

Mu2e-II Workshop (viii) - Introduction

Frank Porter
April 28, 2021
DocDB-38007

This meeting will be recorded

Mu2e-II workshops

Recent and present 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/_xbOzK448M0VhhDARf9UE8AjiOKdshh4et0tYOOhtViPn3qveG95CkQUOHQ0_SzeJ8pxVzw5M0PolvjD.I-zdhaNXvu3i5SII?autoplay=true&startTime=1600873315000
Wednesday, October 28 https://indico.fnal.gov/event/45937/	https://caltech.zoom.us/rec/share/zCGxa2uJwAKwONXm7pyiqrrLPJvIxTaNHkY2cxHRDjtmbmWOYqraV8D9ynUMATk.JNeSkLhSj4-Hfcof
Wednesday, December 9 https://indico.fnal.gov/event/46433/	https://caltech.zoom.us/rec/share/xXVV4YURBMeRsnFOGLQSGAPv-FJ466HNnTGze3VeiAoooyUcRSU7cP16QBwlvNPv.XvSqSC_JVmuSKVA9
Wednesday, March 3 https://indico.fnal.gov/event/47787/	https://caltech.zoom.us/rec/share/po6RL9ZZL27yeF8sjUZ9Wk9xcBw_wqm-TYgRmSNjn6yUYBE5mmb5Myza-ez2k3tFV.deUj8dQcDWOVSqAU
Wednesday, April 28, 2021 https://indico.fnal.gov/event/48516/	https://caltech.zoom.us/rec/share/NM_b0LyWSJopNa_YAu9LXmfjJ05XrCmjXkmfwCoqj9VtBqVfKeA0N4pouLDKGMz.1f96W6EOVkyUsnT4

Mu2e-II collaboration/author list

Mu2e-II Collaboration list							
Sequence	Name	Email	Institution	Address	Name on author list	in Mu2e-II mailing list	in white paper
1	Daniel Ambrose	ambr0028@unm.edu	University of Minnesota	Minneapolis, Minnesota 55455, USA	D. Ambrose	y	
2	A. Artikov	akram@jinr.ru	Joint Institute for Nuclear Research	Dubna, Russia 141980	A. Artikov	y	
3	N. Atanov	atanov@jinr.ru	Joint Institute for Nuclear Research	Dubna, Russia 141980	N. Atanov	y	
4	Richard Bonventre	rbonventre@lbl.gov	Lawrence Berkeley National Laboratory	Berkeley, California 94720, USA	R. Bonventre	y	
5	David Norvil Brown	david.brown@louisville.edu	University of Louisville	Louisville, Kentucky 40292, USA	D. N. Brown	y	
6	Myron Campbell	myron@umich.edu	University of Michigan	Ann Arbor, Michigan 48109, USA	M. Campbell	y	
7	Brendan Casey	bck.casey@gmail.com	Fermi National Accelerator Laboratory	Batavia, Illinois 60510, USA	B.C.K. Casey	y	
8	Raymond L. Culbertson	rlc@fnal.gov	Fermi National Accelerator Laboratory	Batavia, Illinois 60510, USA	R. Culbertson	y	
9	Mary Anne Cummins	macc@fnal.gov	Muons Inc.	Batavia, Illinois 60510, USA	M. A. C. Cummings	y	
10	Yu.I. Davydov	davydov@jinr.ru	Joint Institute for Nuclear Research	Dubna, Russia 141980	Yu.I. Davydov	y	
11	Sergei Denisov	sergey.denisov@ihep.ru	NRC Kurchatov Institute, IHEP	142281, Protvino, Moscow region, Russia	S. Denisov	y	
12	(Edmond) Craig Duke	ecd3m@virginia.edu	University of Virginia, Charlottesville	Virginia 22904, USA	E. C. Dukes	y	
13	Bertrand Echenard	echenard@caltech.edu	California Institute of Technology	Pasadena, CA 91125	B. Echenard	y	
14	Valery Evdokimov	valery.evdokimov@ihep.ru	NRC Kurchatov Institute, IHEP	142281, Protvino, Moscow region, Russia	V. Evdokimov	y	
15	Andrei Gaponenko	gandr@fnal.gov	Fermi National Accelerator Laboratory	Batavia, Illinois 60510, USA	A. Gaponenko	y	
16	Antonio Gioiosa	antonio.gioiosa@df.unipi.it	Università di Pisa; INFN Sezione di Pisa	I-56127 Pisa, Italy	A. Gioiosa	y	
17	Simona Giovannella	simona.giovannella@lnf.infn.it	Laboratori Nazionali di Frascati dell'INFN	I-00044 Frascati, Italy	S. Giovannella	y	
18	V. Glagolev	viglagolev@jinr.ru	Joint Institute for Nuclear Research	Dubna, Russia 141980	V. Glagolev	y	
19	Hank Glass	glass@fnal.gov	Fermi National Accelerator Laboratory	Batavia, Illinois 60510, USA	H. D. Glass	y	
20	Douglas A Glenzinski	douglasg@fnal.gov	Fermi National Accelerator Laboratory	Batavia, Illinois 60510, USA	D. A. Glenzinski	y	
21	Lisa Goodenough	goodenou@fnal.gov	Fermi National Accelerator Laboratory	Batavia, Illinois 60510, USA	L. Goodenough	y	
22	Robert Craig Group	rcg6p@virginia.edu	University of Virginia, Charlottesville	Virginia 22904, USA	R. G. Group	y	
23	Julian Heeck	heck@virginia.edu	University of Virginia, Charlottesville	Virginia 22904, USA	J. Heeck	y	
24	Ken Heller	heller@umn.edu	University of Minnesota	Minneapolis, Minnesota 55455, USA	K. Heller	y	
25	(James) A. Hocker	hocker@fnal.gov	Fermi National Accelerator Laboratory	Batavia, Illinois 60510, USA	A. Hocker	y	
26	(Timothy) Matthew Jones	mjones105@purdue.edu	Purdue University	West Lafayette, Indiana, 47907, USA	M. Jones	y	
27	Cole Kampa	colekampa2024@u.northwestern.edu	Northwestern University	Evanston, Illinois 60208, USA	C. Kampa	y	
28	Vadim Kashikhin	vadim@fnal.gov	Fermi National Accelerator Laboratory	Batavia, Illinois 60510, USA	V. Kashikhin	y	
29	Yury Kolomensky	ygkolomensky@lbl.gov	University of California, Lawrence Berkeley National Laboratory	Berkeley, California 94720, USA	Yu. G. Kolomensky	y	
30	Alexander Kozelov	alexander.kozelov@gmail.com	NRC Kurchatov Institute, IHEP	142281, Protvino, Moscow region, Russia	A. Kozelov	y	
31	Robert K. Kutschke	kutschke@fnal.gov	Fermi National Accelerator Laboratory	Batavia, Illinois 60510, USA	R. K. Kutschke	y	
32	Mark Lancaster	mark.lancaster@manchester.ac.uk	University of Manchester	Manchester, M13 9PL, UK	M. Lancaster	y	
33	Kevin Lynch	klynch@york.cuny.edu	York College and the Graduate Center, The City University of New York	New York, New York 11451, USA	K. Lynch	y	
34	Michael Mackenzie	michaelmackenzie@u.northwestern.edu	Northwestern University	Evanston, Illinois 60208, USA	M. Mackenzie	y	

Partial
snapshot!
see next slide for
link to actual list

Mu2e-II collaboration/author list

- Please respond (to fcpc@caltech.edu)
 - I think most of you will want to be on this list
 - But I don't want to make that assumption and get it wrong
 - 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 will be 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=gkidbcqykvhrmfnl85rfct3z6ybhftqb>

Mu2e-II Working Groups

Mu2e-II working groups	Convenors
Theory mu2eii-theory@fnal.gov	Lorenzo Calibbi Julian Heeck
Accelerator (including PS, production target, extinction) mu2e-ii-accelerator@fnal.gov	Karie Badgley David Neuffer Eric Prebys
Radiation mitigation (includes radiation simulation) mu2eii-radiation@fnal.gov	Michael MacKenzie Stefan Mueller Vitaly Pronskikh
Tracker mu2eii-tracker@fnal.gov	Daniel Ambrose Giovanni Tassielli
Calorimeter (and STM?) mu2eii-calorimeter@listserv.fnal.gov	David Hitlin Luca Morescalchi Ivano Sarra
CRV mu2eii-crv@listserv.fnal.gov	Craig Dukes Yuri Oksuzian
Sensitivity estimate (includes simulation, stopping target) mu2e-ii-sensitivity@listserv.fnal.gov	Lisa Goodenough Sophie Middleton Yuri Oksuzian
Trigger and DAQ mu2eii-tdaq@listserv.fnal.gov	Antonio Gioiosa Giani Pezzullo

Accelerator

Karie Badgley, Convenor, FNAL

David Neuffer, Convenor, FNAL

Eric Prebys, Convenor, UCD

Mary Anne Cummings, Muons, Inc.

Keegan Harrig, UCD

Andrei Gaponenko, FNAL

Vadim Kashikhin, FNAL

Kevin Lynch, CUNY

James Popp, CUNY

Diktys Stratakis, FNAL

- 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

Michael MacKenzie, Convenor, Northwestern

Stefan Mueller, Convenor, HZDR

Vitaly Pronskikh, Convenor, FNAL

Anna Ferrari, Reuven Rachamin, HZDR

Vadim Kashikhin, FNAL

James Popp, CUNY

David Pushka, FNAL

Yuri Oksuzian – CRV

Sophie Middleton – Sensitivity

Giani Pezzullo - TDAQ

Theory

Lorenzo Calibbi, Convenor, Nankai U

Julian Heeck, Convenor, UVa

Robert Szafron, BNL

Yuichi Uesaka, Kyushu Sangyo University

Tracker

Daniel Ambrose, Convenor, UMinn

Giovanni Tassielli, Convenor, INFN Lecce

David Brown, LBNL

Brendan Casey, FNAL

Manolis Kargiantoulakis, FNAL

James Popp, CUNY

Mete Yucel, FNAL

Tracker meetings every two weeks on Tuesdays 12AM CT

Next meeting May 11, 2021 (TBC)

Calorimeter

David Hitlin, Convenor, Caltech

Luca Morescalchi, Convenor, INFN Pisa

Ivano Sarra, Convenor, LNF

Leo Borrell, Bertrand Echenard, Dexu Lin, Sophie Middleton,
James Oyang, Frank Porter, Liyuan Zhang, Renyuan Zhu, Caltech

Eleonora Diociaiuti, Raffaella Donghia, Simona Giovannella,
Fabio Happacher, Stefano Miscetti, LNF

Stefano Di Falco, Simone Donati, Antonio Gioiosa, Elena
Pedreschi, Franco Spinella, INFN Pisa

Cosmic Ray Veto

Craig Dukes, Convenor, Uva

Yuri Oksuzian, Convenor, ANL

Karen Byrum, Simon Corrodi, Peter Winter, Lei Xia, ANL

Raymond Culbertson, Gary Drake, Anna Pla-Dalmau, Greg Rakness, FNAL

Akram Artikov, Yuri Davydov, JINR, Dubna

Timothy Bolton, Glenn Horton-Smith, Yurii Maravin, Kres Neely, KSU

Gerald Blazey, Kurt Francis, Sergey Uzunyan, Vishnu Zutshi, NIU

Merrill Jenkins, U South Alabama

Steven Boi, Ralf Ehrlich, Stephen Goadhouse, Craig Group, UVa

Trigger/DAQ

Antonio Gioiosa, Convenor, INFN Pisa

Gianantonio Pezzullo, Convenor, Yale

Richard Bonventre, LBNL

Rebecca Chislett, UCL, [Tracker](#)

Raffaella Donghia, LNF

Bertrand Echenard, Caltech

Ryan Rivera, FNAL

Franco Spinella, INFN Pisa – [Calorimeter](#)

Craig Dukes, UVa - [CRV](#)

Sensitivity estimates

Lisa Goodenough, Convenor, FNAL

Sophie Middleton, Convenor, Caltech

Yuri Oksuzian, Convenor, ANL

Rebecca Chislett, UCL

Michael Hedges, Purdue

Cole Kampa, Northwestern

Manolis Kargiantoulakis, FNAL

Michael MacKenzie, Northwestern

Snowmass 22 RP Frontier 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 hour
 - Next one is tomorrow, April 29, 10AM CT, see: <https://indico.fnal.gov/event/48815/>
 - 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

- 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>

Edit link

<https://www.overleaf.com/1119452243cbyxyrdrwjzh>

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

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

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

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

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!

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>
- Propose with byline:
 - “For the Mu2e-II Collaboration”
 - Optionally as applicable; “For the <appropriate group name> working group of the Mu2e-II Collaboration”

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 invite link:
 - https://join.slack.com/t/caltech-tka1525/shared_invite/zt-glsr3405-OondWg0KCpBoUJwlr2uyJw

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 now a “complete” resource for links to our meetings and external talks.

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

April 2021

Su	Mo	Tu	We	Th	Fr	Sa
				1	2	3
4	5 Convenors - postponed	6	7	8	9	10
11	12 Convenors	13 Tracker	14	15	16	17
18	19	20	21	22	23	24
25	26	27 Tracker	28 Workshop	29 CLFV coffee	30	

Clicking on date provides details of events for that day

Main Page/2021-04-28

Contents [hide]

- 1 [Mu2e-II Workshop](#)
 - 1.1 [DocDB entry](#)
 - 1.2 [Indico page with agenda and talks](#)
 - 1.3 [Zoom coordinates](#)

Mu2e-II Workshop [edit]

Wednesday, April 28, 2021 10AM to 2PM CT

DocDB entry [edit]

<https://mu2e-docdb.fnal.gov/cgi-bin/sso/DisplayMeeting?conferenceid=11055>

Indico page with agenda and talks [edit]

<https://indico.fnal.gov/event/48516/>

Zoom coordinates [edit]

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

Topic: Mu2e-II Snowmass21 Workshop (viii) Time: Apr 28, 2021 10:00 AM Central Time (US and Canada)

Join Zoom Meeting <https://caltech.zoom.us/j/87946370101>

Meeting ID: 879 4637 0101 One tap mobile +16699006833,,87946370101# US (San Jose) +12133388477,

Workshop: “Potential Fermilab Muon Campus & Storage Ring Experiments”

24-27 May 2021

<https://indico.fnal.gov/event/48469/>

“This workshop provides a venue for exploring ideas to build **short-, medium-, and long-term muon- and non-muon-based** experiments that will have a **small incremental cost on top of existing infrastructure** investments. The goal of this workshop is to promote the development of proposals for the Fermilab PAC review process and current Snowmass exercise.”



Workshop: “Potential Fermilab Muon Campus & Storage Ring Experiments”

24-27 May 2021

- Day 1: Muon $g-2$ negative muon running and dedicated EDM session
- Day 2: Storage ring experiments session
- Day 3: Muon campus experiments session (including **Mu2e-II** and PIP-II upgrades)
- Day 4: Submitted abstracts

Mu2e-II has been invited to give a talk at this workshop

- includes an update on Mu2e
- Perhaps 30 minutes
- Speaker TBD

April 28 Mu2e-II workshop agenda

Indico timetable at: <https://indico.fnal.gov/event/48516/>

When (CT)	Who	What
10:00-10:25	Frank Porter	Introduction
10:25-10:50	Stefan Mueller	Radiation studies
10:50-11:25	Eduard Pozdeyev	PIP-II
11:25-11:35	Eric Prebys/Karie Badgley/David Neuffer	Accelerator - brief report
11:35-11:45	Dan Ambrose	Tracker – brief report
11:45-11:55	David Hitlin	Calorimeter Readout – brief report
11:55-12:30	All	Break
12:30-12:40	Antonio Gioiosa/Giani Pezzullo	TDAQ – brief report
12:40-13:00	Sophie Middleton	Sensitivity – stopping targets
13:00-13:35	Matthew Jones	Extinction monitor
13:35-13:55	Robert Szafron	Theory - DIOs
14:00	All	End

Additional Material

Mu2e-II workshops

Next workshop on Wednesday, April 28, 2021

10AM to 2PM CT

<https://indico.fnal.gov/event/48516/>

Snowmass 22 Planning – “covid pause”

January Snowmass newsletter:

[https://indico.fnal.gov/event/47394/attachments/139229/175180/Snowmass Newsletter Jan.2021.pdf](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

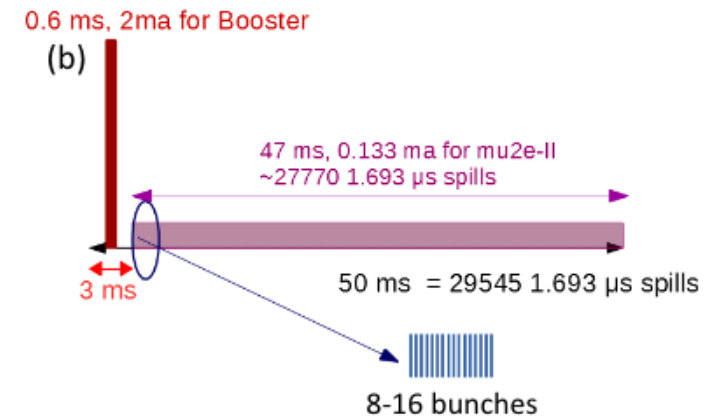
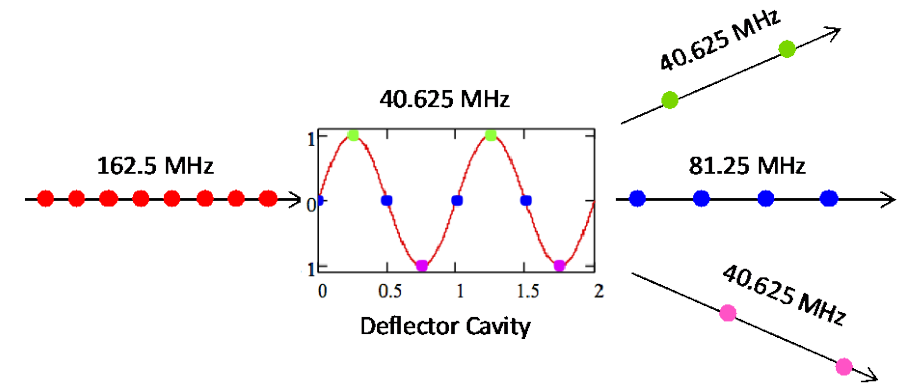
Proposed Mu2e-II beam nomenclature

- 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



Eric Prebys

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

David Neuffer, DocDB 33896

Mu2e-II Snowmass21 Committee

Name	Institution	Email
Dan Ambrose	U Minn	ambrose0028@gmail.com
Rebecca Chislett	UC London	rebecca.chislett@ucl.ac.uk
Lisa Goodenough	FNAL	goodenou@fnal.gov
Julian Heeck	U Virginia	julian.heeck@gmail.com
David Neuffer	FNAL	neuffer@fnal.gov
Yuri Oksuzian	ANL	yoksuzian@anl.gov
Frank Porter (chair)	Caltech	fcp@caltech.edu
Giovanni Tassielli	INFN-Lecce	giovani.tassielli@le.infn.it
Robert Bernstein (ex officio)	FNAL	rhbob@fnal.gov
Jim Miller (ex officio)	Boston U	miller@bu.edu

Calendar

Wiki already has a calendar of Mu2e-II workshops:

- https://mu2eiiwiki.fnal.gov/wiki/Calendar_of_Workshops

Also, Rare frontier has a calendar:

- https://snowmass21.org/rare/start#calendar_of_meetings

Proposing to provide an editable Mu2e-II calendar on the private Wiki page

- Working group meetings and workshops
- Ad hoc working meetings
- Convenor meetings
- Committee meetings
- Related Snowmass21 events
- Include links to Zoom, agendas