

Mu2e-II Workshop (ix) Introduction

Frank Porter
July 21, 2021
DocDB-nnnnn

This meeting will be recorded

Mu2e-II workshops

Recent past workshops

For earlier workshops, see the Mu2e-II calendar at:

https://mu2eii-internal-wiki.fnal.gov/wiki/Main_Page#Calendar

Workshop dates	Links to recordings
Wednesday, September 23 https://indico.fnal.gov/event/45632/	https://caltech.zoom.us/rec/play/xbOzK448M0VhhDArf9UE8AjiOKdshh4et0tYOOhtViPn3qv_eG95CkQUOHQ0_SzeJ8pxVzw5M0PolvjD.l-zdhaNXvu3i5SII?autoplay=true&startTime=1600873315000
Wednesday, October 28 https://indico.fnal.gov/event/45937/	https://caltech.zoom.us/rec/share/zCGxa2uJwAKwONXm7pyiqrrLPJvixTaNHkY2cxHRDjtm_bmWOYqraV8D9ynUMATk.JNeSkLhSj4-Hfcof
Wednesday, December 9 https://indico.fnal.gov/event/46433/	https://caltech.zoom.us/rec/share/xXVV4YURBMeRsnF0GLQSGAPv-FJ466HNnTGze3VeiAoooyUcRSU7cP16QBwlvNPv.XvSqSC_JVmuSKVA9
Wednesday, March 3 https://indico.fnal.gov/event/47787/	https://caltech.zoom.us/rec/share/po6RL9ZZL27yeF8sjUZ9Wk9xcBw_wqm-TYgRmSNjn6yUYBE5mnb5Myza-ez2k3tFV.deUj8dQcDWOVSqAU
Wednesday, April 28, 2021 https://indico.fnal.gov/event/48516/	https://caltech.zoom.us/rec/share/NM_b0LyWSJopNa_YAu9LXmfjJ0_5XrCmjXkmfwCoqj9VtBqVFKeA0N4pouLDKGMz.1f96W6EOVkyUsnT4

Mu2e-II collaboration/author list

- Please respond (to fcpc@caltech.edu)
 - Philosophy is people need to sign on
 - So please send me an email if you haven't already
 - Also, please check that I got your information right!
- I will make sure anyone on the list is also on the Mu2e-II email list
 - That is: mu2eii@listserv.fnal.gov
 - The email list is a superset of the collaboration list
- Collaboration/author list is available from the internal Mu2e-II wiki page
 - https://mu2eii-internal-wiki.fnal.gov/wiki/Main_Page#Mu2e-II_Collaboration_and_Author_list
- Also directly accessible with link
 - <https://caltech.app.box.com/file/793439425745?s=gkidbcqykvhrmfnl85rfct3z6ybhfqb>

Mu2e-II collaboration/author list, page 1

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Mu2e-II Working Groups

Email convenors if you wish to participate
Anyone can subscribe to email lists

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Andrei Gaponenko, FNAL

Vadim Kashikhin, FNAL

Kevin Lynch, CUNY

James Popp, CUNY

Diktys Stratakis, FNAL

- Accelerator meetings every other Thursday, 1PM CT. Next meeting July 29, 2021 (TBC)
- TBD, 2021 (10-12 CT): AF2/AF5/AF7/RP/NP target workshop (contact: Eric Prebys)
<https://indico.fnal.gov/event/46752/>

Radiation simulation and mitigation

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Tracker meetings every two weeks on Tuesdays 12AM CT
Next meeting August 3, 2021 (TBC)

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Cole Kampa, Northwestern

Manolis Kargiantoulakis, FNAL

Michael MacKenzie, Northwestern

Snowmass 22 Schedule

Rare Processes & Precision Measurements Frontier

The rare processes and precision measurements frontier plans to pause activities until the end of August

- Will be about three “heartbeat” status meetings among the topical group conveners in that time but no workshops
 - CLFV coffee hours
 - Most recently, May 28, 10AM CT (tau CLFV), see: <https://indico.fnal.gov/event/49178/>
 - Generic discussion on approaches to improve theoretical calculations for muon conversion and decays
- Community members should pursue their individual physics interests as they wish
- At the end of August, will resume activities again with a schedule to be determined
- Plan to postpone Frontier meeting by one year to around May 2022

Mu2e-II Snowmass Schedule

March 15, 2022 deadline for submission of Mu2e-II contribution to arXiv

That is, we need to be “done” in eight months!

- This will serve as the input to the Topical Group Convenors
 - Their deadline for preliminary reports is May 31, 2022
- Mu2e-II aim for a “good first draft: by February 1, 2022

Outline and framework on Overleaf (read link):

<https://www.overleaf.com/read/mrbgttkmfgvq>

(let me know if you need edit link)

Mu2e-II talks

- If you plan to submit an abstract or give a Mu2e-II talk, or are invited to give such a talk, please
 - Email [Kevin Lynch](#) and [Frank Porter](#)
 - If you have an invitation, please email us even if you do not wish to accept – we may be able to suggest someone else
- Fermilab requirements – writeups
 - Acknowledgment should usually include:
 - This document was prepared by members of the Mu2e-II Collaboration using the resources of the Fermi National Accelerator Laboratory (Fermilab), a U.S. Department of Energy, Office of Science, HEP User Facility. Fermilab is managed by Fermi Research Alliance, LLC (FRA), acting under Contract No. DE-AC02-07CH11359.
 - Fermilab preprint number
 - <https://mu2e-docdb.fnal.gov/cgi-bin/private/ShowDocument?docid=4083>
- With byline, include:
 - “For the Mu2e-II Collaboration”
 - Optionally as applicable; “For the <appropriate group name> working group of the Mu2e-II Collaboration”

Mu2e-II talks – Material for Speakers

- Have added a “Materials for Speakers” section to the public Mu2e-II Wiki https://mu2eiiwiki.fnal.gov/wiki/Material_for_speakers
- Resource of “Blessed” material
- Please use while preparing Mu2e-II talks
 - Work in progress
 - Suggestions for additional material
 - Corrections
 - Removal of obsolete material

Mu2e-II Communication

- Public wiki page: <https://mu2eiiwiki.fnal.gov>
 - Please email Lisa or Frank if you wish to have write access
- Private wiki page:
https://mu2eii-internal-wiki.fnal.gov/wiki/Main_Page
 - SSO log-on
 - May need to contact Lisa or Frank to request access
 - This page has the Mu2e-II calendar with links to zoom, indico, etc.
- Mu2e-II mailing list: mu2eii@listserv.fnal.gov
- Mu2e-II Slack channel link:
 - <https://Caltech-tka1525.slack.com>

Mu2e-II Calendar

- On main page of **private** Wiki
https://mu2eii-internal-wiki.fnal.gov/wiki/Main_Page

Have added events back to 2020, so a “complete” resource for links to our meetings and external talks.

- Let me know if something is missing, or feel free to edit yourself

July 2021

Su		Tu	We	Th	Fr	Sa
				1	2	3
4	5	6 Tracker	7 Tracker workshop - postponed	8 Accelerator	9 DPF practice	10
11	12 Convenors; DPF meeting start	13	14	15 Accelerator	16	17
18	19	20 Tracker	21 Mu2e-II workshop	22	23	24
25	26	27	28	29 Accelerator	30	31

Clicking on date provides details of events for that day

Main Page/2021-07-21

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- 1 Mu2e-II Snowmass22 Workshop (ix)
 - 1.1 DocDB entry
 - 1.2 Indico page with agenda and talks
 - 1.3 Zoom link
 - 1.4 Meeting recording

Mu2e-II Snowmass22 Workshop (ix) [edit]

Wednesday, July 21, 2021, 10AM to 2PM CT

DocDB entry [edit]

<https://mu2e-docdb.fnal.gov/cgi-bin/sso/DisplayMeeting?conferenceid=11444>

Indico page with agenda and talks [edit]

<https://indico.fnal.gov/event/49360/>

Zoom link [edit]

Frank C. Porter is inviting you to a scheduled Zoom meeting.

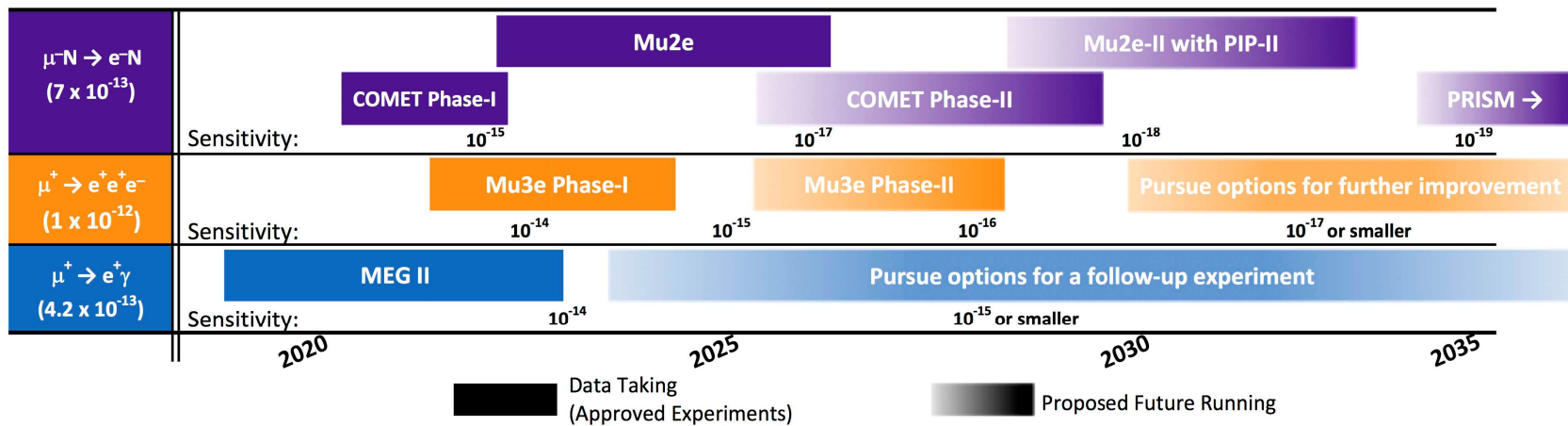
Topic: Mu2e-II Snowmass21 Workshop (ix) Time: Jul 21, 2021 10:00 AM Central Time (US and Canada)

Join Zoom Meeting <https://caltech.zoom.us/j/82754823698>

Thinking about “when”

View from 2020 European Strategy Physics input on CLFV

<https://arxiv.org/pdf/1812.06540.pdf>

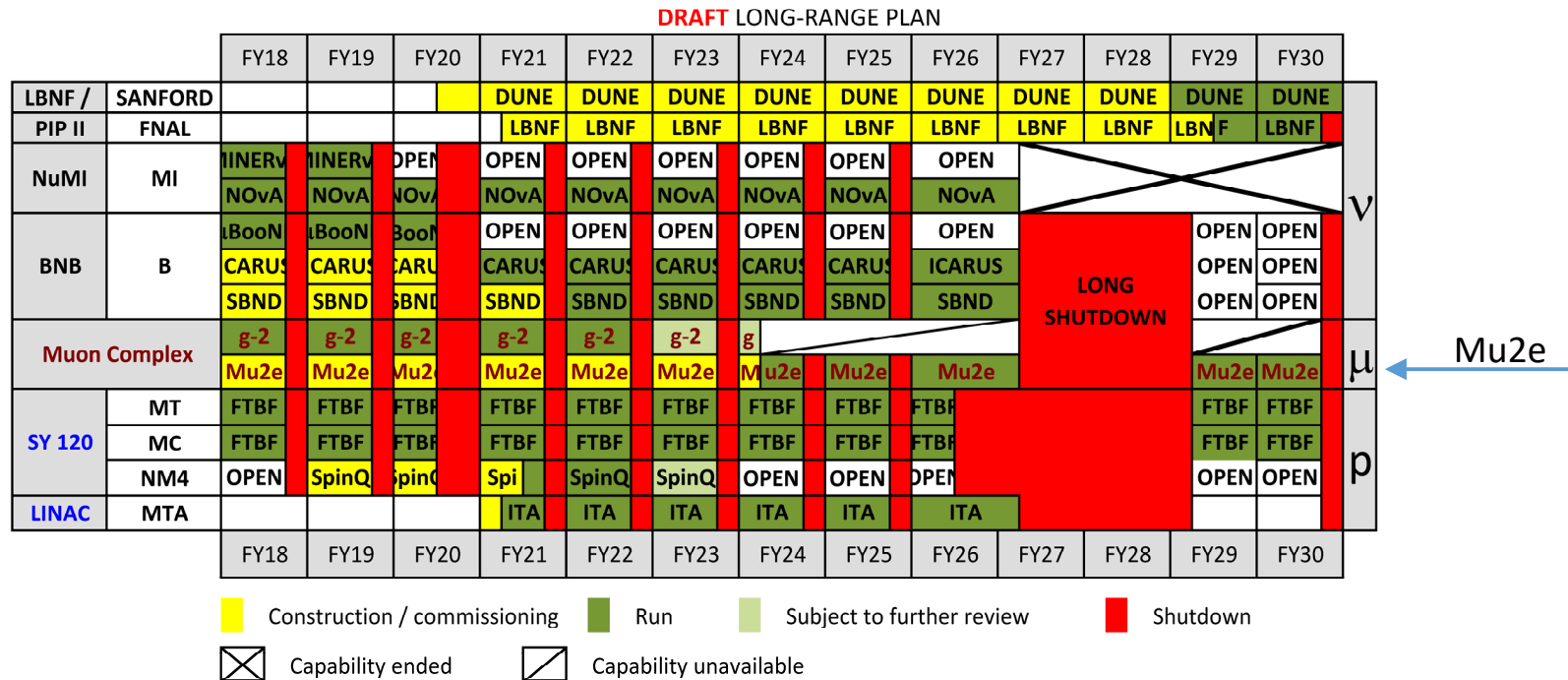


- Nice overview, but already wrong when it appeared (not only for Mu2e)
- Latest Mu2e is “Project Complete” April 2024 (R.Ray, DocDB-38699)

Thinking about “when”

FNAL draft long-range plan (Jan 2021, excluding accompanying notes)

<https://ppp-docdb.fnal.gov/cgi-bin/sso/RetrieveFile?docid=724&filename=10yr-PLAN-Current.pdf>



Shows Mu2e running until end of FY30

Shows PIP-II operation beginning mid FY29 (PIP-II CD4 December 2028)

Thinking about “when”

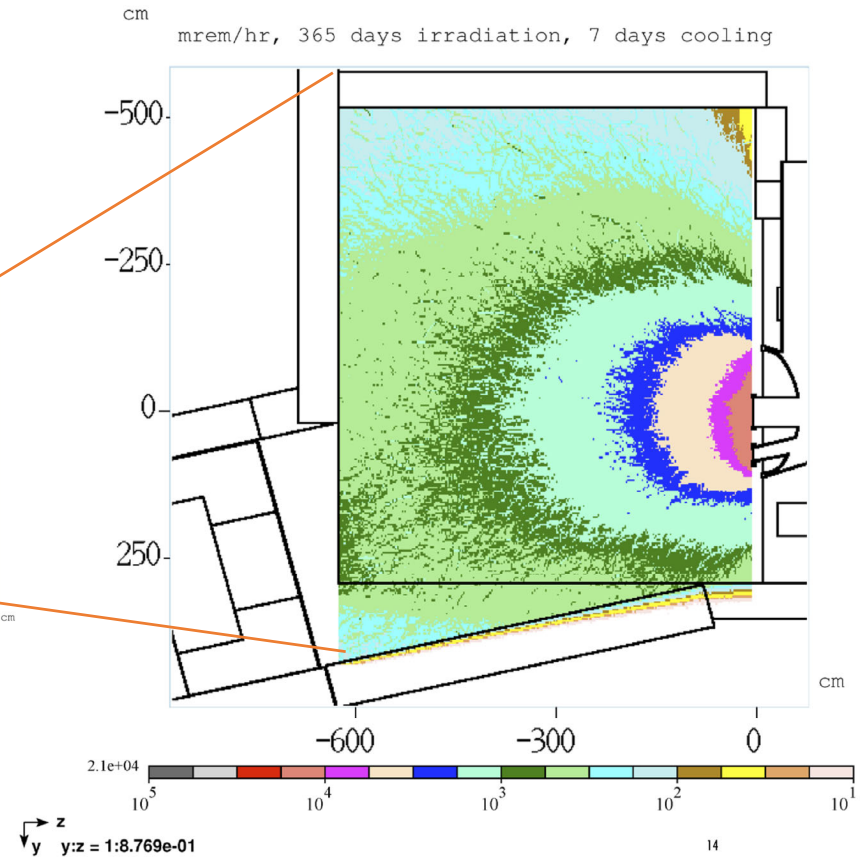
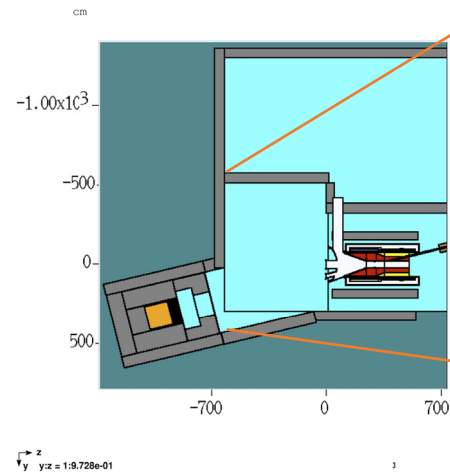
If Mu2e runs until end of 2030, when does Mu2e-II run?

- Mu2e experience useful to have in designing Mu2e-II
- Significant construction could happen in parallel with Mu2e run, long shutdown
- Major installation cannot begin until Mu2e is complete
 - Except perhaps portions of beamline from PIP-II
- Sticky question: When/how can work happen in PS area?
 - Residual radiation

Thinking about “when”

Residual dose at production solenoid

- 365 days irradiation
- 8 GeV
- 8 kW
- after 1 week cooldown
- mid-plane of PS



Hottest point in this region: 21 rem/hr

DocDB-5629 (Leveling)

See also:

<https://www.sciencedirect.com/science/article/abs/pii/S0168900217309415> (FermiCORD paper)

July 21 Mu2e-II workshop agenda

[Indico timetable at: https://indico.fnal.gov/event/49380/](https://indico.fnal.gov/event/49380/)

When (CT)	Who	What
10:00-10:25	Frank Porter	Introduction
15	Craig Dukes	Cosmic ray veto
15	Antonio/Giani	TDAQ
25	Mary Anne Cummings	Alternate beam delivery
25	Eric Prebys	Accelerator – Proton economics
15	David Hitlin	Calorimeter
12:00-12:30	All	Break
20	Vitaly Pronskikh	Radiation studies
25	Yuri Oksuzian	Sensitivity
25	Julian Heeck	Theory
20	Daniel Ambrose	Tracker
14:00	All	End

Additional Material

Mu2e-II Working Groups

Mu2e-II working groups	Convenors
Theory mu2eii-theory@fnal.gov	Lorenzo Calibbi Julian Heeck
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CRV mu2eii-crv@listserv.fnal.gov	Craig Dukes Yuri Oksuzian
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Muon stops

Quantity	Mu2e	Mu2e-II (nominal)	Units
Stopped μ /POT	1.5×10^{-3} (37571)*	8.9×10^{-5} (37571)	
Beam kinetic energy	8000	800	MeV
Beam power	8	100	kW
POT (3 yr)	3.6×10^{20} (12014)	4.5×10^{22}	
Stopped μ	5.4×10^{17}	4.0×10^{18}	
SES	3.7×10^{-17} (12014)*		

numbers in () are DocDB references

POT = Protons On Target
SES = Single Event Sensitivity

$$\text{POT} = 3 \text{ yr} \times 1.92 \times 10^7 \text{ (s/yr)} \times \text{power(W)} / \text{Ebeam(J)}$$

*DocDB 7464 says 0.00187 stopped μ /POT (corresponds to SES 3×10^{-17});
SES here is scaled from this using 0.0015 stopped μ /POT

$$\text{Stopped } \mu \text{(Mu2e-II)} / \text{Stopped } \mu \text{(Mu2e)} = 40 / 5.4 = 7.4$$

Muon stops

This means that for a SES of 10x better than Mu2e, or $SES = 3.7 \times 10^{-18}$, the beam power should be 135 kW

In other words,

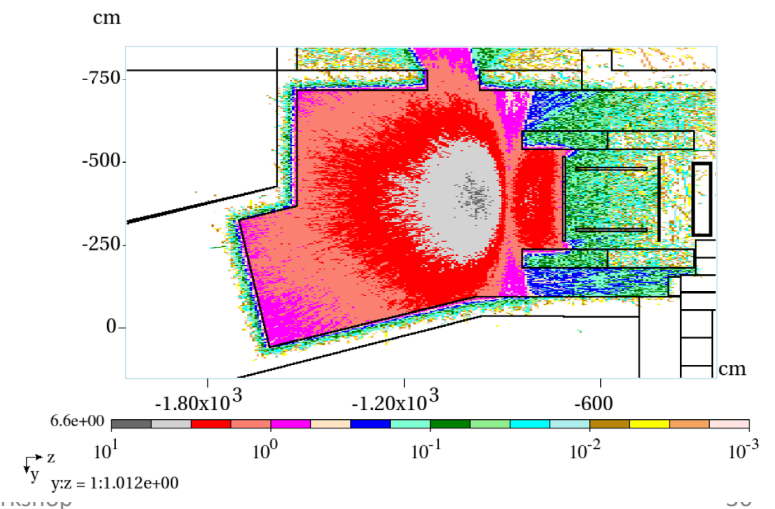
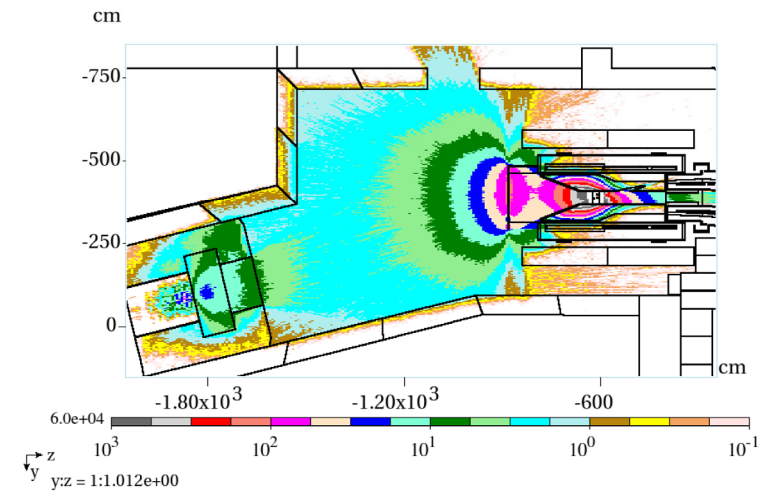
$$SES(\text{Mu2e-II}) = 5 \times 10^{-18} \times \frac{100 \text{ kW}}{P}$$

(We assume the efficiency to observe a conversion electron is the same in Mu2e-II as in Mu2e)

Comment: These are early results and will change!

Thinking about “when”

<https://www.sciencedirect.com/science/article/abs/pii/S0168900217309415>



7/21/2021

F. Porter - Mu2e Snowmass21 workshop

Snowmass 22 Planning – “covid pause”

January Snowmass newsletter:

https://indico.fnal.gov/event/47394/attachments/139229/175180/Snowmass_Newsletter_Jan.2021.pdf

<https://snowmass21.org/announcements>

- **High-level activities on hold until the end of June 2021**
 - Includes Frontier-level and Topical Group-level workshops, All-conveners meetings, Advisory Group meetings and Newsletters.
- **Other Topical Group and cross-frontier activities paused or reduced to a significantly lower level, proceeding only as necessary to ensure:**
 - scientific continuity
 - meet essential programmatic needs
 - maintain collaborative work with other units and communities
- No critical decisions will be made during the hiatus
- No individuals obligated to participate in these activities
- **Individual, collaborative and self-organized work can continue at the discretion of the individuals involved**

Snowmass 22 - Endgame Schedule

- **White Paper submission to arXiv: no later than March 15, 2022**
 - Late submissions and updates unlikely to be incorporated in the working group reports
- Preliminary reports by the Topical Groups due: no later than May 31, 2022
- Preliminary reports by the Frontiers due: no later than June 30, 2022
- Snowmass Community Summer Study (CSS): July 2022 at UW-Seattle
- Final reports by Frontiers due: no later than September 30, 2022
- Snowmass Book and on-line archive documents due: October 31, 2022

Contributed Paper – Proposed Top Level Outline

- I. Overview
 - II. Theory
 - III. Accelerator and beam line
 - IV. Production target and environment
 - V. Solenoids
 - VI. Radiation
 - VII. Tracking
 - VIII. Calorimetry
 - IX. Cosmic ray veto
 - X. Trigger and Data Acquisition
 - XI. Physics sensitivity
- References

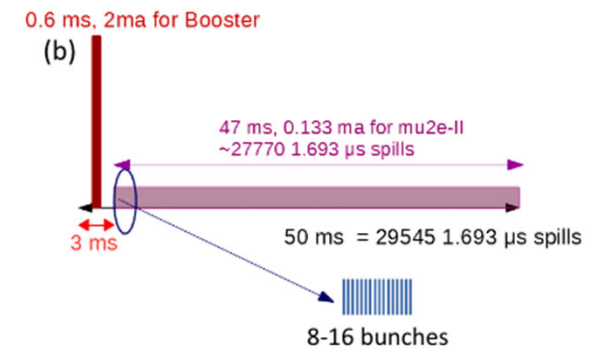
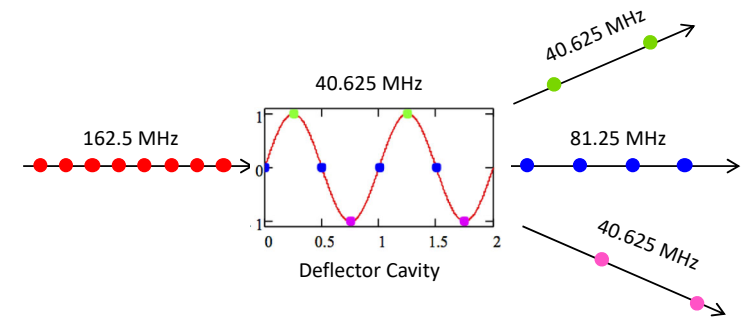
Proposed Mu2e-II beam nomenclature

- Follow accelerator group usage
- Beam delivery is different than Mu2e

Quantity	Name
Beam in one PIP-II RF bucket (162.5 MHz)	Bunch
PIP-II pulse (20 Hz/0.55 ms)	Pulse (but see below)*
Mu2e-II repetition (e.g., 1693 ns)	Spill (also pulse, but see above)**
Set of bunches in one spill (e.g., 8)	Burst (also pulse, but see above)**

*One PIP-II pulse is about 27770 Mu2e-II spills; suggest saying “PIP-II pulse” to avoid confusion.

**“Pulse” may be used when distinction is not important



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<https://indico.fnal.gov/event/44997/>

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