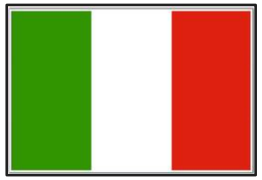
Mu2e Progress, Status & Schedule

Jim Miller (Boston University), On behalf of the Mu2e Collaboration

Mu2e Collaboration

Over 200 Scientists from 38 Institutions
(Increase from 160 in 2015, 6 new institutes)

Argonne National Laboratory, Boston University, University of California Berkeley, University of California Irvine, California Institute of Technology, City University of New York, Joint Institute of Nuclear Research Dubna, Duke University, Fermi National Accelerator Laboratory, Laboratori Nazionale di Frascati, University of Houston, Helmholtz-Zentrum Dresden-Rossendorf, INFN Genova, Institute for High Energy Physics, Protvino, Kansas State University, Lawrence Berkeley National Laboratory, INFN Lecce, University Marconi Rome, Lewis University, University of Liverpool, University College London, University of Louisville, University of Manchester, University of Michigan, University of Minnesota, Muon Inc., Northwestern University, Institute for Nuclear Research Moscow, INFN Pisa, Northern Illinois University, Purdue University, Rice University, Sun Yat-Sen University, University of South Alabama, Novosibirsk State University/Budker Institute of Nuclear Physics, University of Virginia, University of Washington, Yale University



Outline

- Introduction: What is Mu2e?
- Experimental Method
- Project Status
- Schedule

What is Mu2e?

- Precision search for neutrinoless conversion of a muon to an electron, where muon is bound in atomic orbit on aluminum

$$R_{\mu e} = \frac{\mu^- + {}^{27}_{13}Al \rightarrow e^- + {}^{27}_{13}Al}{\mu^- + {}^{27}_{13}Al \rightarrow \text{nuclear capture}}$$

- Example of Charged Lepton Flavor Violation (CLFV)
- Related but complementary to

  $\mu^+ \rightarrow e^+ + \gamma,\ \mu^+ \rightarrow e^+ + e^+ + e^-,\ \tau \rightarrow e + \gamma\ ,\ \tau \rightarrow \mu + \gamma,\ \tau \rightarrow 3e....$
- LFV is observed experimentally (neutrino oscillations), but so far CLFV has not been seen
- Mu2e sensitivity goal x10000 improvement over previous best measurement $\text{Single event sensitivity } R_{\mu e} = 3\times10^{-17}$

Mu2e Sensitivity to BSM Physics

- μ-e conversion impacts broad range of models

W. Altmannshofer, A.J.Buras, S.Gori, P.Paradisi, D.M.Straub

	AC	RVV2	AKM	δLL	FBMSSM	LHT	RS
$D^0 - \bar{D}^0$	★★★	★	★	★	★	★★★	?
ϵ_K	★	★★★	★★★	★	★	★★	★★★
$S_{\psi\phi}$	★★★	★★★	★★★	★	★	★★★	★★★
$S_{\phi K_S}$	★★★	★★	★	★★★	★★★	★	?
$A_{CP}(B \to X_s\gamma)$	★	★	★	★★★	★★★	★	?
$A_{7,8}(B \to K^*\mu^+\mu^-)$	★	★	★	★★★	★★★	★★	?
$A_9(B \to K^*\mu^+\mu^-)$	★	★	★	★	★	★	?
$B \to K^{(*)}\nu\bar{\nu}$	★	★	★	★	★	★	★
$B_s \to \mu^+\mu^-$	★★★	★★★	★★★	★★★	★★★	★	★
$K^+ \to \pi^+\nu\bar{\nu}$	★	★	★	★	★	★★★	★★★
$K_L \to \pi^0\nu\bar{\nu}$	★	★	★	★	★	★★★	★★★
$\mu \to e\gamma$	★★★	★★★	★★★	★★★	★★★	★★★	★★★
$\tau \to \mu\gamma$	★★★	★★★	★	★★★	★★★	★★★	★★★
$\mu + N \to e + N$	★★★	★★★	★★★	★★★	★★★	★★★	★★★
d_n	★★★	★★★	★★★	★★	★★★	★	★★★
d_e	★★★	★★★	★★	★	★★★	★	★★★
$(g-2)_\mu$	★★★	★★★	★★	★★★	★★★	★	?

Table 8: "DNA" of flavour physics effects for the most interesting observables in a selection of SUSY and non-SUSY models ★★★ signals large effects, ★★ visible but small effects and ★ implies that the given model does not predict sizable effects in that observable.

Mu2e Sensitivity to BSM Physics

- μ-e conversion impacts broad range of models
  - Three stars signals discovery potential
  - Sensitivity across the board

W. Altmannshofer, A.J.Buras, S.Gori, P.Paradisi, D.M.Straub

	AC	RVV2	AKM	δLL	FBMSSM	LHT	RS
$D^0 - \bar{D}^0$	★★★	★	★	★	★	★★★	?
ϵ_K	★	★★★	★★★	★	★	★★	★★★
$S_{\psi\phi}$	★★★	★★★	★★★	★	★	★★★	★★★
$S_{\phi K_S}$	★★★	★★	★	★★★	★★★	★	?
$A_{\rm CP}\,(B \to X_s\gamma)$	★	★	★	★★★	★★★	★	?
$A_{7,8}(B \to K^*\mu^+\mu^-)$	★	★	★	★★★	★★★	★★	?
$A_9(B \to K^*\mu^+\mu^-)$	★	★	★	★	★	★	?
$B \to K^{(*)}\nu\bar{\nu}$	★	★	★	★	★	★	★
$B_s \to \mu^+\mu^-$	★★★	★★★	★★★	★★★	★★★	★	★
$K^+ \to \pi^+\nu\bar{\nu}$	★	★	★	★	★	★★★	★★★
$K_L \to \pi^0\nu\bar{\nu}$	★	★	★	★	★	★★★	★★★
$\mu \to e\gamma$	★★★	★★★	★★★	★★★	★★★	★★★	★★★
$\tau \to \mu\gamma$	★★★	★★★	★	★★★	★★★	★★★	★★★
$\mu + N \to e + N$	★★★	★★★	★★★	★★★	★★★	★★★	★★★
d_n	★★★	★★★	★★★	★★	★★★	★	★★★
d_e	★★★	★★★	★★	★	★★★	★	★★★
$(g-2)_\mu$	★★★	★★★	★★	★★★	★★★	★	?

Table 8: "DNA" of flavour physics effects for the most interesting observables in a selection of SUSY and non-SUSY models ★★★ signals large effects, ★★ visible but small effects and ★ implies that the given model does not predict sizable effects in that observable.

Mu2e Sensitivity to BSM Physics

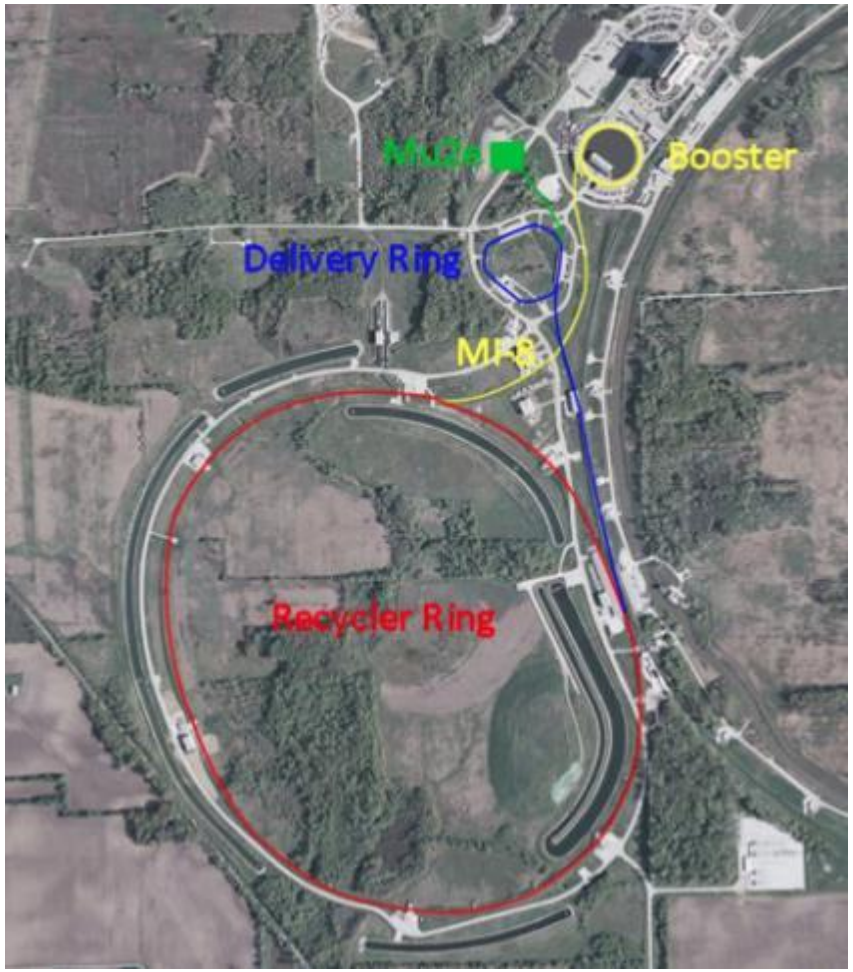
- Λ_{eff} ~ 10^3 – 10^4 TeV/c^2
  - Beyond the reach of accelerators
- The SM contribution is negligible: No SM background

W. Altmannshofer, A.J.Buras, S.Gori, P.Paradisi, D.M.Straub

	AC	RVV2	AKM	δLL	FBMSSM	LHT	RS
$D^0 - \bar{D}^0$	★★★	★	★	★	★	★★★	?
ϵ_K	★	★★★	★★★	★	★	★★	★★★
$S_{\psi\phi}$	★★★	★★★	★★★	★	★	★★★	★★★
$S_{\phi K_S}$	★★★	★★	★	★★★	★★★	★	?
$A_{CP}\,(B \to X_s\gamma)$	★	★	★	★★★	★★★	★	?
$A_{7,8}(B \to K^*\mu^+\mu^-)$	★	★	★	★★★	★★★	★★	?
$A_9(B \to K^*\mu^+\mu^-)$	★	★	★	★	★	★	?
$B \to K^{(*)}\nu\bar{\nu}$	★	★	★	★	★	★	★
$B_s \to \mu^+\mu^-$	★★★	★★★	★★★	★★★	★★★	★	★
$K^+ \to \pi^+\nu\bar{\nu}$	★	★	★	★	★	★★★	★★★
$K_L \to \pi^0\nu\bar{\nu}$	★	★	★	★	★	★★★	★★★
$\mu \to e\gamma$	★★★	★★★	★★★	★★★	★★★	★★★	★★★
$\tau \to \mu\gamma$	★★★	★★★	★	★★★	★★★	★★★	★★★
$\mu + N \to e + N$	★★★	★★★	★★★	★★★	★★★	★★★	★★★
d_n	★★★	★★★	★★★	★★	★★★	★	★★★
d_e	★★★	★★★	★★	★	★★★	★	★★★
$(g-2)_\mu$	★★★	★★★	★★	★★★	★★★	★	?

Table 8: "DNA" of flavour physics effects for the most interesting observables in a selection of SUSY and non-SUSY models ★★★ signals large effects, ★★ visible but small effects and ★ implies that the given model does not predict sizable effects in that observable.

Mu2e Proton Beam

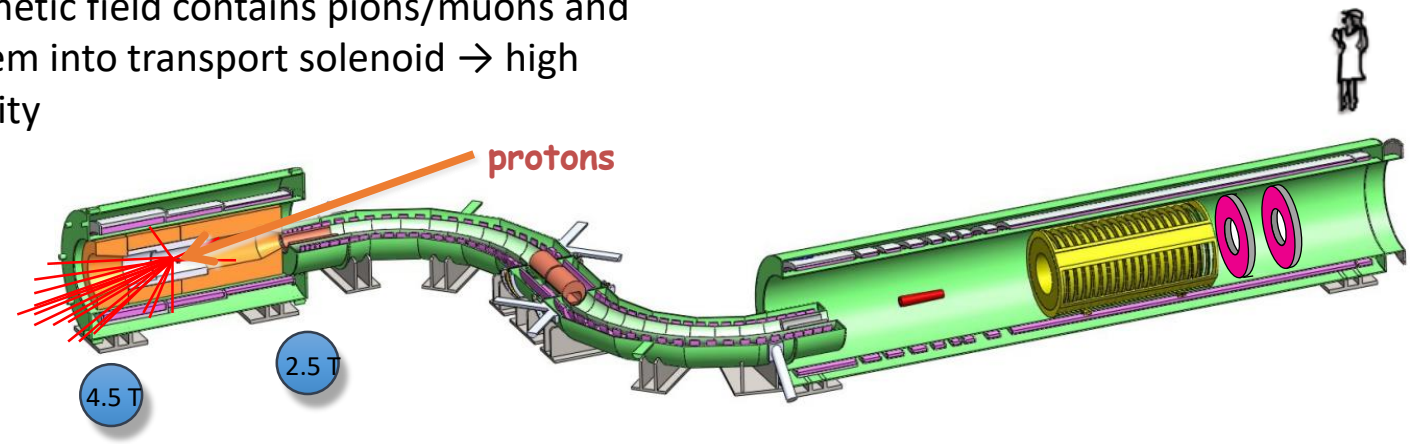


- Mu2e uses 8 GeV protons from Booster
- Mu2e and (g-2) repurposed much of the Tevatron anti-proton complex to deliver protons and muons
- Mu2e will run in parallel with neutrino program

Muon Experimental Concept

Production Target / Solenoid (PS)

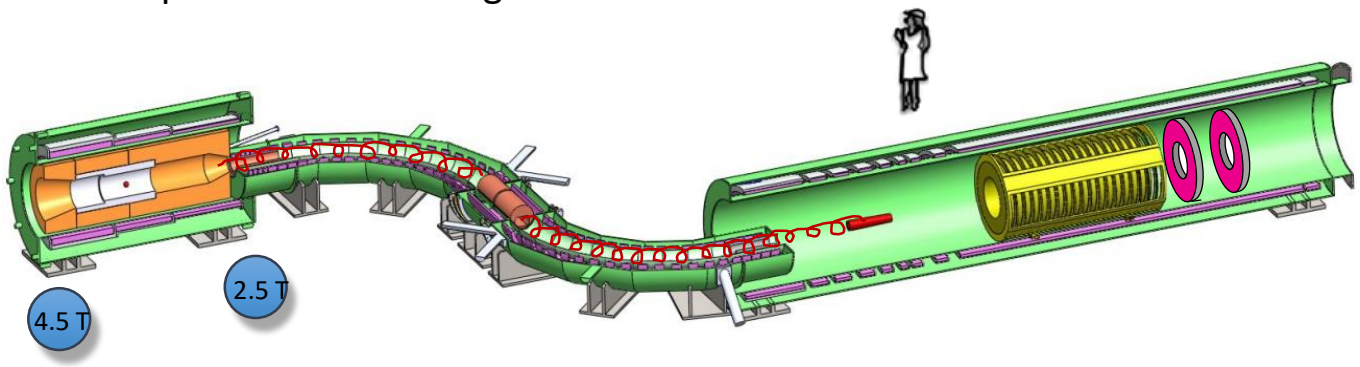
- Proton beam strikes target, producing mostly pions
- Graded magnetic field contains pions/muons and collimate them into transport solenoid → high muon intensity



Muon Experimental Apparatus

Production Target / Solenoid (PS)

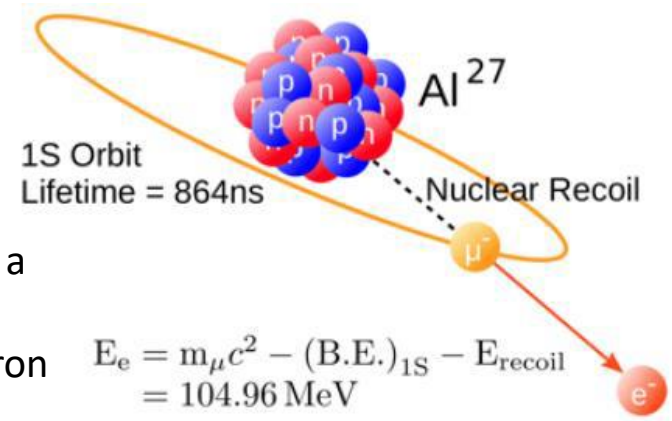
- Proton beam strikes target, producing mostly pions
- Graded magnetic field contains pions/muons and collimate them into transport solenoid → high muon intensity



Transport Solenoid (TS)

- Collimator selects low momentum, negative muons
- Antiproton absorber
- The S shape eliminates photons and neutrons

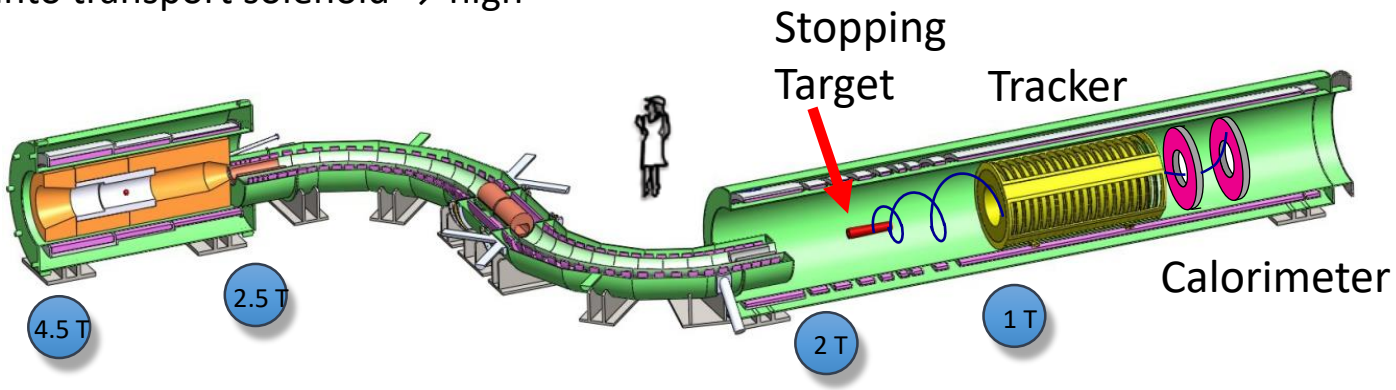
Muon Experimental Apparatus



Production Target / Solenoid (PS)

- Proton beam strikes target, producing mostly pions
- Graded magnetic field contains pions/muons and collimate them into transport solenoid → high muon intensity

Muon converts in the field of a nucleus that is left intact
Signal: Mono-energetic Electron



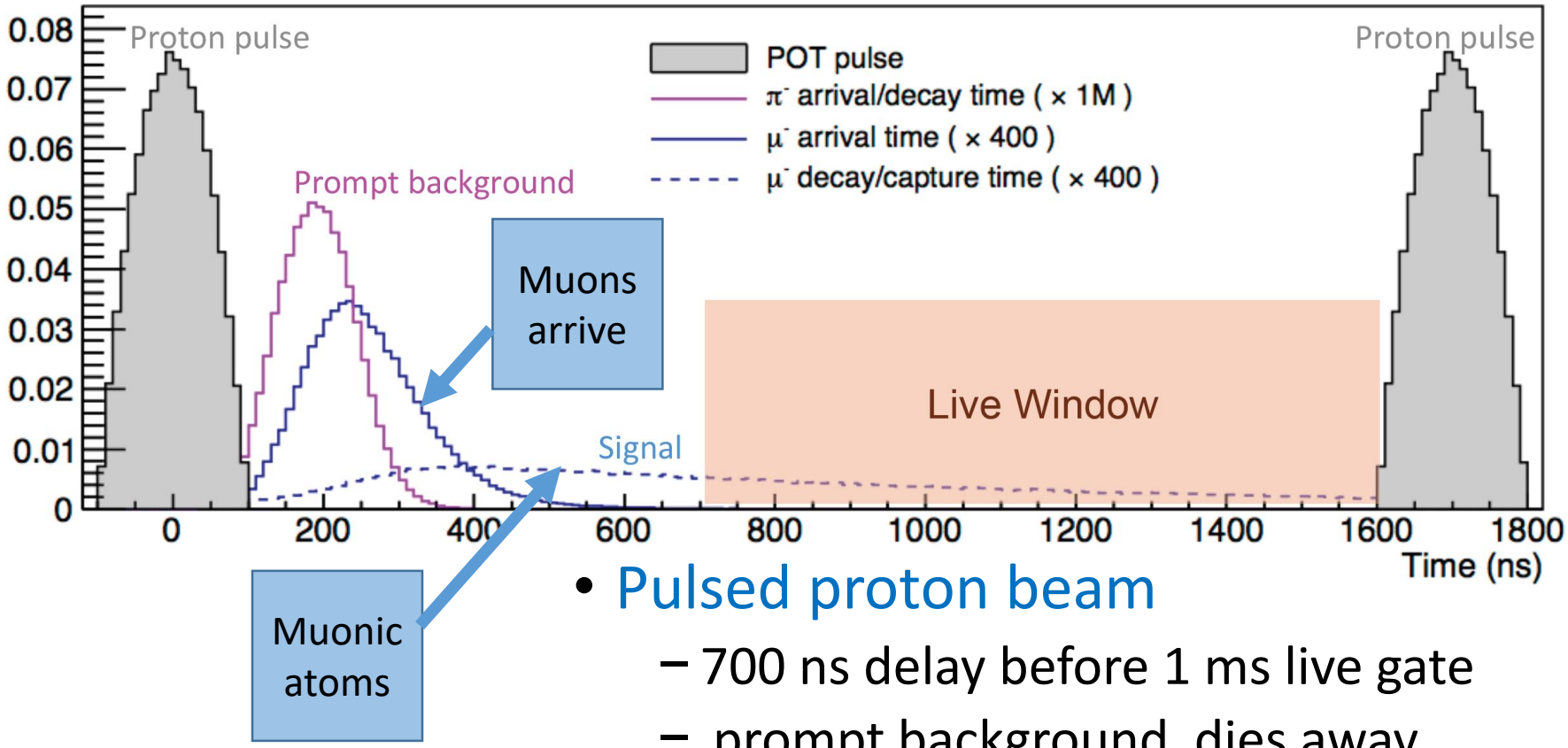
Transport Solenoid (TS)

- Collimator selects low momentum, negative muons
- Antiproton absorber
- The S shape eliminates photons and neutrons

Target, Detector and Solenoid (DS)

- Capture muons on Al target
- Measure momentum in tracker and energy in calorimeter
- Graded field “reflects” downstream conversion electrons emitted upstream, improving efficiency

Mu2e Beam Time Structure



- Pulsed proton beam
  - 700 ns delay before 1 ms live gate
  - prompt background dies away
- Extinction factor (rate of out-of-time protons) of 10^{-10} is required

Mu2e Key Advances

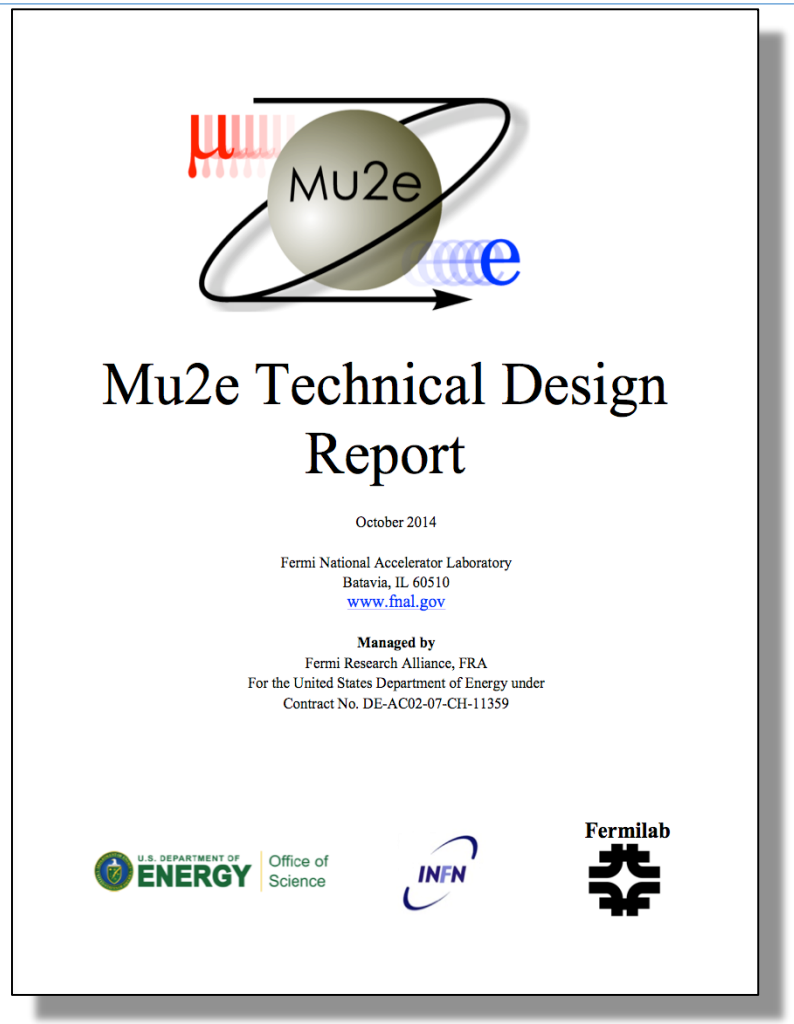
- Keys to x10000 better sensitivity
  - By placing our production target inside a high-field solenoid, we obtain a highly efficient low-E muon beam (0.002 stopped muons/proton)
    - The stopped rate ~ x100 increase over current beam lines
  - By using a pulsed proton beam we can suppress prompt backgrounds by employing a delayed live gate
    - Narrow proton pulses (~250 ns wide) every 1695 ns
    - Delay live gate for ~700 ns relative to arrival of protons
    - Achieves significant suppression of backgrounds from beam electrons and prompt pion interactions in the stopping target
    - Time structure is good match to muonic aluminum lifetime (864 ns)

Mu2e Project

- Mu2e Project scope is to design, construct, and install the Mu2e apparatus, to modify and upgrade the accelerator complex, build a new beam-line and a new detector hall
- TPC is $273.7M
- Project is 65% complete (versus 30% in 2015)
- Schedule float to CD-4: 16 months (versus 21 months in 2015)
- 34% ($28M) contingency relative to work remaining (Project started with 33%)

Mu2e CD Progress

- Technical Design Report completed arXiv:1501.05241
  - Oct. 2014, 888 pages, 621 figures
- Awarded CD-3a (June 2014)
  - Authorized purchase of superconductor in production lengths
- Awarded CD-2/3b (March 2015)
  - Project baseline at $273.7M
  - Authorized building start, TS coil fabrication
- CD-3 Awarded (July 2016)
  - Authorization for remaining construction



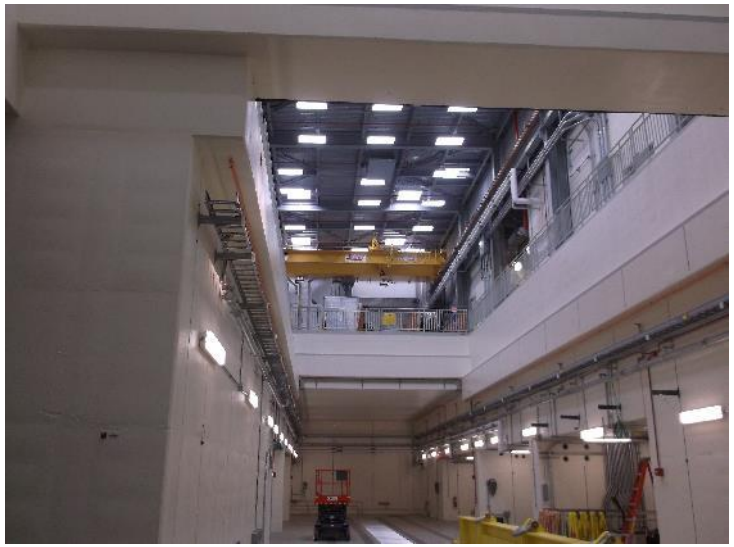
Mu2e Progress

- All major contracts in place
  - Completed Superconductor Procurement (75 km)
  - Completed Mu2e Building
  - Contract placed for TS Coil Modules
  - Contract placed for PS & DS
  - Contracts in place for Heat and Radiation Shield
  - Contracts placed for CsI Crystals
  - Contracts placed for major cryo infrastructure

PS Superconductor

Mu2e Status – Detector Hall

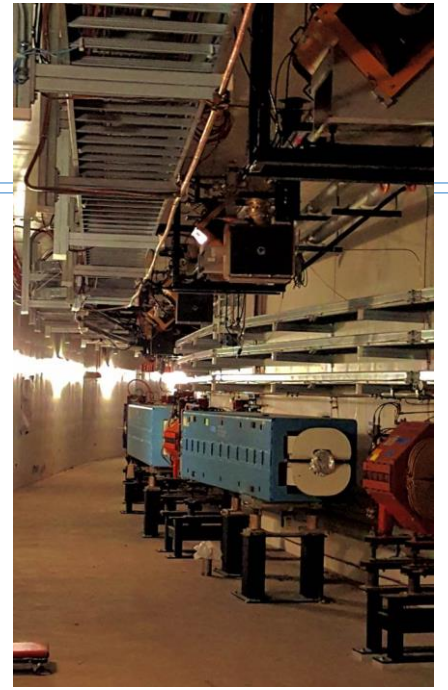
- Detector Hall Building
  - Broke Ground (April 2015)
  - Building Acceptance (March 2017)
- Infrastructure installation (on going)
  - LCW pipes
  - Bus bar
  - Cable Trays
  - Interlocks
  - Networking
  - DAQ infrastructure
  - Etc.



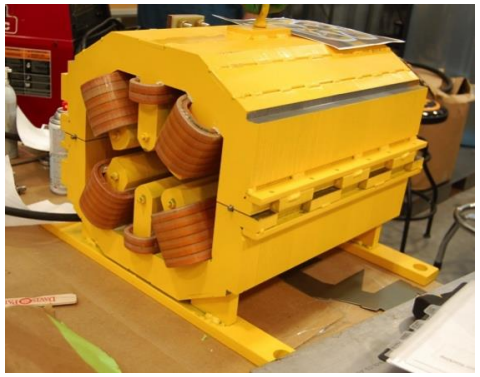
Inside the detector hall

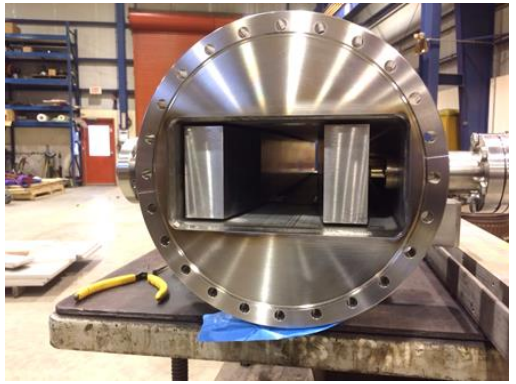
Mu2e Status – Proton Beamline

- Most beamline elements up to final focus are installed or are being fabricated
- Extinction system prototype AC dipole & collimators fabricated
- Full prototype of Electrostatic Septum by end of CY
- Resonant Extraction Sextupoles are being fabricated in industry
- Production target for beam commissioning being procured.
  - R&D is continuing to develop higher lifetime target design.
- Prototype Remote Target Handling system fabricated and tested


Mu2e Beamline


Prototype Remote Target Handler


Res Extraction Sextupole

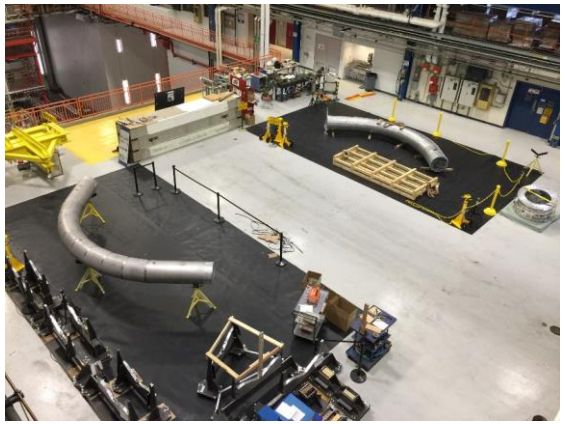

Extinction Collimator


HRS Bronze Pieces

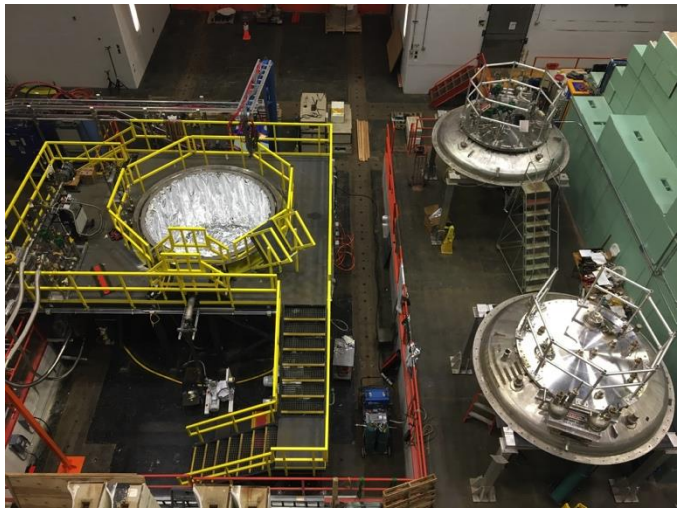
Mu2e Status – Transport Solenoids

- 14 Production TS Units being fabricated at ASG (Genoa)
  - 1st TS module at Fermilab undergoing cold test at Fermilab
  - 90% of coils have been wound, 75% epoxy impregnated, 38% machined


TS Assembly Tooling


TS cryostat inner bore & Thermal shield at FNAL

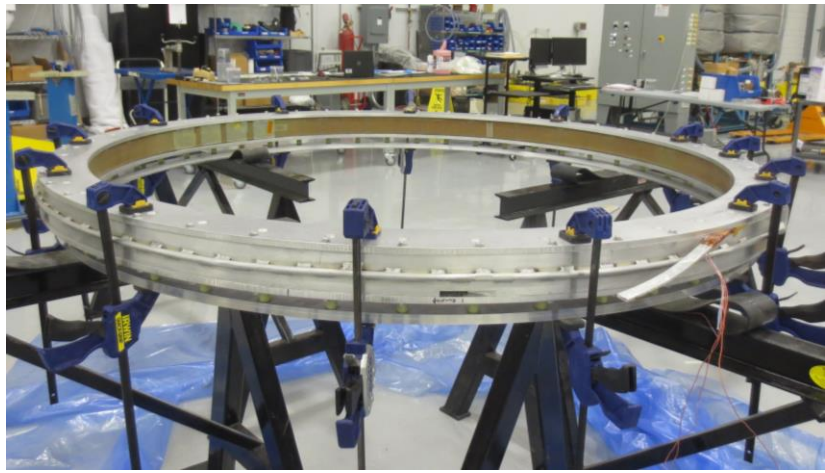

TS Coils at ASG


TS Test Facility at Fermilab


TS 1st Unit Test Prep

Mu2e Status – Production & Detector Solenoids

- Preparing for PS/DS Model Coil Cold Test at General Atomics (Tupelo)
- Coil winding issues with 1st DS unit
  - Conductor buckling during radial bend onto mandrel
  - GA currently modifying winding machine



Model Coil at GA Tupelo

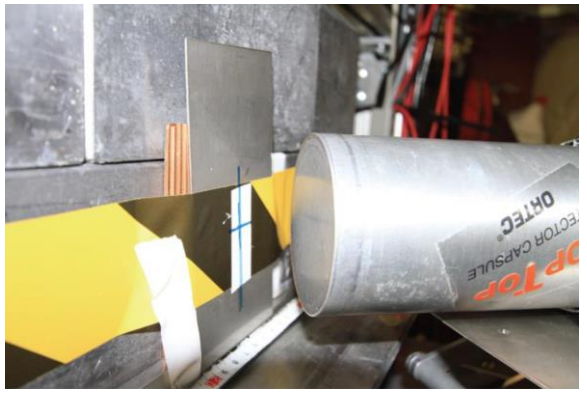
PS and DS lifting fixtures at FNAL

Tooling & DS Warm bore at GA Tupelo

Cryostated Model Coil at GA Tupelo

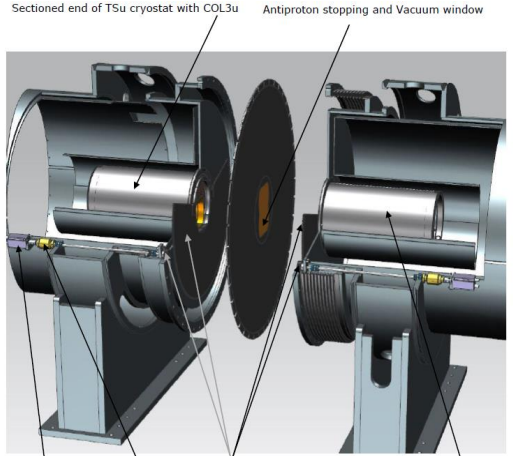
Mu2e Status – Muon Beamline

- Muon Beamline
  - Prototyping Stopping Target Foils
  - Designing beamline elements (anti-proton window, collimators, inner proton & outer proton absorbers, CRV shielding)
  - Finishing designs of PS/DS vacuum systems
  - Studying Stopping Target Monitor prototypes
    - STFC (UK) partnership: major engineering support, FEE, purchase HPGe detectors
    - Test beam support at ELBE (HZDR) Dresden



HPGe detector tests: HZDR

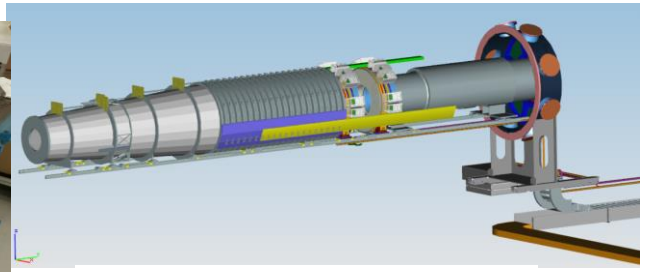
Stopping Target Mock-up



Rotating Collimator Design

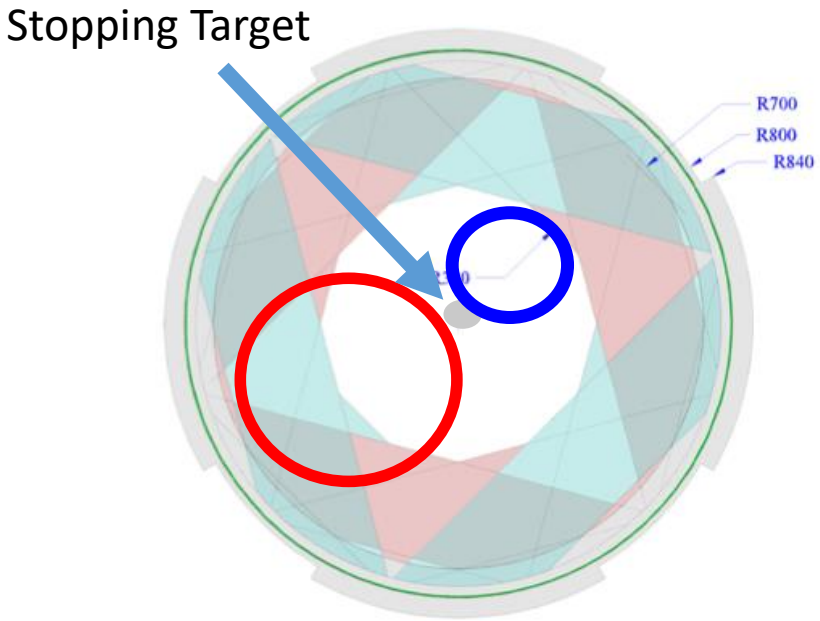
Model endcap support

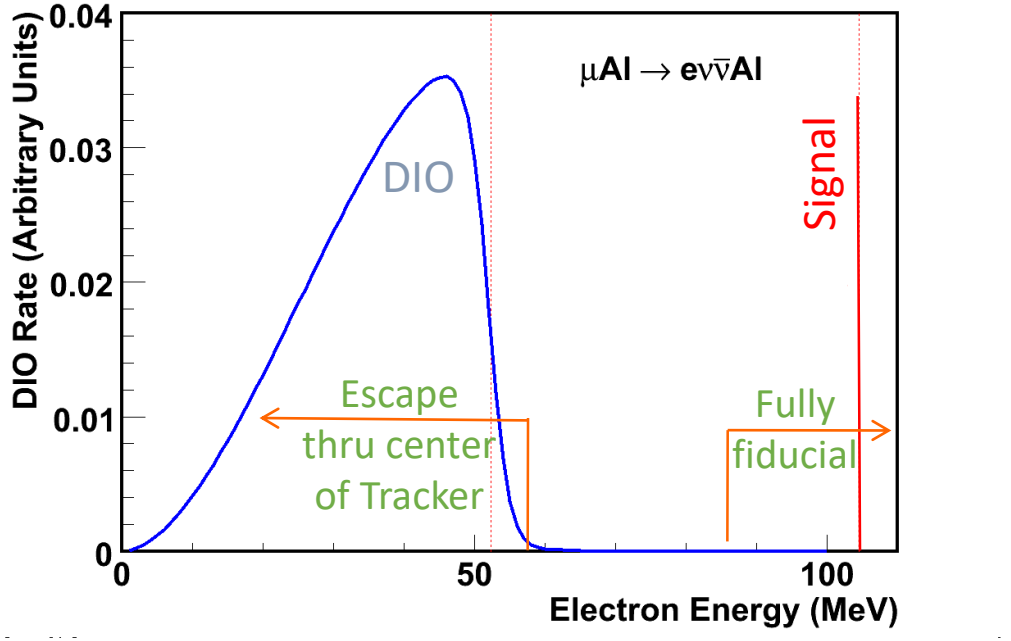
Half-scale IPA prototype



Detector Train Design

The Mu2e Tracker

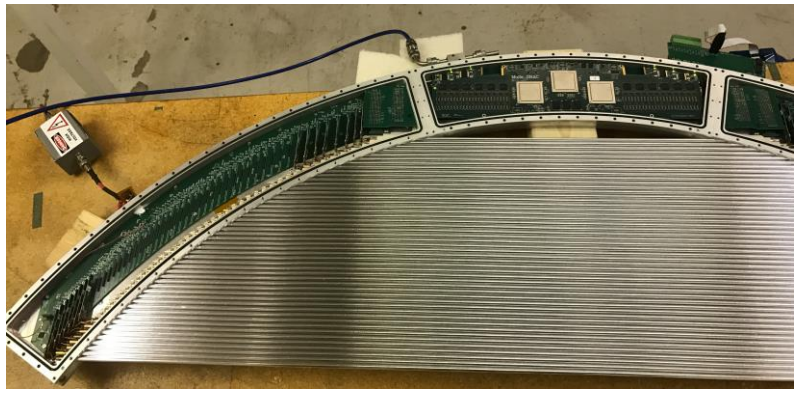




- Inner 38 cm is intentionally un-instrumented
  - Blind to beam flash
  - Blind to >99% of DIO spectrum

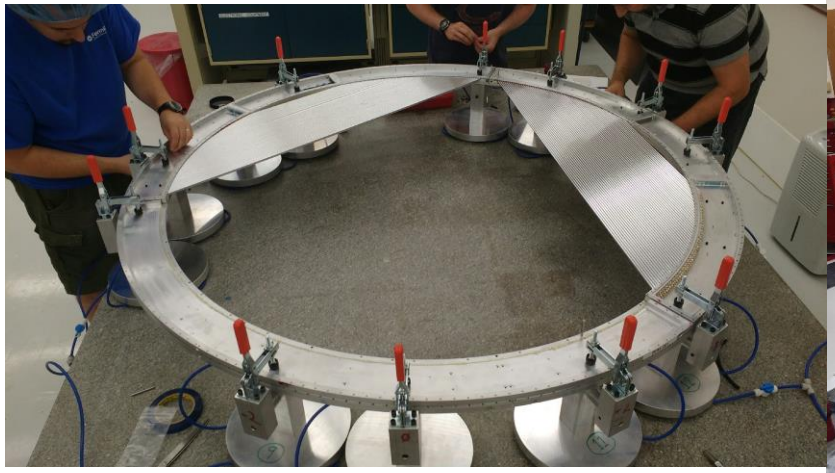
Mu2e Status - Tracker

- Straw Procurement Complete (30k straws)
- Panels
  - Design Complete
  - Production assembly fixtures being fabricated
  - UMN Panel Factory & QC Station set up is in progress
- Plane
  - Plane assembly tooling fixture design is nearly complete
- Electronics
  - Final Design to incorporate rad hard FPGA nearly complete



Panel w/Front-End Electronics

Panel: Straw Installation

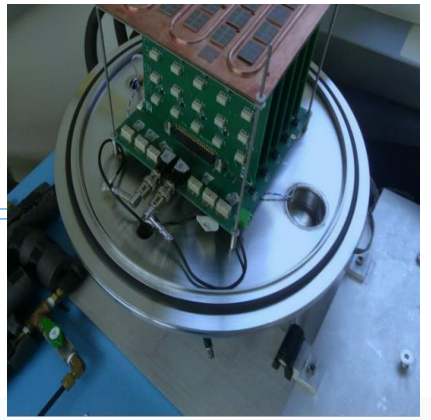


Two panels installed in plane

Plane Assembly Tooling

Mu2e Status - Calorimeter

- CsI Crystal POs placed (2 vendors, each produces ½ total)
  - 1st vendor: 28% produced. 98% accepted.
  - 2nd vendor: issues meeting mech specs (~50% rejected) Working to improve procedures
- SiPMs
  - ~1/3 produced (~3% percent rejected)
- Working on mechanical design issues (cooling, disk frame, stacking, etc.)
- Finalizing Front-end & Back-end Electronics designs
- Successful partnership between DOE & INFN
  - INFN: 100% SiPMs, 1/3 Crystals, mech structure, FEE
  - US DOE: 2/3 Crystals



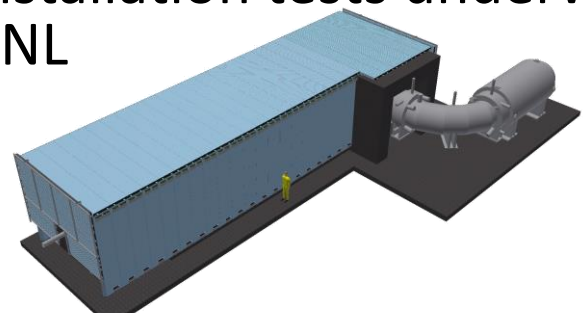
SiPM QC Test Station at SiDet

Crystal QC Station

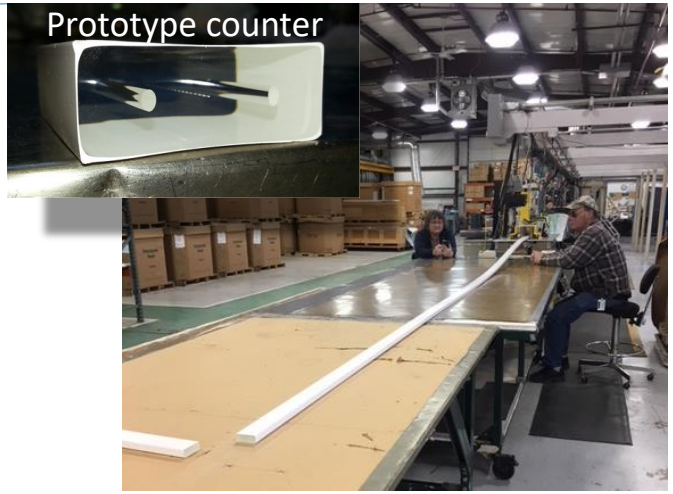
Mechanical Mock-up

Mu2e Status – Cosmic Ray Veto

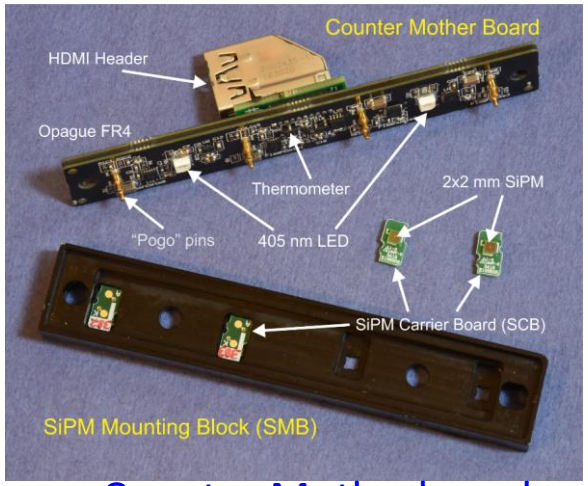
- CRV module and electronics designs are nearly complete.
- Modules
  - Extrusion fabrication complete
  - Di-counter fabrication started at UVA
- Electronics
  - Pre-production Front-End & Back-End Boards complete
- Installation
  - Installation tests underway at ANL



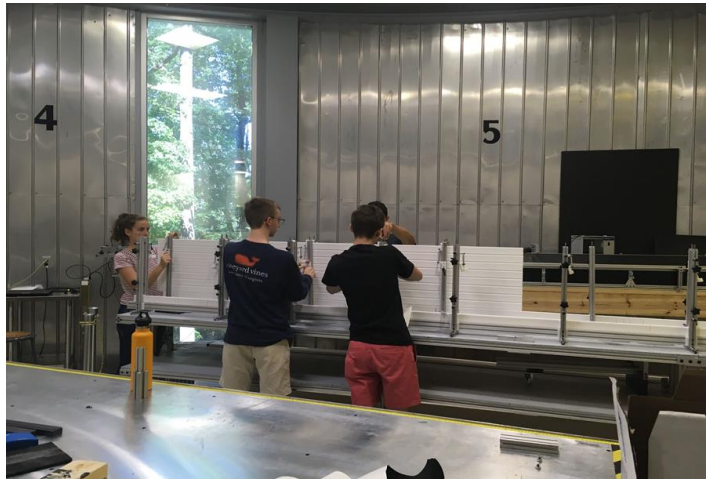
Side module installation test



Scintillator Extrusion



Counter Motherboard



Di-Counter Facility at UVA

Mu2e Status – Trigger & DAQ

- All racks are installed at Mu2e Hall
  - Rack Controllers installed
- Optical data readout path components validated
- Approaching target online filter event processing time (~4ms/event, big improvements over last year)
- Working on TDAQ/subdetector vertical slice integration tests

Racks in DAQ Room at Mu2e Hall

Mu2e Status – Simulations

- >60M cpu-h for CD3 campaign thanks to large scale OSG running
  - Produced updated background and muon stopping rate estimates
- Sophisticated of simulation package
  - Detailed GEANT4-based model of building, earth and concrete shielding, magnetic field, collimators, solenoids, absorbers, detectors…
  - Detailed models of hits in detectors
    - Hit level tracker simulations includes effects of ionization drift in straws, signal transit and electronic amplification, shaping, and digitization.
    - Include a complete models of background overlays and pileup
    - Tripled data rates and performance did not dramatically change
  - Developed and validated experimental design
  - Established feasibility of reconstruction and analysis
- Recent developments to utilize HPC resources
  - NERSC, Argonne
  - The GEANT4 model has been adapted for multithreading
  - Utilization is just beginning.

Mu2e Status – Analysis Preparations

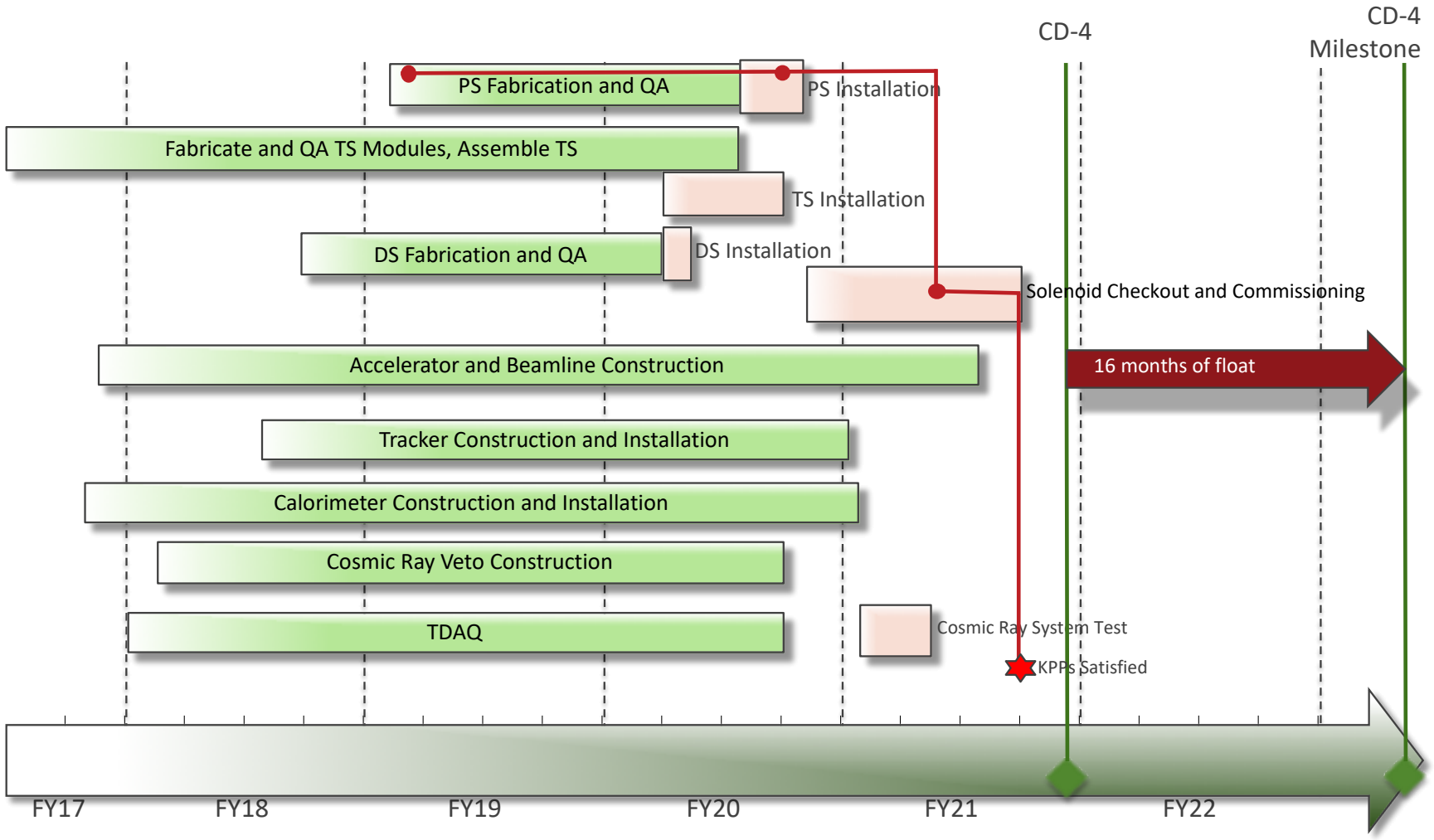
- Summary of ongoing work
  - Reconstruction algorithms that start from simulated raw data
  - Developing blinding strategies
  - Developing online triggers
  - Roadmap to Operations
    - Mock Data Challenge in initial stages
      - Signals+ backgrounds, integrate data from detectors into events
      - Reconstruct data
      - Test online trigger
      - Focus this year: develop mechanisms of calibration and alignment of detectors
    - Developing online and offline software for DAQ and analysis
    - Use and continue to develop advanced models of detector: geometry, detector response, data formats…
  - Engaging Non-Experts: documentation & tutorials being prepared by ENE group

Mu2e Sensitivity

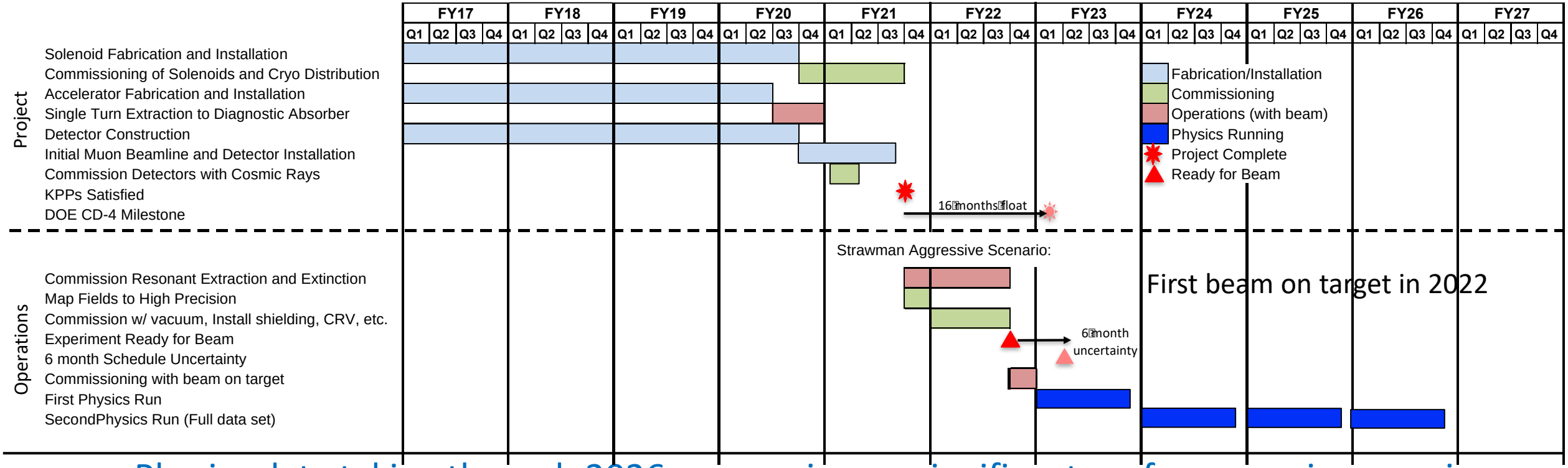
- Mu2e Expected Background Yield: <0.5 events over life of experiment
- 3 years production
  - 3.6×10^{20} protons on target
  - 6×10^{17} stopped muons
  - Single event sensitivity 3×10^{-17}
  - Null signal upper limit (90% CL) 8×10^{-17}
  - Discovery sensitivity (5 σ) 2×10^{-16}

Category	Source	Events
Intrinsic	μ Decay in Orbit	0.14
	Radiative μ Capture	<0.01
Late Arriving	Radiative π Capture	0.02
	Beam electrons	<0.01
	μ Decay in Flight	<0.01
	π Decay in Flight	<0.01
Miscellaneous	Anti-proton induced	0.04
	Cosmic Ray induced	0.21
Total Background		0.41

Mu2e Project Schedule



Mu2e Physics Schedule



- Physics data taking through 2026 – assuming no significant performance issues arise
- Note: LBNF shutdown currently scheduled for 2y starting mid-2024
  - Strong motivation to collect full data set as soon as possible
  - This schedule maintains our competitive advantage over COMET Phase-II.
  - Strong Lab and DOE support needed to maintain current schedule

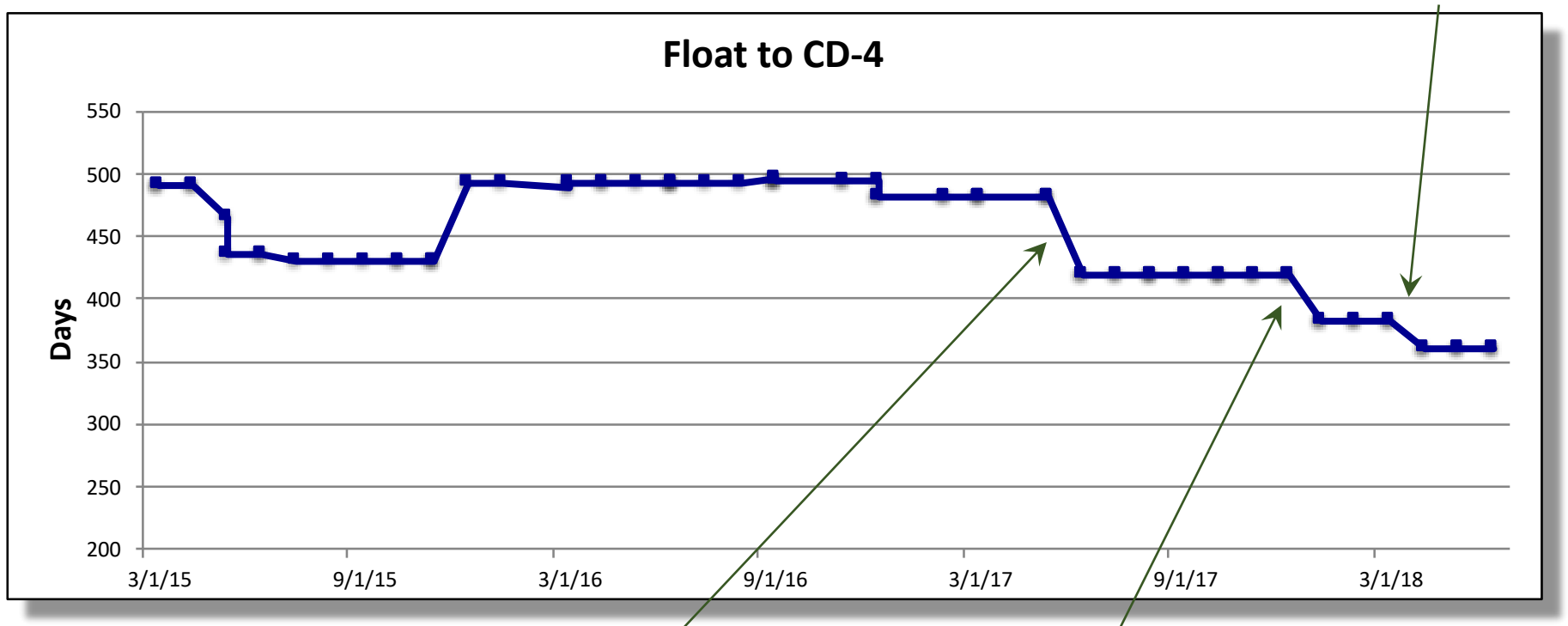
Summary

- Mu2e addresses compelling science- validated twice by P5
- Mu2e has made great progress since 2015
- Mu2e is on budget & scheduled to complete construction in 2021
- Mu2e preparations for data taking are well underway
- Mu2e data taking will last at least through 2026
  - Assuming project maintains current schedule, no significant performance issues arise, LBNF shutdown delayed

Backup Slides

Schedule Slippage

Lost 5 months of schedule float due to delays at General Atomics

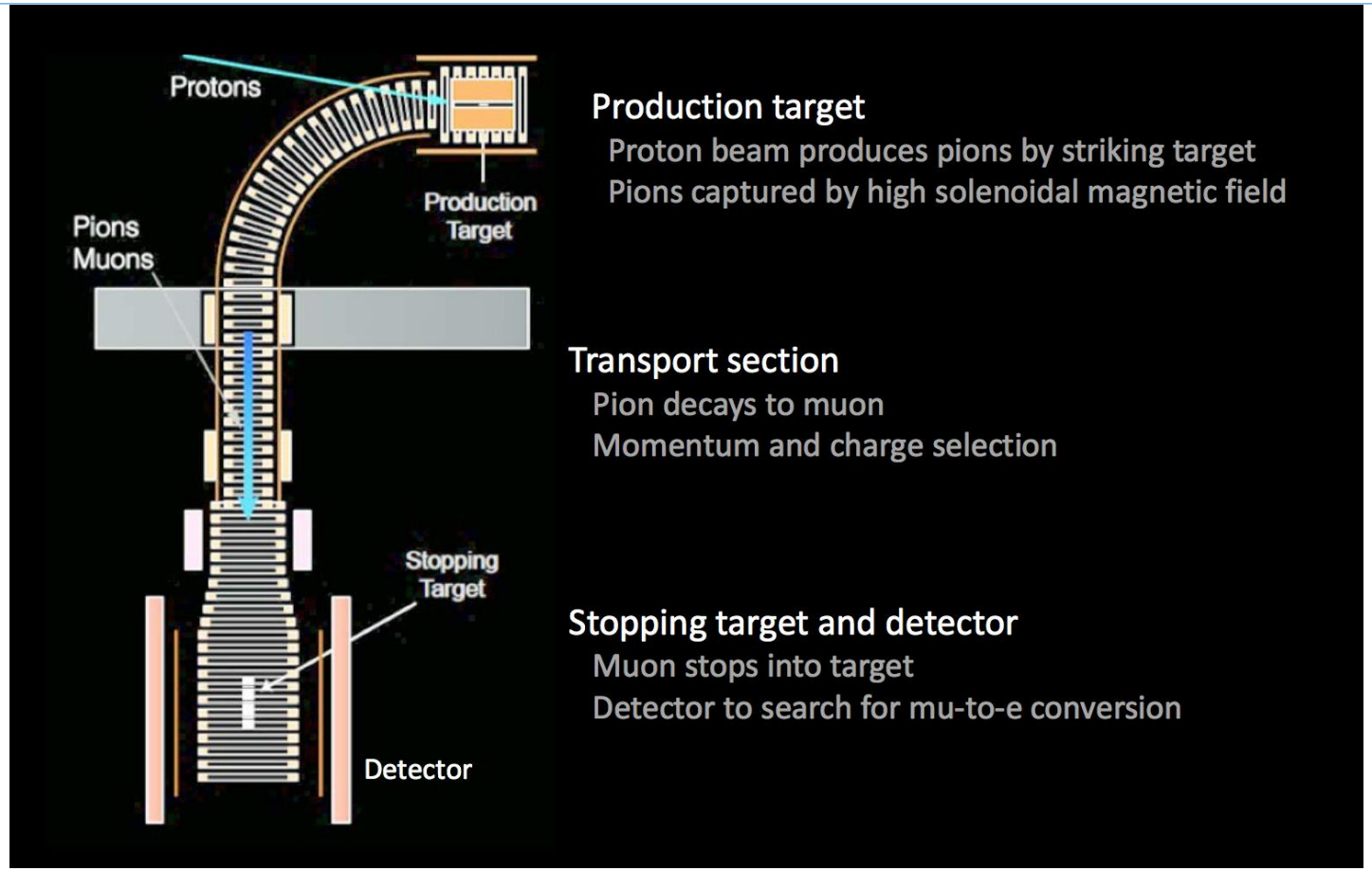


Project Cost and Schedule Benchmarks

- Project is 65% complete. SPI=0.96. CPI=0.94.
- 80% Obligated
  - $188M obligated out of $236M Budget at Completion
  - All major procurements under contract
- Baseline has increased 7% since CD-2
- Consumed $24M of contingency since CD-2. $29M of contingency remaining (34% of work remaining)
- 16 months of schedule float remaining

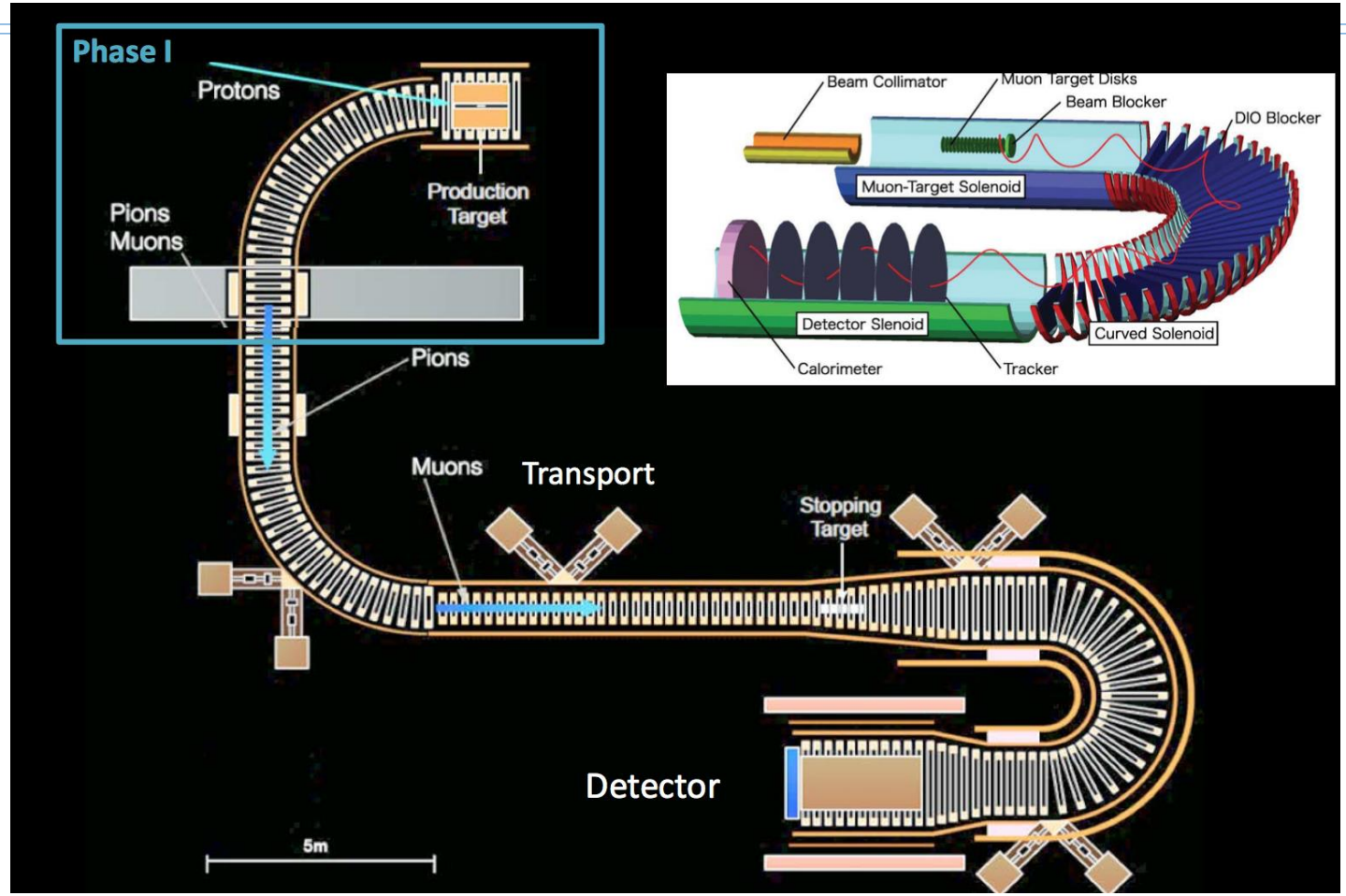
From the June 2017 DOE Mini-Review:
“The project has an experienced, stable, well-functioning and capable management team”

COMET experiment Phase-I



- Aims to explore cross sections, rates, $R_{\mu e}$ ~10^{-14} (vs Mu2e ~ 10^{-16})
- Data taking expected to begin ~2020 at JPARC

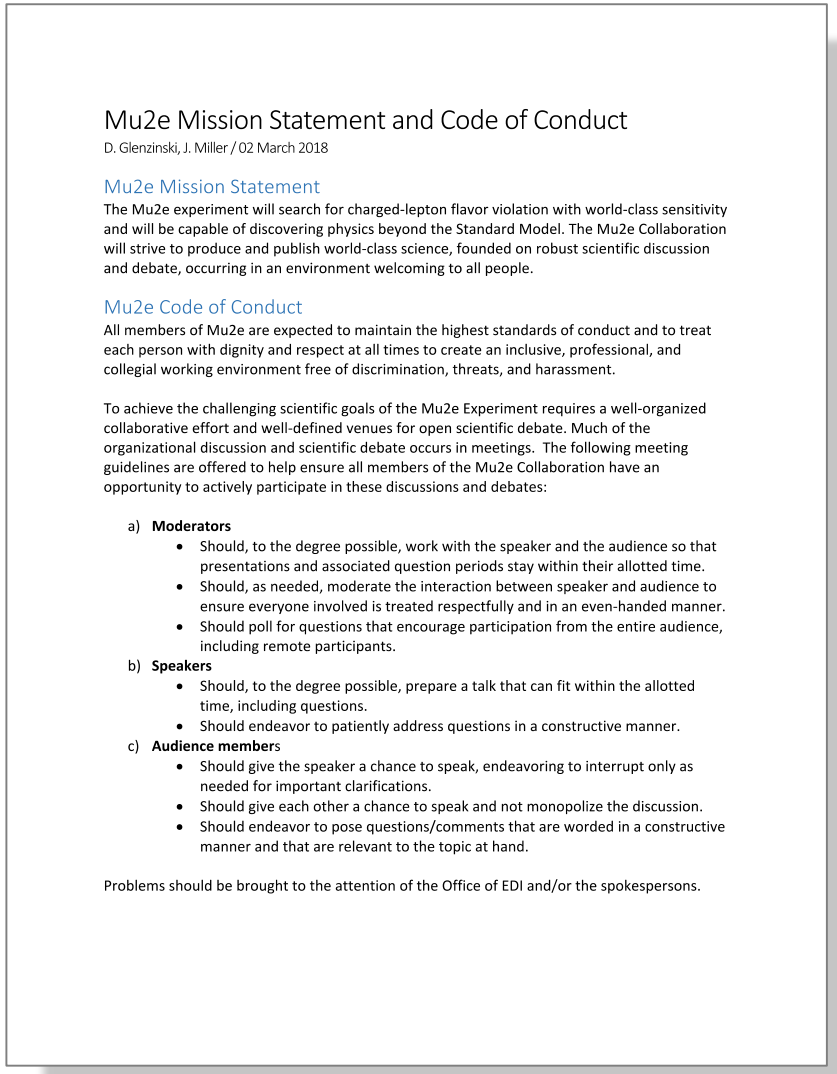
COMET experiment Phase-II



- Aims to explore $R_{\mu e} \sim 10^{-16}$ comparable to Mu2e
- Not yet approved – pending successful completion of Phase-I

Mu2e Equity, Diversity, Inclusion

- D&I Task Force
- Mission Statement & Code of Conduct
- Office of EDI
- Partnering with FNAL D&I Office & other collaborations



Mu2e Mission Statement and Code of Conduct

D. Glenzinski, J. Miller / 02 March 2018

Mu2e Mission Statement

The Mu2e experiment will search for charged-lepton flavor violation with world-class sensitivity and will be capable of discovering physics beyond the Standard Model. The Mu2e Collaboration will strive to produce and publish world-class science, founded on robust scientific discussion and debate, occurring in an environment welcoming to all people.

Mu2e Code of Conduct

All members of Mu2e are expected to maintain the highest standards of conduct and to treat each person with dignity and respect at all times to create an inclusive, professional, and collegial working environment free of discrimination, threats, and harassment.

To achieve the challenging scientific goals of the Mu2e Experiment requires a well-organized collaborative effort and well-defined venues for open scientific debate. Much of the organizational discussion and scientific debate occurs in meetings. The following meeting guidelines are offered to help ensure all members of the Mu2e Collaboration have an opportunity to actively participate in these discussions and debates:

a) **Moderators**
   - Should, to the degree possible, work with the speaker and the audience so that presentations and associated question periods stay within their allotted time.
   - Should, as needed, moderate the interaction between speaker and audience to ensure everyone involved is treated respectfully and in an even-handed manner.
   - Should poll for questions that encourage participation from the entire audience, including remote participants.

b) **Speakers**
   - Should, to the degree possible, prepare a talk that can fit within the allotted time, including questions.
   - Should endeavor to patiently address questions in a constructive manner.

c) **Audience member**s
   - Should give the speaker a chance to speak, endeavoring to interrupt only as needed for important clarifications.
   - Should give each other a chance to speak and not monopolize the discussion.
   - Should endeavor to pose questions/comments that are worded in a constructive manner and that are relevant to the topic at hand.

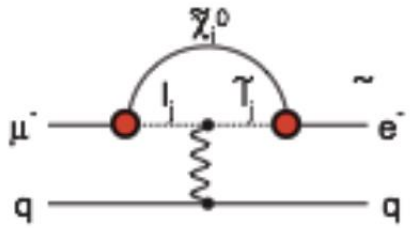
Problems should be brought to the attention of the Office of EDI and/or the spokespersons.

Mu2e Outreach

- Summer lecture series
- Open house tours
- Young Mu2e Outreach coordinator

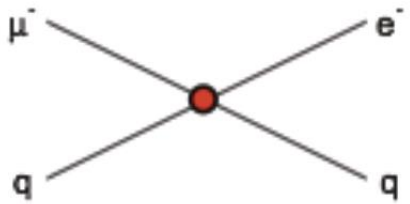
Sample diagrams: μ-e conversion

Supersymmetry



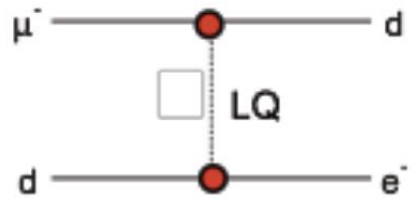
Compositeness

$\Lambda_c \sim 3000$ TeV



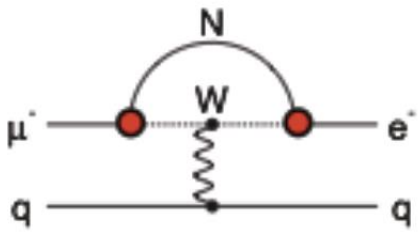
Leptoquark

$M_{LQ} = 3000\ (\lambda_{\mu d}\lambda_{ed})^{1/2}$ TeV/c²



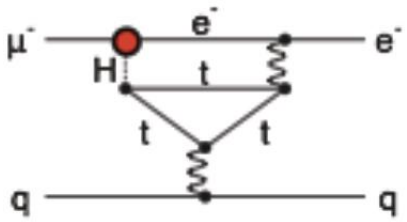
Heavy Neutrinos

$|U_{\mu N}U_{eN}|^2 \sim 8\times10^{-13}$



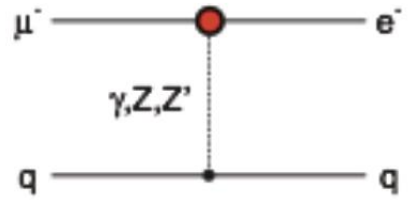
Second Higgs Doublet

$g(H_{\mu e}) \sim 10^{-4} g(H_{\mu\mu})$



Heavy Z' Anomal. Z Coupling

$M_{Z'} = 3000$ TeV/c²



Some CLFV Processes

Process	Current Limit	Next Generation exp
$\tau \rightarrow \mu\eta$	BR < 6.5 E-8	
$\tau \rightarrow \mu\gamma$	BR < 6.8 E-8	10^{-9} - 10^{-10} (Belle II)
$\tau \rightarrow \mu\mu\mu$	BR < 3.2 E-8	
$\tau \rightarrow eee$	BR < 3.6 E-8	
$K_L \rightarrow e\mu$	BR < 4.7 E-12	
$K^+ \rightarrow \pi^+e^-\mu^+$	BR < 1.3 E-11	
$B^0 \rightarrow e\mu$	BR < 7.8 E-8	
$B^+ \rightarrow K^+e\mu$	BR < 9.1 E-8	
$\mu^+ \rightarrow e^+\gamma$	BR < 4.2 E-13	10^{-14} (MEG)
$\mu^+ \rightarrow e^+e^+e^-$	BR < 1.0 E-12	10^{-16} (PSI)
$\mu N \rightarrow eN$	$R_{\mu e}$ < 7.0 E-13	10^{-17} (Mu2e, COMET)

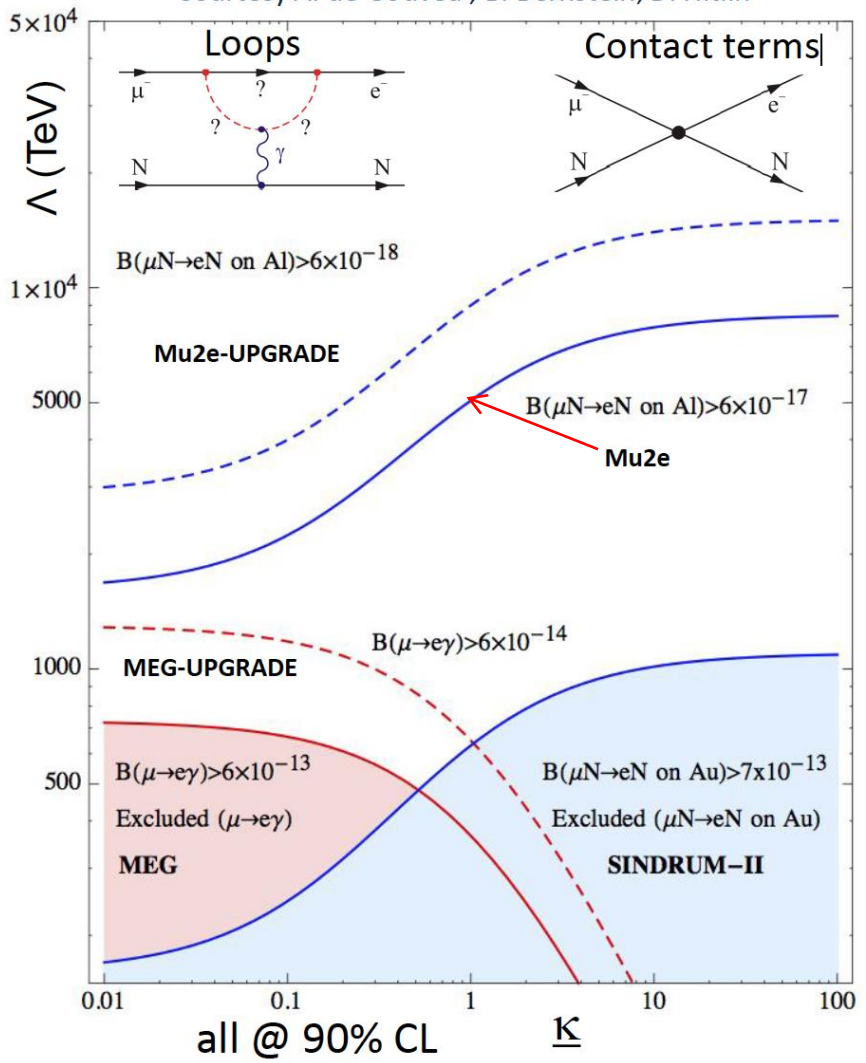
- There is a global interest in CLFV

Mu2e Physics Motivation

- Impact on most NP models
- Sensitive to Λ_{eff} ~ 10^3 – 10^4 TeV
  - Beyond the reach of accelerators
- Complementary to other cLFV reactions

  e.g. $\mu \rightarrow e\gamma$
- Strongly endorsed by P5

Courtesy A. de Gouvea , B. Bernstein, D. Hitlin



Winding Issues at General Atomics

- The machine for winding conductor into coils was not designed properly.
  - Machine was designed by General Atomics and built by Italian company TPA.
- Makes final hard-way bend of conductor on the mandrel where it cannot be constrained from buckling.
  - When conductor is bent properly it can be wound at proper radius. Demonstrated multiple times.
- General Atomics is working on winding machine modifications to allow proper winding technique.
- 2-6 month schedule delay, depending on difficulty of engineering a fix.

MDC2018 Specific Goals

- Exploit improved simulation realism
  - updated geometry, detector response, data formats, …
- Integration
  - Tracker + Calorimeter + CRV in one datastream
- Update methodologies
  - Job management, code validation, data processing workflows, …
- Provide standard simulation samples for:
  - Trigger and reconstruction algorithm development and testing
  - Development of calibration techniques
  - Tutorials and training
  - Analysis