Cornell Laboratory for Accelerator-based Sciences and Education (CLASSE)

Damping Ring status/plans at Cornell

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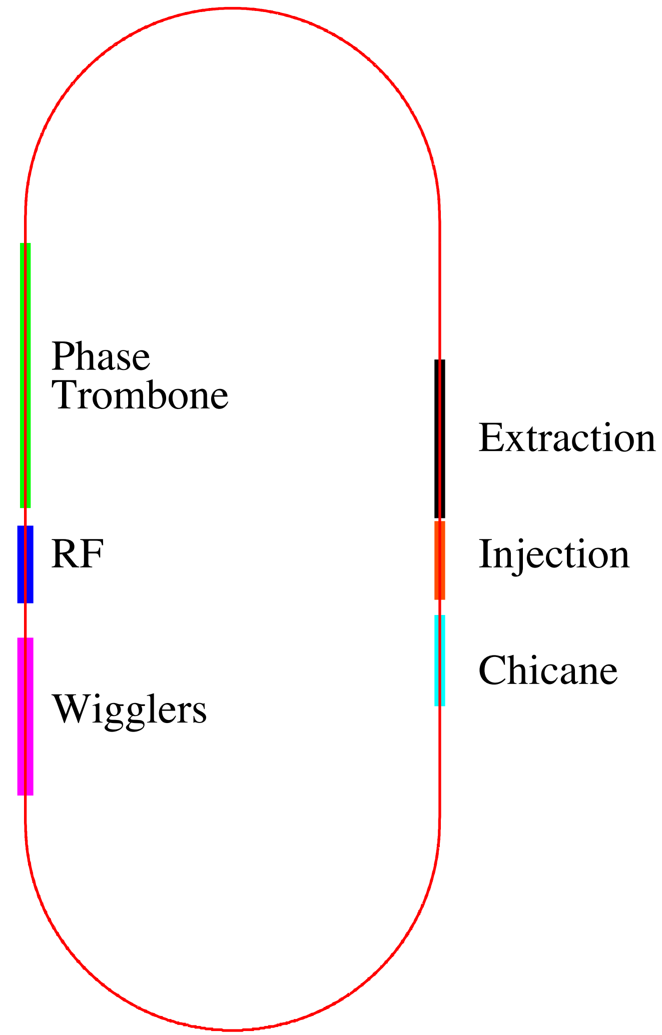
Stewardship

Maintain current damping ring lattice models for the various operating modes

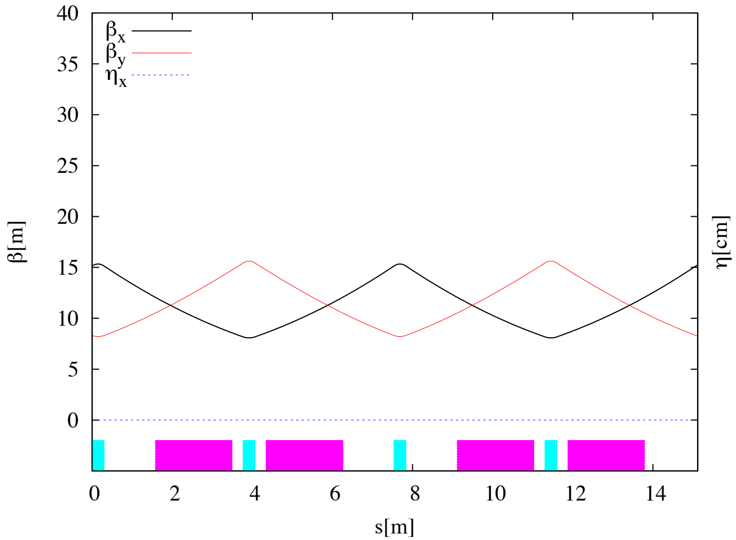
- Lists of guide field magnets (quads, sextupoles, dipoles, correctors) and magnet parameters, including error tolerance
- Damping wiggler parameters
- Complement of RF cavities and cavity specs
- Injection hardware (kickers and kicker specifications)
- Alignment tolerances for all of the above



Review power requirements and heat loads -synchrotron radiation and wakes

Operating modes

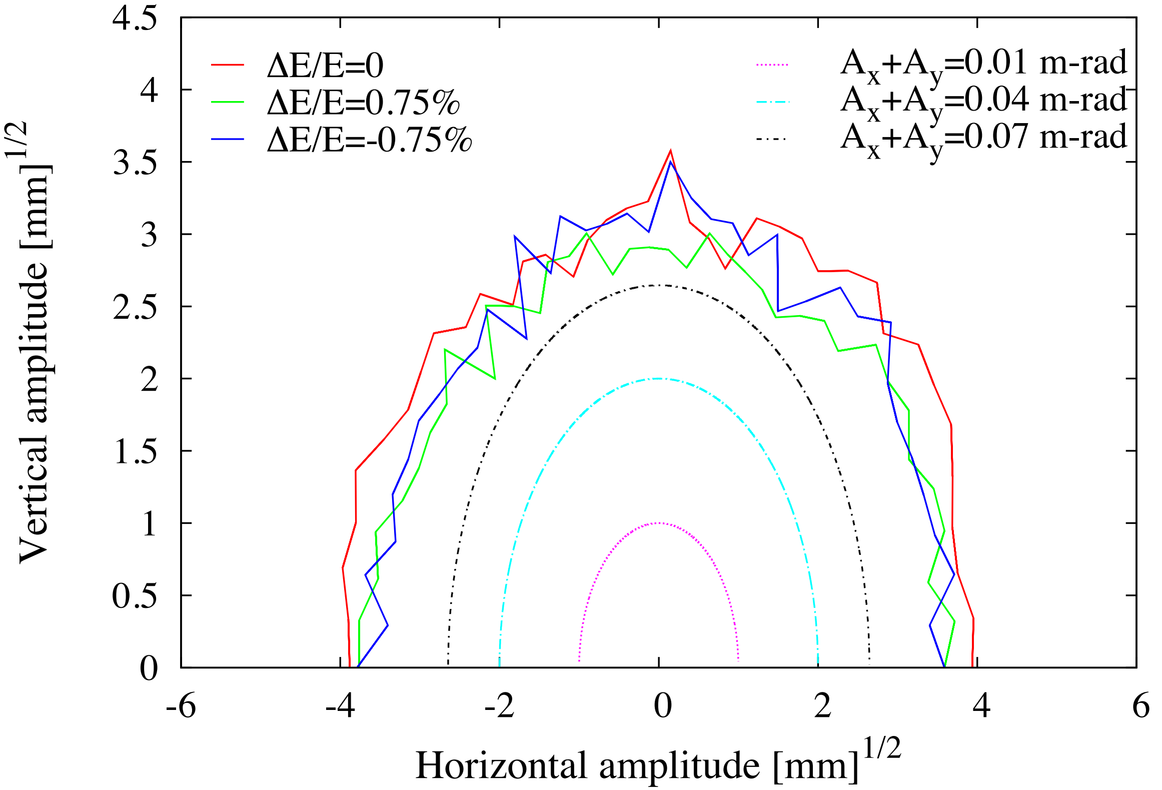
- Baseline 5Hz –
  - Electrons and positrons, τ_D = 24ms (1.5T wig)
- High lumi 10 Hz
  - Positrons – τ_D = 13ms (2.2 T wigglers)
  - Electrons – τ_D = 18ms (1.8T)



54 - 2.1m long wigglers

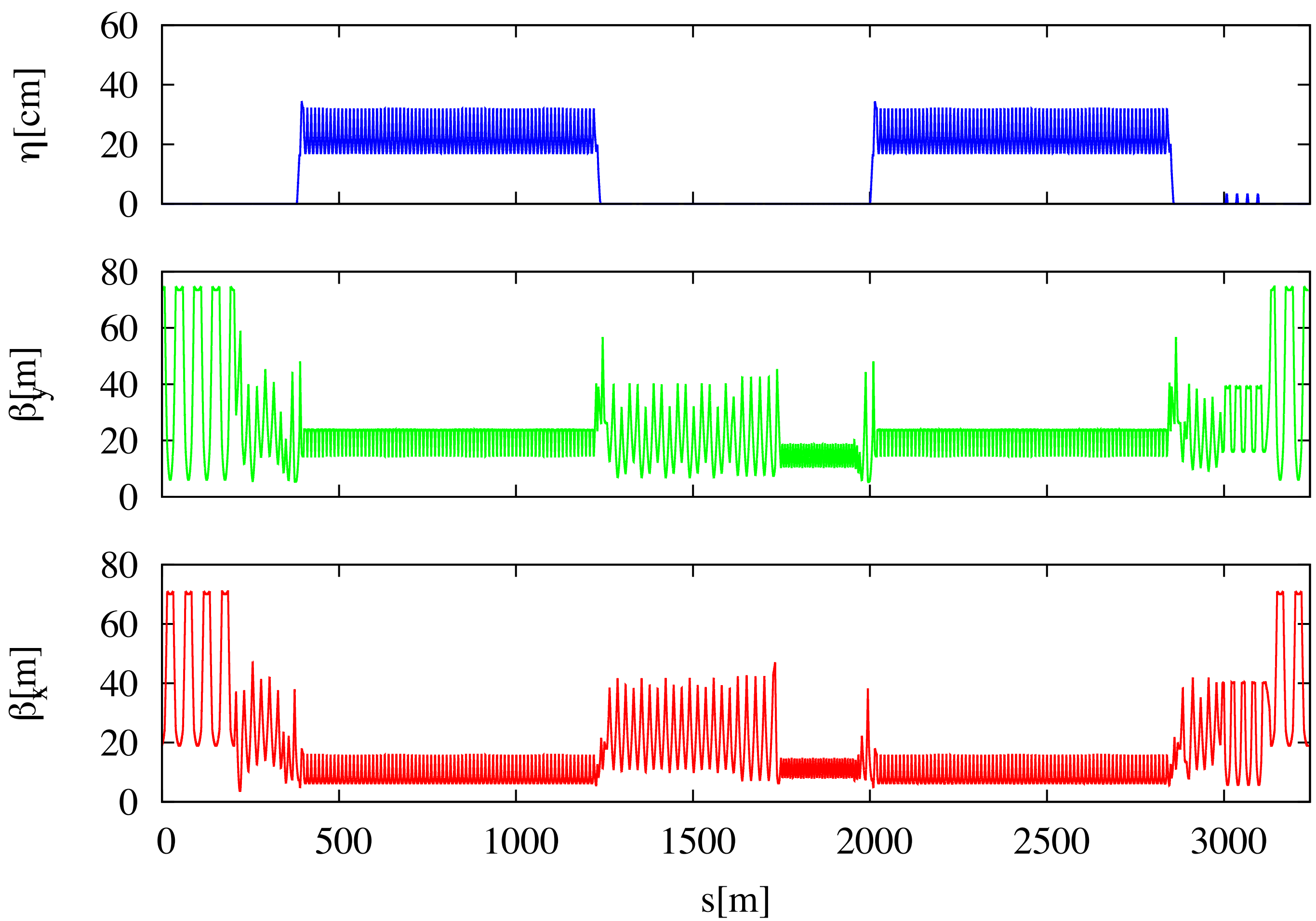
Maintain tools for modeling damping ring properties

– Tracking codes for evaluating dynamic aperture, injection and extraction (to evaluate the implications of adjusting path length by shifting RF frequency)



Stewardshop

Accelerator modeling code for computing lattice properties, dependencies, etc.



Instrumentation

Define emittance tuning procedure

Maintain list of instrumentation required for commissioning and emittance tuning

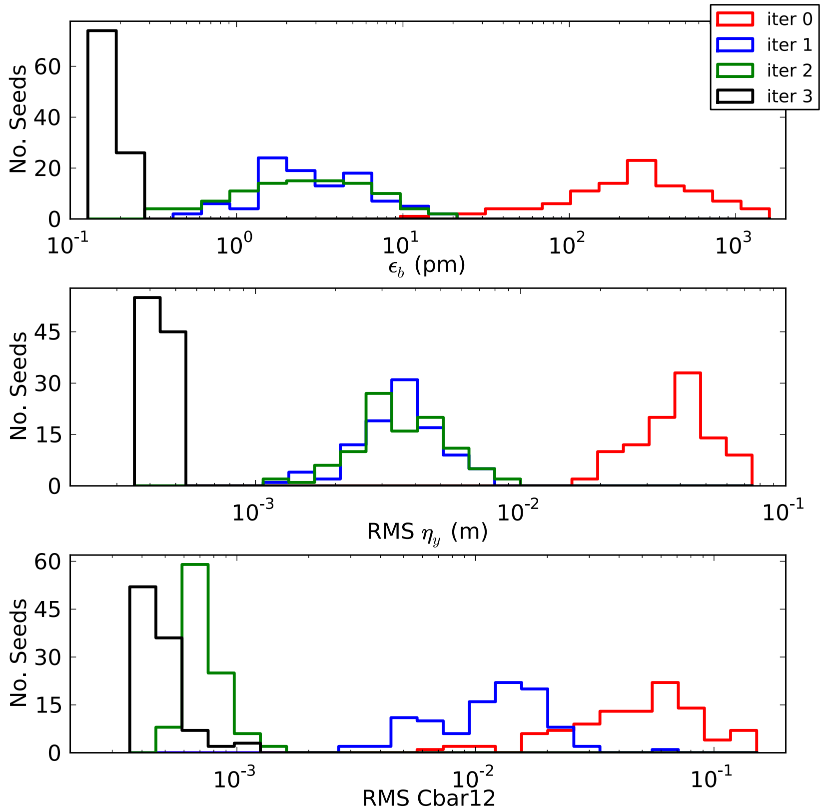
Emittance tuning procedure

1. Measure closed orbit (511 BPMs) and correct (563 steering correctors)
2. Measure betatron phase and coupling and dispersion. Correct betatron phase, horizontal dispersion and coupling using all 813 normal quadrupoles and 160 skew quads
3. Remeasure orbit, coupling, dispersion and correct using vertical steering and skew quads

Emittance tuning instrumentation

1. 511 bunch by bunch and turn by turn BPMs with 1μm differential resolution
2. "Tune tracker" and kickers to drive a single bunch at horizontal, vertical and synchrotron tunes for measurements of β-phase, coupling, dispersion
3. Independently powered quadrupoles, 563 dipole correctors and 160 skew quads to make corrections

DTC04 emittance tuning



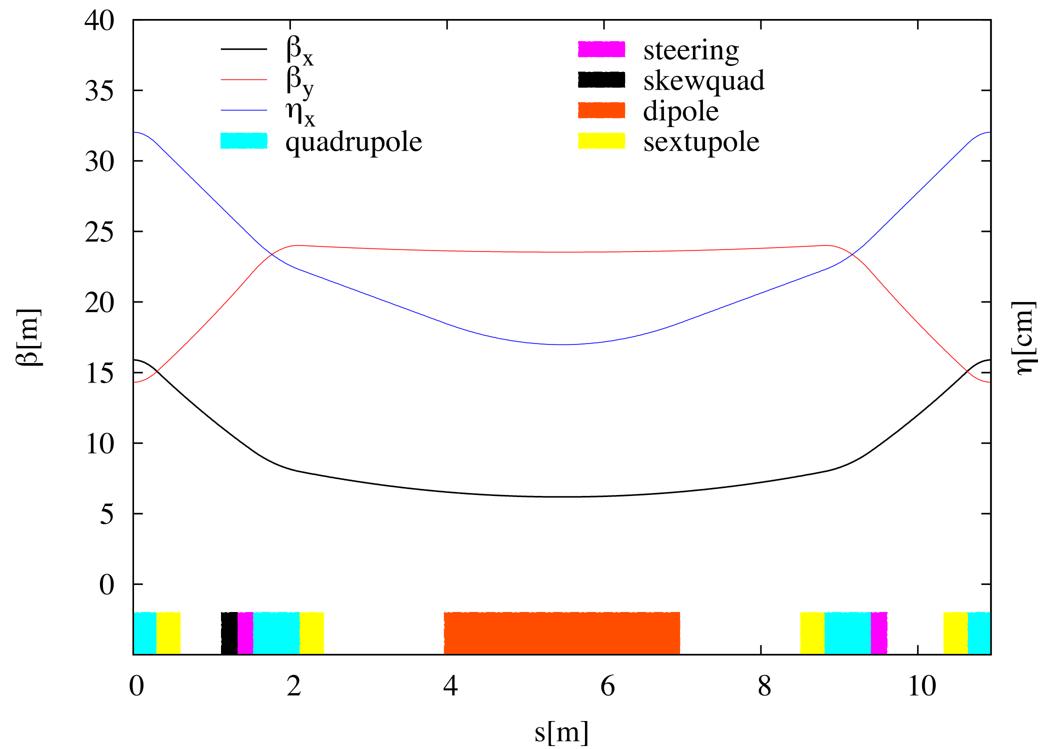
Value Engineering

Explore possibility of reducing magnet count

- Replacing pair of vertically focusing quads and bend with combined function magnets in arcs
- Incorporate sextupole component in combined function magnets to eliminate one or more individual sextupoles.

Each cell contains :
1 - 3m dipole, θ = π/75
3 – quadrupoles
4 - sextupoles
3 - corrector magnets
    1-horizontal steering
    1-vertical steering
    1- skew quad
2 beam position monitors

75-cells/arc



Value Engineering

Determine the minimal instrumentation required to achieve and maintain low emittance targets:

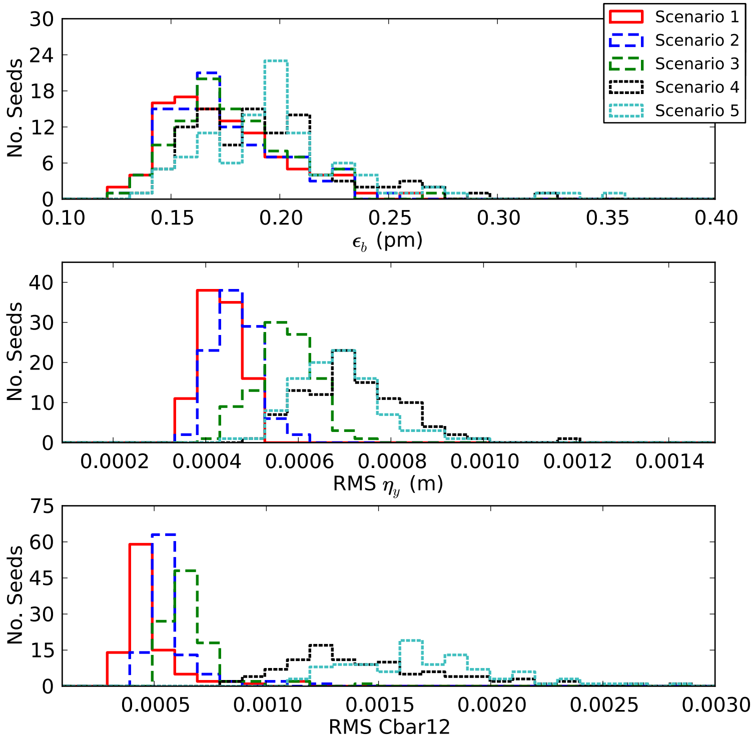
– Minimum number of beam position monitors (with the appropriate level of redundancy) and

– How to deploy BPMs

– Required resolution and band width.

Scenario

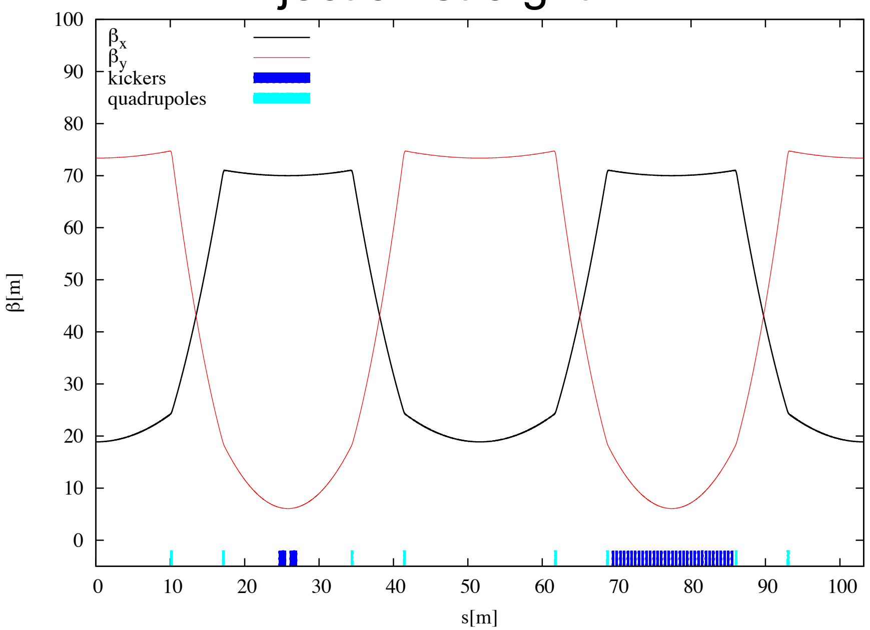
1. 511 BPMs (baseline)
2. 361 – a
3. 361 – b
4. 287 – a
5. 287 – b



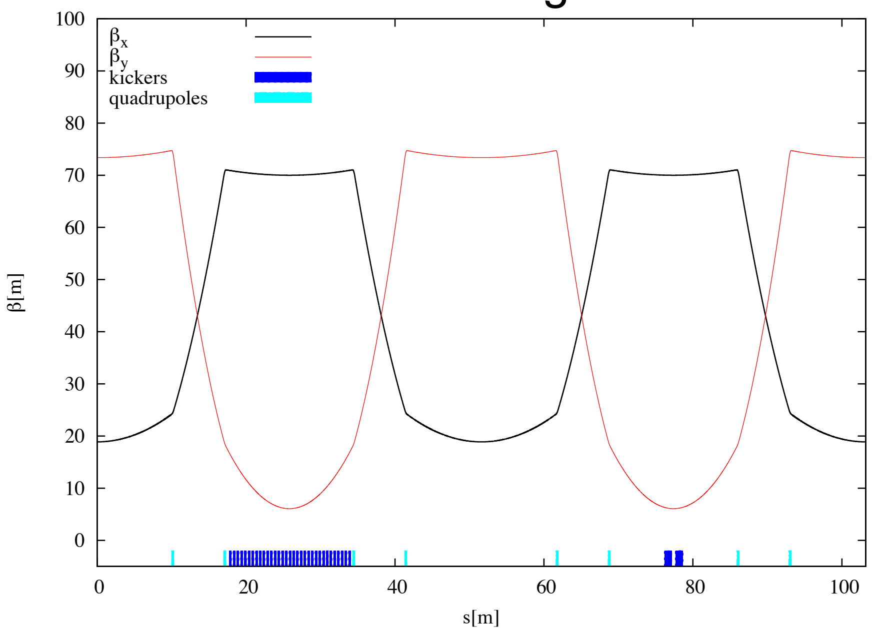
Injection and Extraction

Develop tools for a tracking study of the injection and extraction process to better understand the tolerances and requirements of the hardware – evaluate kicker impedance, etc.

Injection straight



Extraction straight

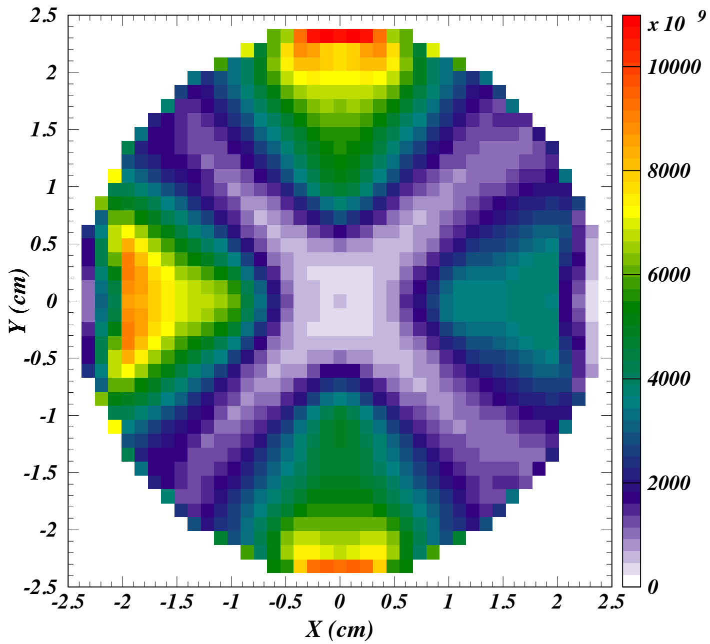


42 - 30cm strip line kickers

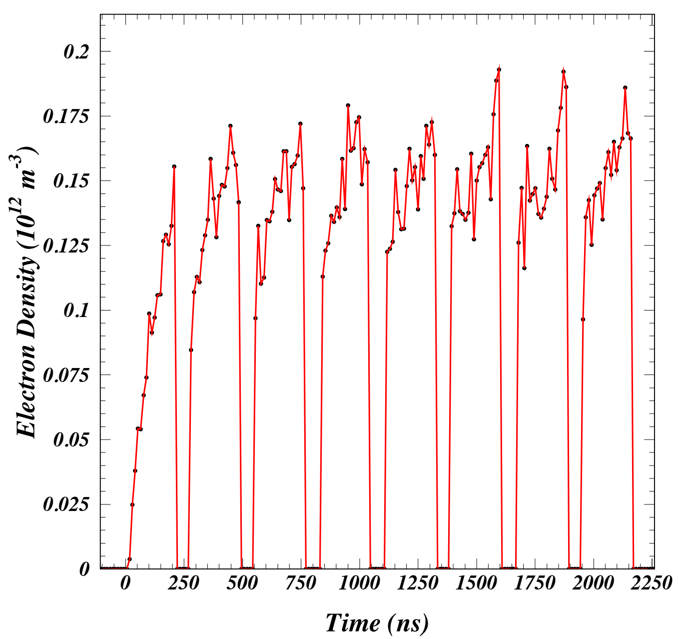
Revisit electron cloud emittance growth and instability thresholds

Codes have been developed:

- to simulate distribution of synchrotron radiation photons, scattering, reflections, absorption, etc. (Synrad3D)
- Simulate photo-emission, secondary emission of electrons, and evolution of the cloud in the environment of the passing beam (ECLOUD, POSINST)



Electron distribution in quadrupole



Evolution of quadrupole cloud

Electron Cloud

We are developing weak-strong model
of positron beam – electron cloud interaction

Goal:

Model that can predict equilibrium emittance of positron beam propagating through cloud computed with Synrad3D & ECLOUD

=> determine whether we need one positron damping ring or two

Stewardship

- Add key damping ring technical design documents in EDMS – beginning with damping ring parameter tables
- As needed studies to maintain damping ring compatibility with the collider as a whole as new design features and operating modes are explored.

END