REDTOP Beam Modeling For Raised Transition Energy and Third Integer Resonance Extraction

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Sponsored by DOE SULI Program

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- Dark photon theorized in second decay mode

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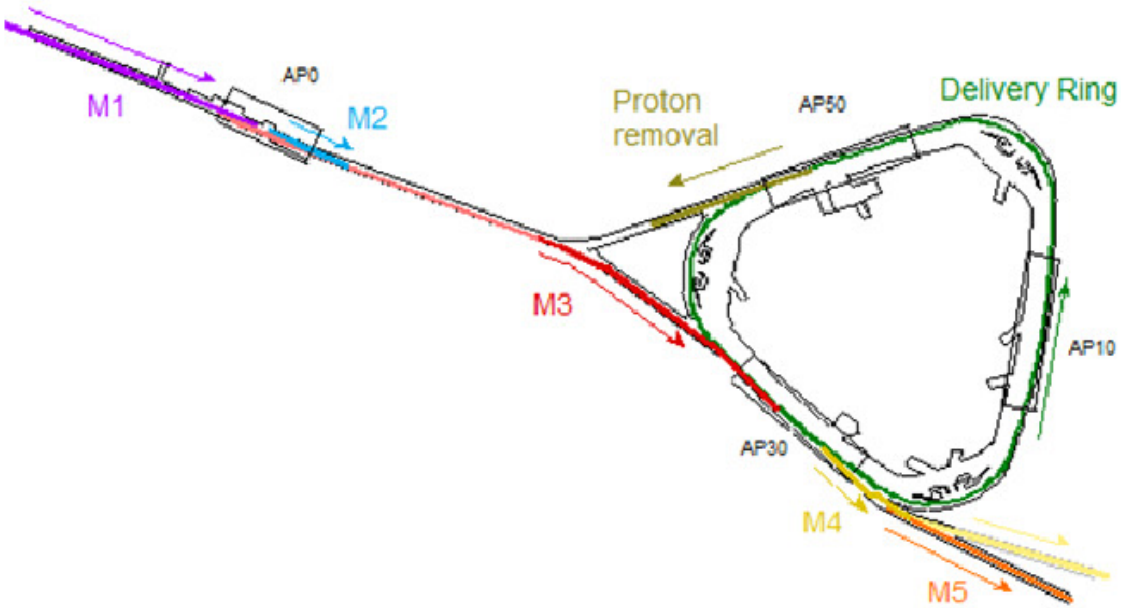
- Will make use of current Muon Campus:



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- Third integer resonance extraction requires stable phase space be triangular
- Sextupoles introduced to limit phase space

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- Relevant modules: Twiss and PTC

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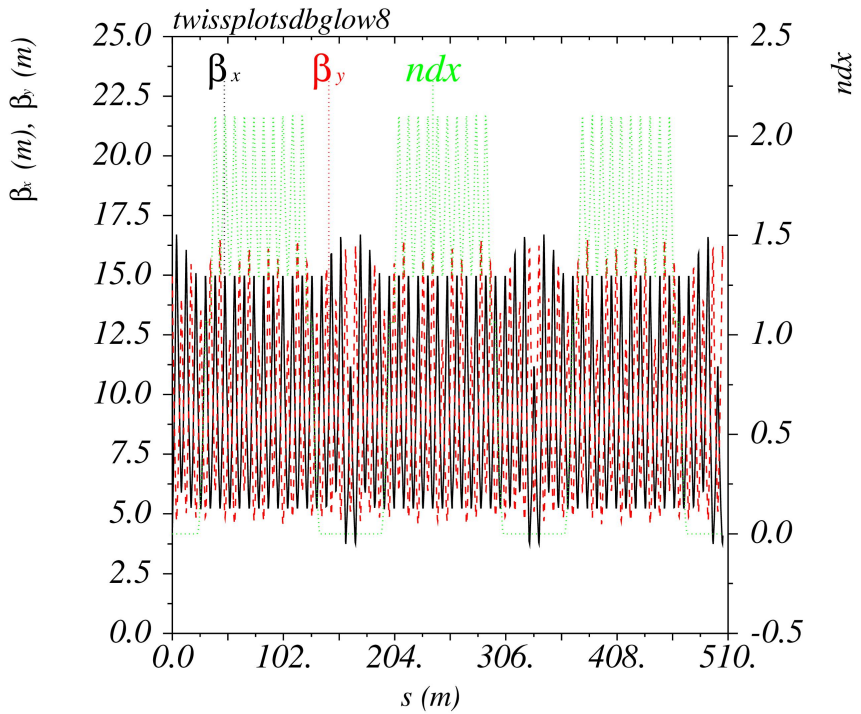
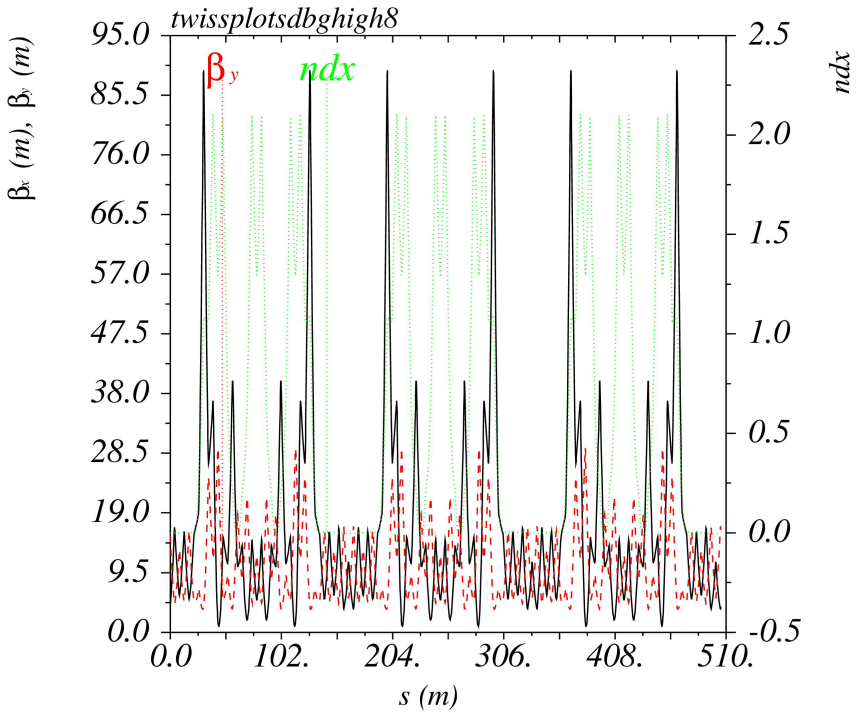
- For $\gamma_{tr} = 7.64$, beta functions look like:



- After raising γ_{tr} to 10.0286, the beta functions look like:



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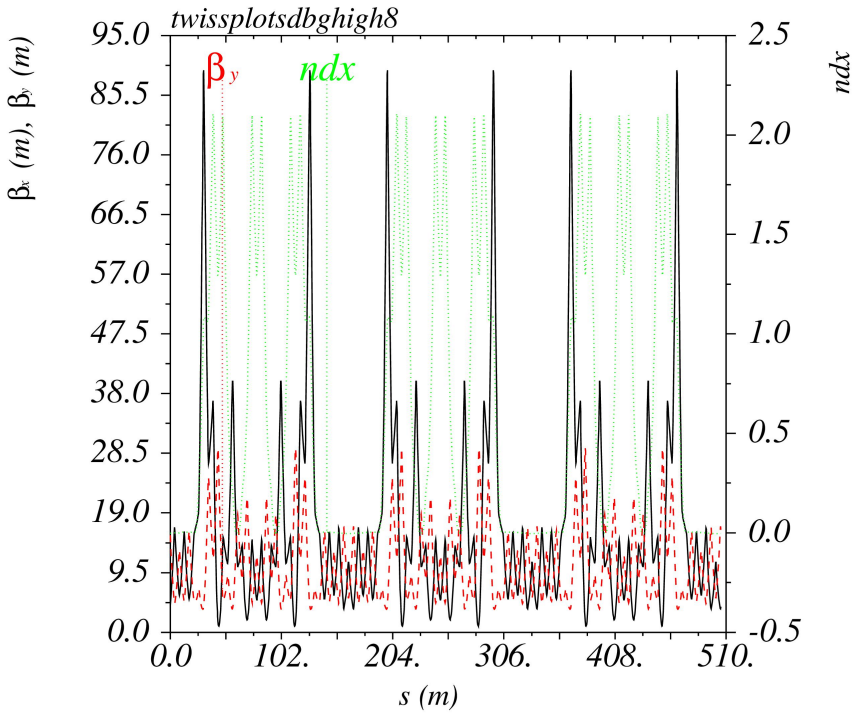

- Dispersion drops to 0 more often
- Beta functions drastically changed

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- So, for $\beta_x = 90$ m and an 8 GeV beam, $\sigma_x = 4.89$ mm

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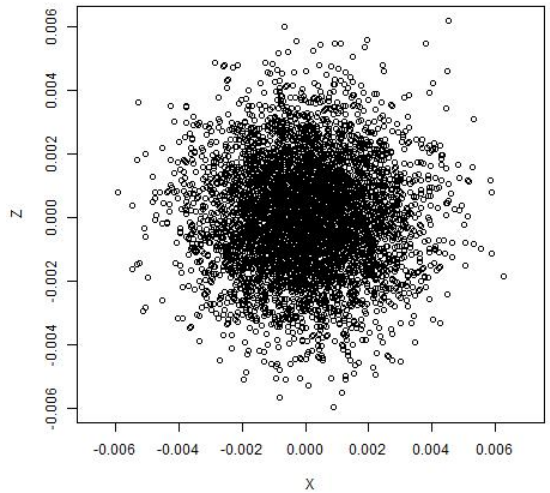
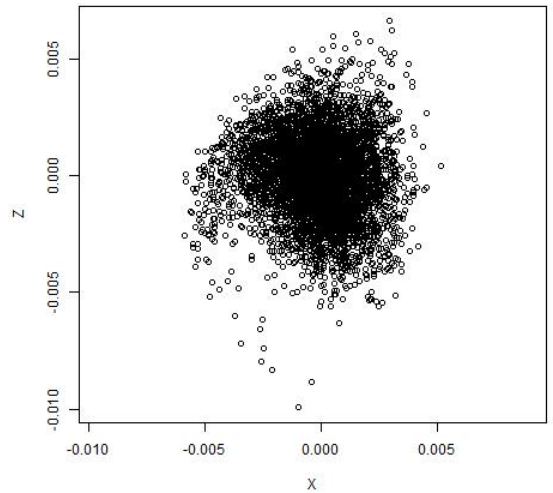
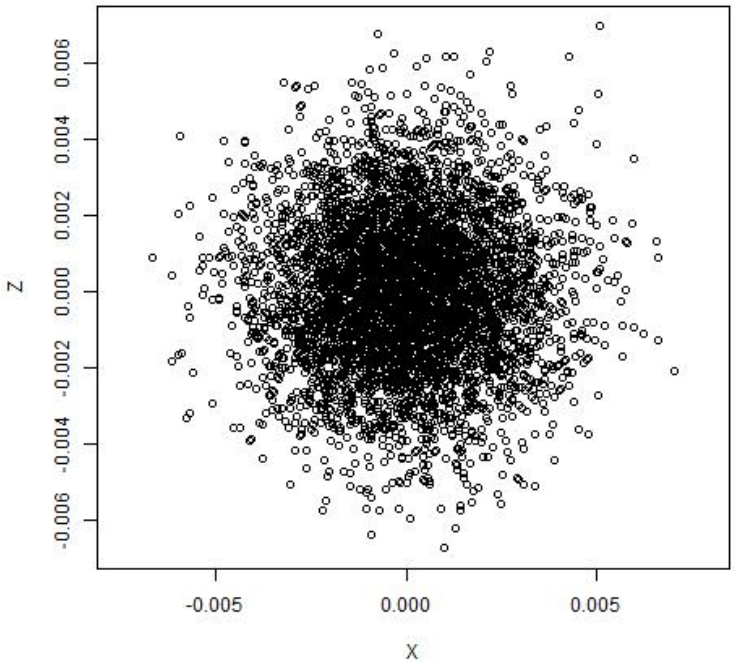
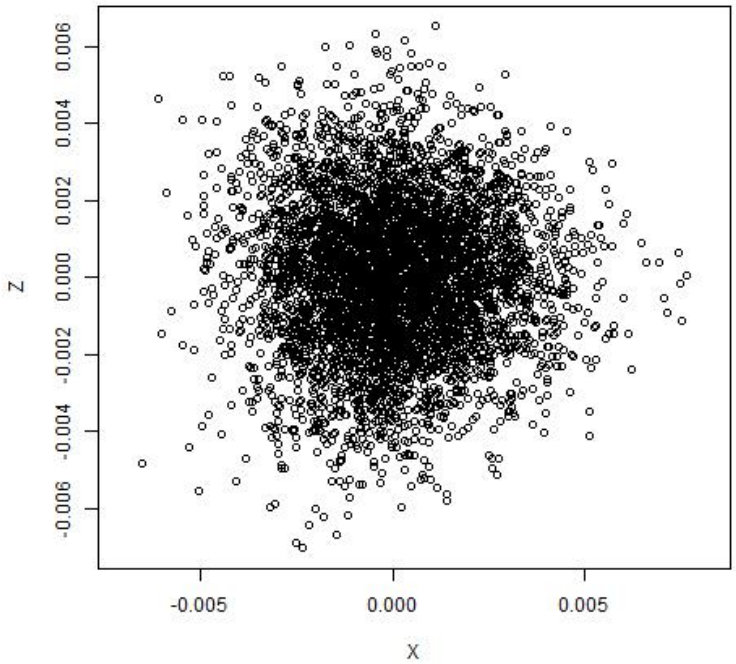
- $Z = \alpha \times X + \beta \times X'$





Triangular Phase Space





Sextupole Strengths

- Strength based on phase advance (μ_x) and β_x

$$s^2 = s_s^2 + s_c^2 \tag{2}$$

$$s_s = \frac{1}{4\pi} \sum_i \frac{k}{6} \bar{\beta}^{3/2} \sin(29\theta_i) \tag{3}$$

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- From this, $k = 11.18224 \frac{1}{\text{m}^2}$

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- Future modeling to confirm entire experimental setup

Thank you for your attention.

Acknowledgments. This work would not have been possible without the support and expertise from John Johnstone at Fermi National Accelerator Laboratory, Andrew Fiedler at Northern Illinois University, and the rest of Fermilab's accelerator community. This work was supported in part by the U.S. Department of Energy, Office of Science, Office of Workforce Development for Teachers and Scientists (WDTS) under the Science Undergraduate Laboratory Internship (SULI) Program.

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