Simulation Studies for LARP RHIC Experiment

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Simulation Goals

- Establish amount of physics needed:
  - Noise
  - Lattice non-linearities
  - Longitudinal dynamics
  - Chromaticity

Simulation Tool: PLIBB

(Stands for Proton Lifetime with Beam-Beam Interaction), a C++ toolkit for beam dynamics:

Features

- Massively parallel tracking code, optimized for speed
- Reads MADX and MAD8 input files
- Extensively benchmarked against MAD8
- Originally created for Tevatron, optimized for multiple parasitic crossings

Simulation Tool: PLIBB

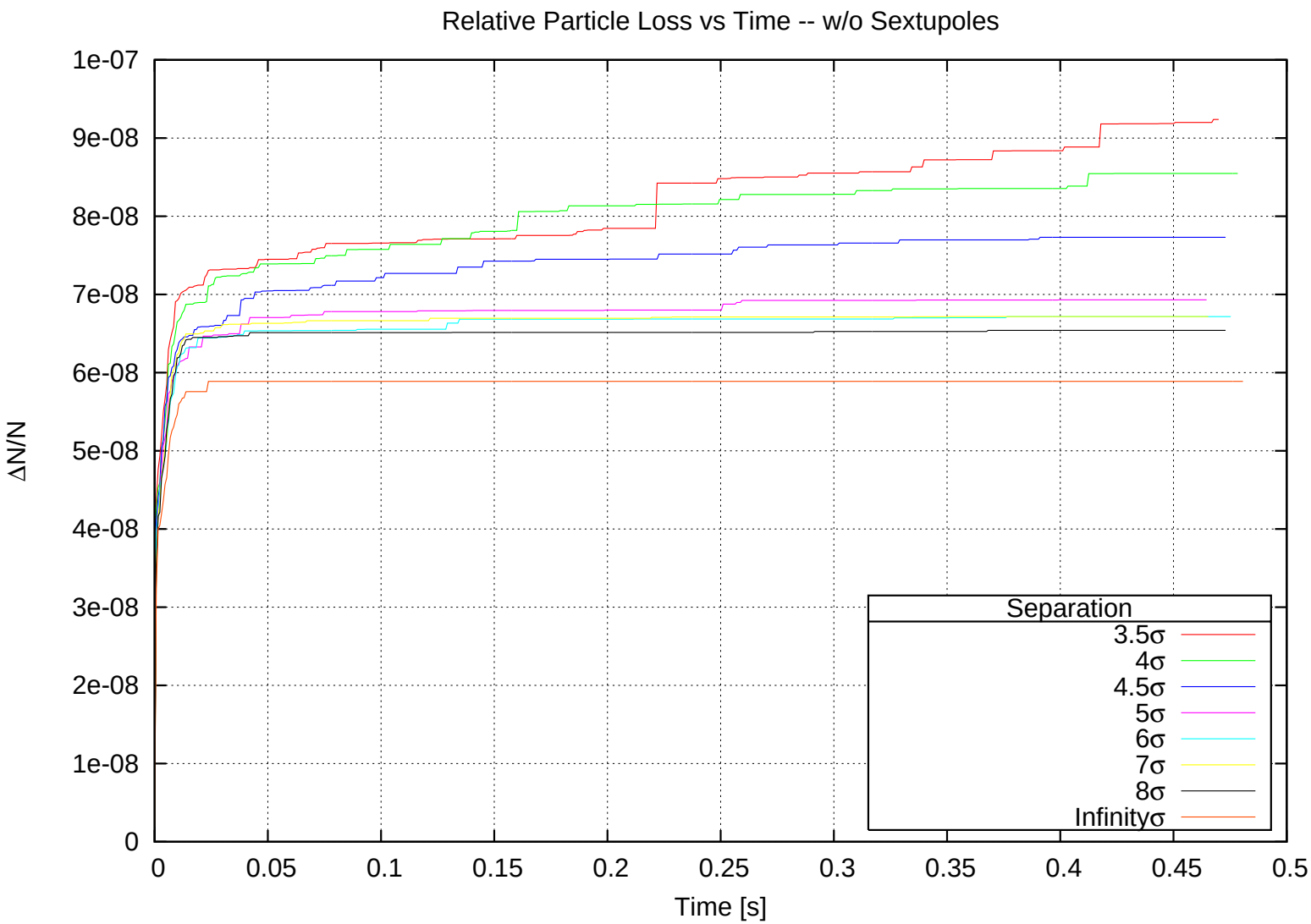
Physics/Numerics

- Differential algebra & Fast tracking engine
- Fully 6D
- Most magnetic elements
- Weak/strong beam-beam (sliced, synchrobetatron)
- Thick or thin elements
- Linear or chromatic lumped sections
- Noise
- Current wires (circular)

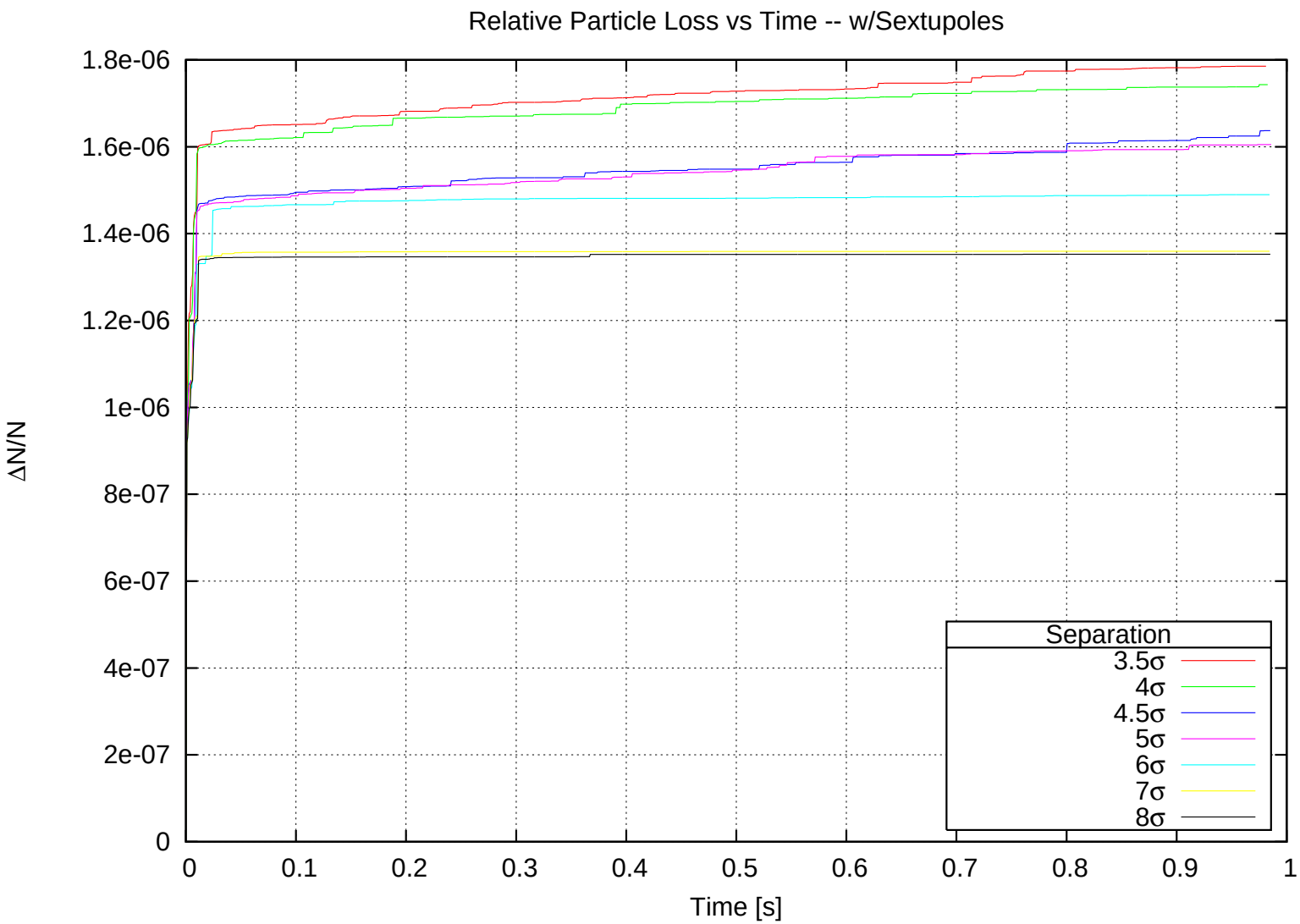
Simulation Setup

- Blue and Yellow Ring are read in from MADX description
- Elements are split at the interaction positions
- Strong 6D Equilibrium distributions are calculated at the interaction positions
- Beam-Beam elements are inserted
- Weak 6D Equilibrium distributions are calculated at the interaction positions
- Monte Carlo distribution is set up
- Tracking for typically $10^{10} \ldots 10^{12}$ particles $\cdot$ turns
- Loss rates are calculated from tagged particles

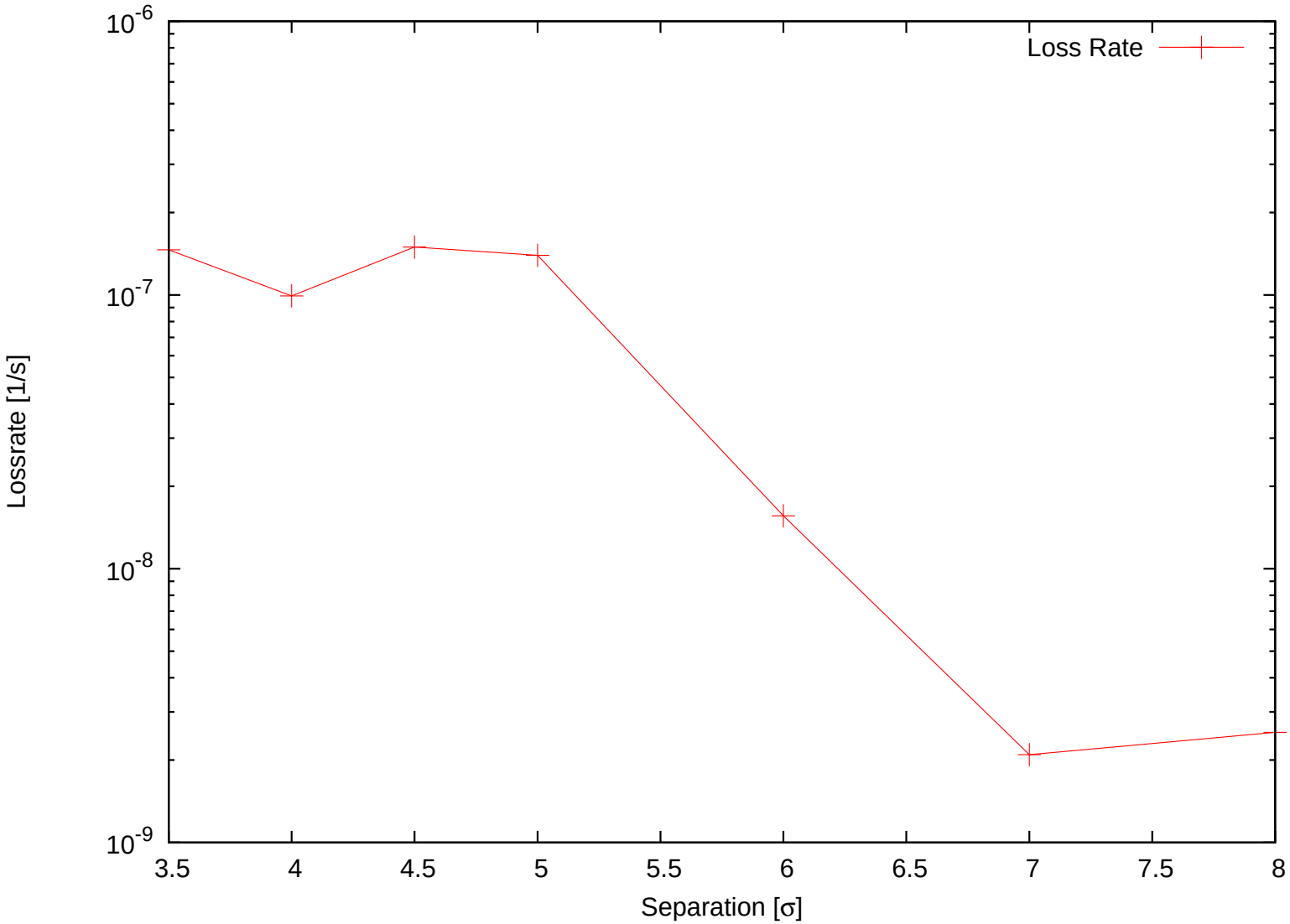
Parasitic Crossing Only



Parasitic Crossing + Sextupoles



Exponential Fit



Future Work:

- Include more physics: noise, more non-linearities
- Add wires
- Longer simulation runs
- Compare with element-by-element tracking