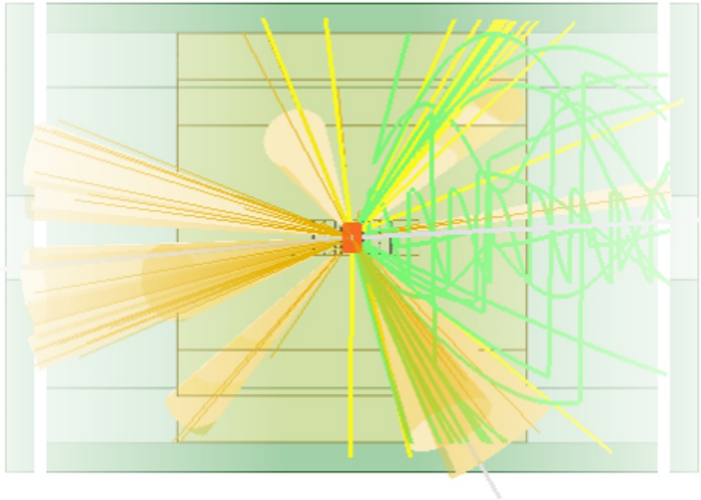






# Why are we here?

Sergo Jindariani (Fermilab)

Princeton Muon Collider Workshop

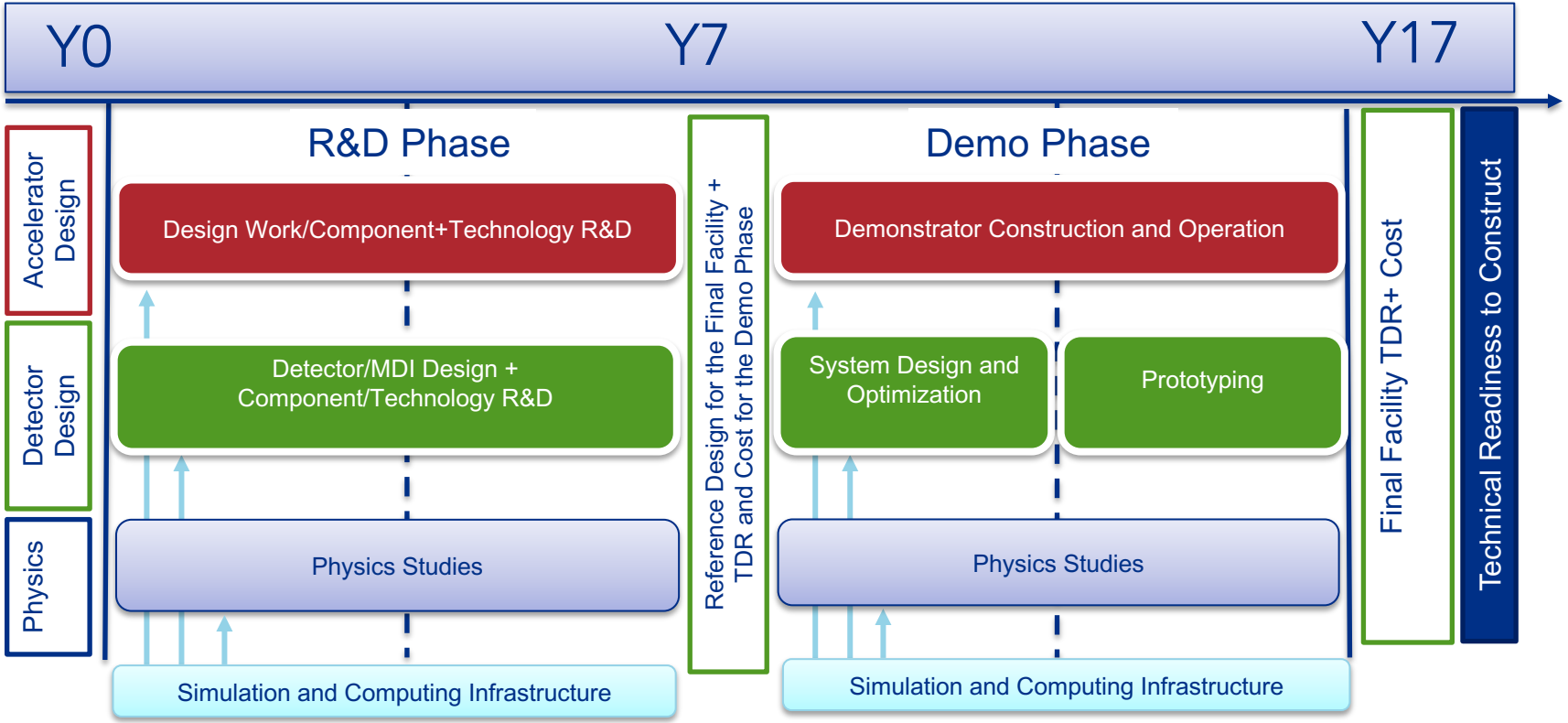
February 2024

Thank you to Princeton for hosting this meeting!

# Reminder of Snowmass and pre-P5 events:

- AF+EF+TF Cross-frontier Muon Collider Forum Report :
  - 180 authors: **arXiv:2209.01318, published in special issue of JINST**
  - Includes work from 40+ White papers and prior work by MAP etc
  - **Conclusions**: No fundamental showstoppers identified, but many engineering challenges exist, requiring a significant R&D investment and development cycle
- Muon Collider R&D Coordination Panel for P5:
  - Produced R&D planning document, submitted to P5
  - R&D needs (labor and M&S) for both accelerator and detector, timeline and major milestones
  - The document is not public but can be shared upon request

# US Muon Collider R&D timeline submitted to P5



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# Excerpts from the P5 report

- The proposed program aligns **with the long-term ambition of hosting a major international collider facility in the US, leading the global effort** to understand the fundamental nature of the universe.

- In particular, **a muon collider** presents an attractive option both for technological innovation and for bringing energy frontier colliders back to the US.

- The footprint of a **10 TeV pCM muon collider is almost exactly the size of the Fermilab campus.**

- Although **we do not know if a muon collider is ultimately feasible**, the road toward it leads from current Fermilab strengths and capabilities to **a series of proton beam improvements and neutrino beam facilities**, . . . .
- At the end of the path is an unparalleled global facility on US soil.

# Excerpts from the P5 report

- Support **vigorous R&D toward a cost-effective 10 TeV pCM collider** based on proton, muon, or possible wakefield technologies, including an evaluation of options for US siting of such a machine, with a goal of being ready to build **major test facilities and demonstrator facilities within the next 10 years**
- Enhance research in **theory** to propel innovation, maximize scientific impact of investments in experiments, and expand our understanding of the universe
- Conduct **R&D** efforts to define and enable new projects in the next decade, including detectors for an $e^+e^-$ Higgs factory and 10 TeV pCM collider
- Develop plans for improving the **Fermilab accelerator complex** that are consistent with the long-term vision of this report, including neutrinos, flavor, and a 10 TeV pCM collider

# P5: Collider Panel

- Convene **a targeted panel** with broad membership across particle physics later this decade that makes **decisions on the US accelerator-based program** at the time when major decisions concerning an off-shore Higgs factory are expected, and/or significant adjustments within the accelerator-based R&D portfolio are likely to be needed. A plan for the Fermilab accelerator complex consistent with the long-term vision in this report should also be reviewed.
- The panel would consider the following:
  - The level and nature of **US contribution in a specific Higgs factory** including an evaluation of the associated schedule, budget, and risks once crucial information becomes available.
  - Mid- and **large-scale test and demonstrator facilities** in the accelerator and collider R&D portfolios.
  - A plan for the evolution of the **Fermilab accelerator complex** consistent with the longterm vision in this report, which may commence construction in the event of a more favorable budget situation.

# IMCC Status and Plans

- International Muon Collider Collaboration established in 2020
  - Hosted by CERN, about 40-50 FTE, funding from CERN, EU, INFN, UK etc
  - Representation from the US on the Steering Board, Coordination Committee, and International Advisory Board
  - Work based mostly on MAP concepts with improvements to the design and and more recently some engineering studies
  - P5 supported collaboration with IMCC! Some US institutions joined IMCC, exploring possibility of having an addendum to the DOE-CERN collaborative agreement to enable national labs to join the effort too
- IMCC Interim Report draft expected release in March – generally aligned with Snowmass and US planning, but some design features will have to be revisited for US siting
- IMCC Annual Meeting is next month, expect some discussions of integration of US effort. **But we in the US need to decide how we want in structured.**

# Why US Muon Collider Collaboration?

- Facilitate collaborative work, communication and coordination across involved US institutions (particularly important while no dedicated DOE funding)
- Preparation and planning for deliverables for the Collider Panel (~ 5 years) and the next P5 (~10 years)
- Conduct work related to studies of domestic sitings
- Reduced dependence on regional budgetary and geopolitical considerations

- Provide forum for discussions when facing major strategic decisions etc
- Provide interfaces to IMCC in international discussions and negotiations
- Plan and organize US events

# US Organization

- **For this meeting, discuss and possibly agree on:**
  - The Collaboration's role and structure
  - Collaboration model with IMCC
  - Collaboration model with other interested institutions (e.g. from Canada, Latin America, etc)

# R&D Priorities

- Per P5, should expect a Collider Panel review for proceeding to major demonstration work on the timescale of 5 years  - will require making progress and preparation
- Critical to identify priorities and agree on what can be done with the current budget climate – physics, accelerator and detector work (including software)
- According to DOE, dedicated funding will not be available until FY26, and even then there will be a ramp-up. Must be creative with small pots of money.
- Important to coordinate to minimize unnecessary overlaps domestically and internationally

# Priorities

- **For this meeting, discuss and possibly agree on:**
  - Initial set of priorities and deliverables for the next 3-5 years (but in the context of a longer R&D program) and how this fits with ongoing IMCC/MuCol work
  - Potential funding sources – LDRD, portions of GARD, KA25, others?
  - Expertise is limited, how to grow and foster the community

# Agenda

**Welcome to Princeton** — *Isobel Ojalvo*
*Princeton University* 12:30 - 12:45

**Goals for the workshop** — *Sergo Jindariani*
*Princeton University* 12:45 - 13:00

13:00

**The US effort towards making a Muon Collider** — *Diktys Stratakis*
*Princeton University* 13:00 - 13:30

**Fermilab accelerator evolution and plans** — *Alexander Valishev*
*Princeton University* 13:30 - 14:00

14:00

**Coffee Break**
*Princeton University* 14:00 - 14:30

**Discussion: US organization** — *Sridhara Dasu*
*Princeton University* 14:30 - 15:30

15:00

16:00

**Princeton Colloquium: Muon Collider** — *Mark Palmer*
*Princeton University* 16:00 - 17:00

17:00

09:00

**Target and capture R&D needs and priorities for the next 3-5 years** — *Katsuya Yonehara*
*Princeton University* 09:00 - 09:30

**Magnet R&D needs and priorities for the next 3-5 years** — *Steve Gourlay*
*Princeton University* 09:30 - 10:00

10:00

**SRF and NCRF R&D needs and priorities for the next 3-5 years** — *Sergey Belomestnykh et al.*
*Princeton University* 10:00 - 10:30

**Coffee Break**
*Princeton University* 10:30 - 11:00

11:00

**Ionization cooling prototyping and demonstrator program.** — *Scott Berg*
*Princeton University* 11:00 - 11:30

**SNS accelerator synergies for Muon Collider R&D** — *Austin Hoover*
*Princeton University* 11:30 - 12:00

12:00

**Discussion of Accelerator R&D Priorities**
*Princeton University* 12:00 - 13:00

14:00

**Physics Benchmarks for next 3-5 years** — *Nathaniel Craig et al.*
*Princeton University* 14:00 - 14:30

**Detector status, challenges and requirements** — *Karri diPetrillo*
*Princeton University* 14:30 - 15:00

15:00

**Software and computing tools, needs in the next 3-5 years** — *Simone Pagan Griso*
*Princeton University* 15:00 - 15:30

**Discussion**
*Princeton University* 15:30 - 16:00

16:00

**Coffee Break**
*Princeton University* 16:00 - 16:30

**Tracker R&D directions, needs in the next 3-5 years** — *Timon Heim (tbc)*
*Princeton University* 16:30 - 17:00

17:00

**Calorimeter R&D directions, needs in the next 3-5 years** — *Chris Tully*
*Princeton University* 17:00 - 17:30

**Discussion** — *Tova Holmes*
*Princeton University* 17:30 - 18:00

18:00

**Wrap up and next steps**
*Princeton University* 18:00 - 18:20



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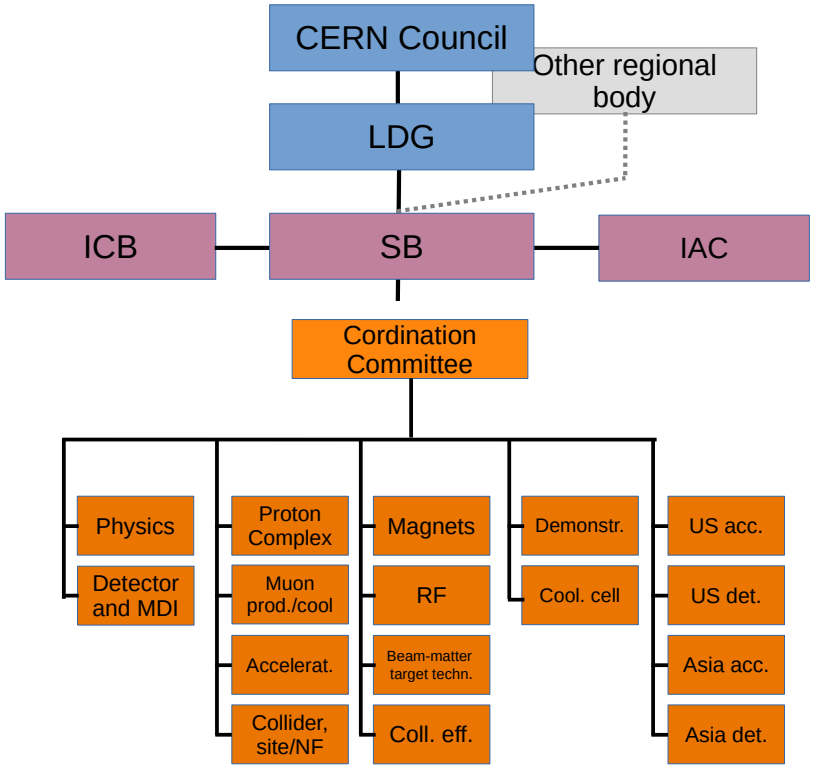
# Saturday Morning

- Saturday morning is reserved for the organizers to produce a summary report
- The report will be shared with the participants after the workshop

# Backup

# IMCC Organization



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