Analysis of CesrTA Electron Cloud-Induced Tune Shifts with POSINST

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Look across range of different data sets

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- Compare simulation to measurement

Simulation Technique

 POSINST takes user "guesses," simulates electron cloud density

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 Mathematica script finds tune shifts from density

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• Observe results and iterate

- # of freed electrons/photon ("primaries"):
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 - ~50%



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 - ~.1
- # of freed electrons/electron ("secondaries") at peak energy:
 - ~2.0
- Incident energy of peak secondary yield:
 - ~310 eV
- % of electrons elastically scattered from wall:
 - ~50%
- % of electrons go into wall and reemerge ("rediffused"):





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•2.1 GeV, 45-bunch positron beam, .75 mA/bunch, 4ns

Nominal values

•New Values



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Nominal values

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Note nonlinear effects

• Electron beam tune shifts smaller, negative

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•5.3 GeV 45bunch electron
beam, 0.75
mA/bunch,
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•Simulation



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- Variant of Newton's Method estimates how to best change parameters
- More efficient use of comp. time (and my time)

6-D Newton's Method

• Linear estimate of Jacobian

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•Each fit perturbs one thing; determines sensitivity of each parameter

Newton's Method Results

- 5.3 GeV 45-bunch positron beam, 0.75 mA/bunch, 4 ns
- Before Newton
- After Newton



Newton's Method Results

- 5.3 GeV 45-bunch positron beam, 0.75 mA/bunch, 4 ns
- Before Newton
- After Newton
- 2.1 GeV 45-bunch positron beam, 0.75 mA/bunch, 4 ns





Witness Bunches

•Send bunches after main train to measure cloud decay

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 4.0 GeV 20-bunch positron beam, 0.50 mA/bunch, 8 witnesses, 20 ns



Simulation

Data (black)

Witness Bunches

•Send bunches after main train to measure cloud decay

- 4.0 GeV 20-bunch positron beam, 0.50 mA/bunch, 8 witnesses, 20 ns
- 4.0 GeV 20-bunch positron beam, 1.00 mA/bunch, 8 witnesses, 20 ns





Simulation

Data (black)

SEY value higher compared to other methods;
 2.3 vs. ~1.5

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Spurious parameter sets possible

- Difficulty with high-current and/or low-energy data
 - Nonlinearities

Acknowledgements

- Many thanks to mentor David Kreinick
- Thanks to Joe Calvey for help with Newton technique
- Thanks to Gerry Dugan for Mathematica tune shift scripts
- Thanks to the National Science Foundation and Cornell CLASSE REU program for making this experience possible

Questions?

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