



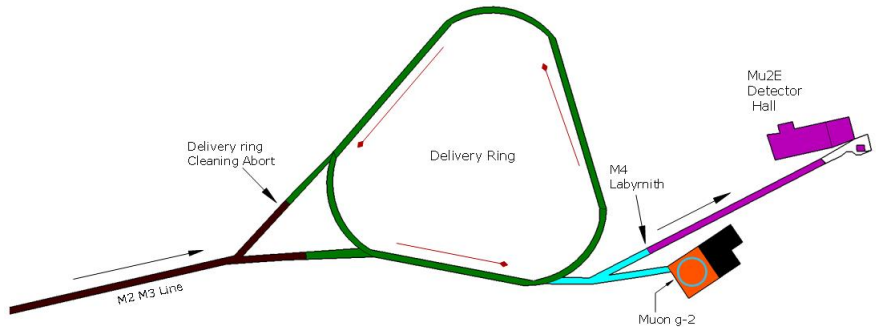
Northern Illinois
University

Simulation of Resonant Extraction for *Mu2e*

Prudhvi Raj Varma Chintalapati†

†Northern Illinois University, USA

June 10, 2019



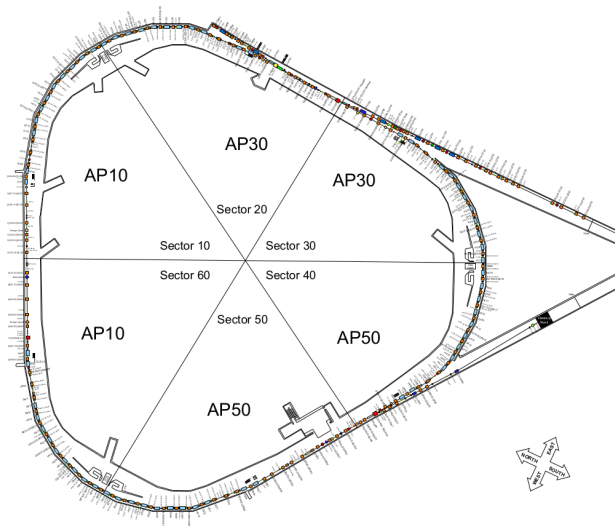


Parameter	Value	Units
Beam Energy	8.89	GeV
Transverse emittance	16π	mm-mrad
Maximum Intensity	1×10^{12}	protons
Intensity of each pulse	3×10^7	protons
Bunch length	250	nsec
Time difference between pulses	1.695	nsec
Duration of spill	54(32000)	msec (turns)
ν_x	9.65	

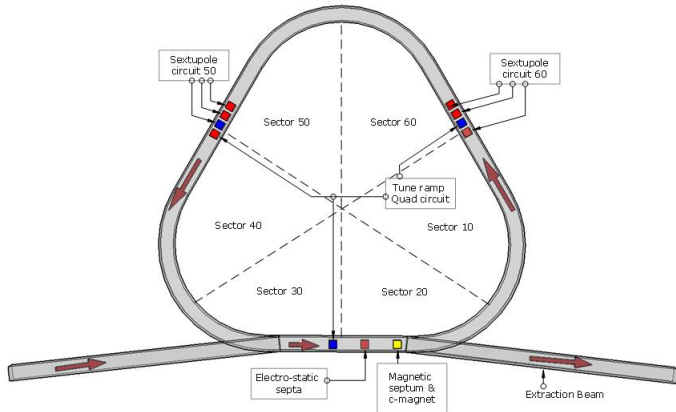
R and MAD-X are used for tracking particles in the simulation.

Table: Parameters that are considered for this simulation. The last four are at extraction point

Type	value
Emittance(normalized)	16π mm-mrad
Beam Energy	8.89 GeV
ν_x	9.65
Septum placement (from center of beam)	12mm
Septum thickness	$50\mu\text{m}$
Target extraction Rate	0.003%



<http://operations.fnal.gov/members/baginski/drawings/pbar-map-new.pdf>



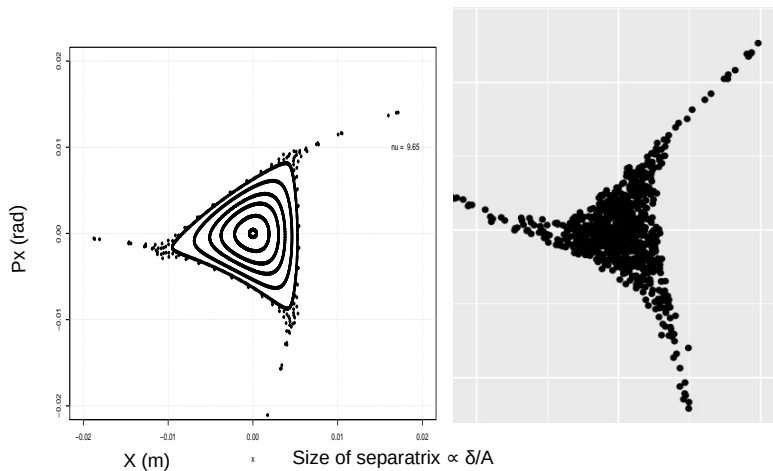
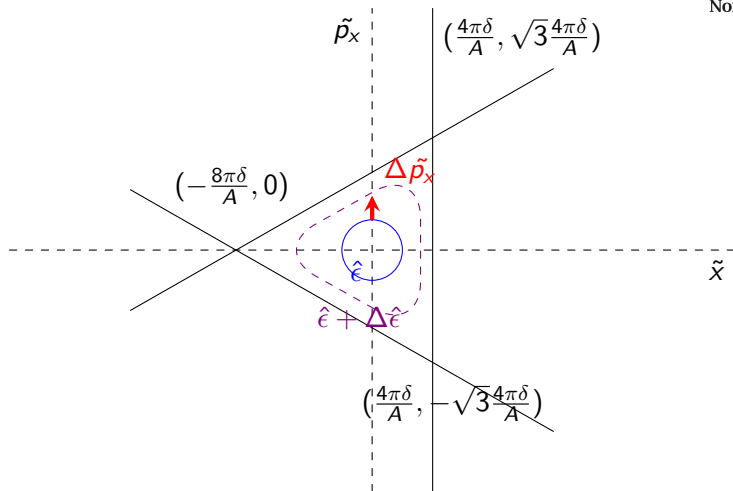


Figure: Phase evolution for individual particles (on the Left) and an Ensemble (on the Right) over 500 turns





$$\hat{\epsilon} = \beta\epsilon = \pi\langle x^2 \rangle \quad \Delta\hat{\epsilon}(\text{per turn}) = \pi \frac{\langle \Delta p_x^2 \rangle}{2} = \pi \frac{\langle \beta \Delta x'^2 \rangle}{2} \quad (1)$$

Figure: $Noise(\Delta x'_{max}) = 10^{-6}$ (Top); $Noise(\Delta x'_{max}) = 5 \times 10^{-6}$ (Bottom)

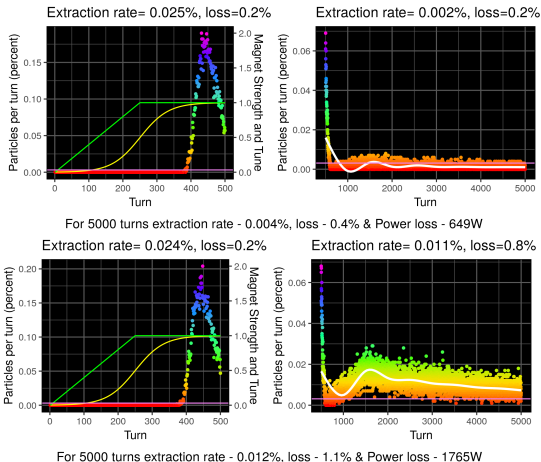


Figure: $Noise(\Delta x'_{max}) = 8 \times 10^{-6}$ (Top); $Noise(\Delta x'_{max}) = 2 \times 10^{-6}$ (Bottom)

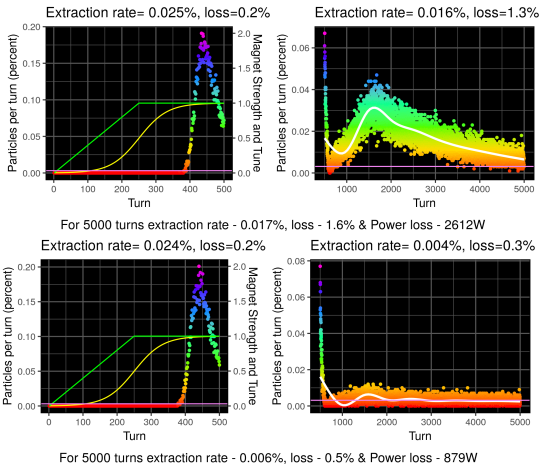
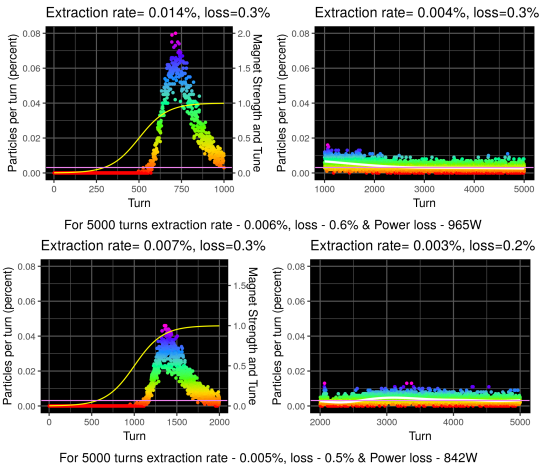


Figure: Adiabatic change 0-1000(Top), 0-2000(Bottom);
 Noise($\Delta x'_{max}$) = 2×10^{-6}





- Understanding the beam dynamics, phase space evolution, and extraction for *Mu2e* have been the central part of this study.



- Understanding the beam dynamics, phase space evolution, and extraction for *Mu2e* have been the central part of this study.
- Simulations have shown how the following parameters influence the extraction rate
 - Rate of change in Tune and Sextupole field strength
 - Noise
 - Desired phase space parameters at the extraction location



- Expanding the understanding of noise induced resonance extraction.



- Expanding the understanding of noise induced resonance extraction.
- Including the longitudinal parameters like momentum spread and dispersion.



- Expanding the understanding of noise induced resonance extraction.
- Including the longitudinal parameters like momentum spread and dispersion.
- Examination of the idea of varying the beam energy in the Delivery Ring.

Betatron function of Delivery Ring - Backup



Northern Illinois University

