

Simulation of Transverse Electron Beam Tails

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Beam lifetime as function of aperture

$$\tau_{\text{life}} = \frac{1}{2a_{\beta}r_{\beta}} \cdot e^{r_{\beta}},$$

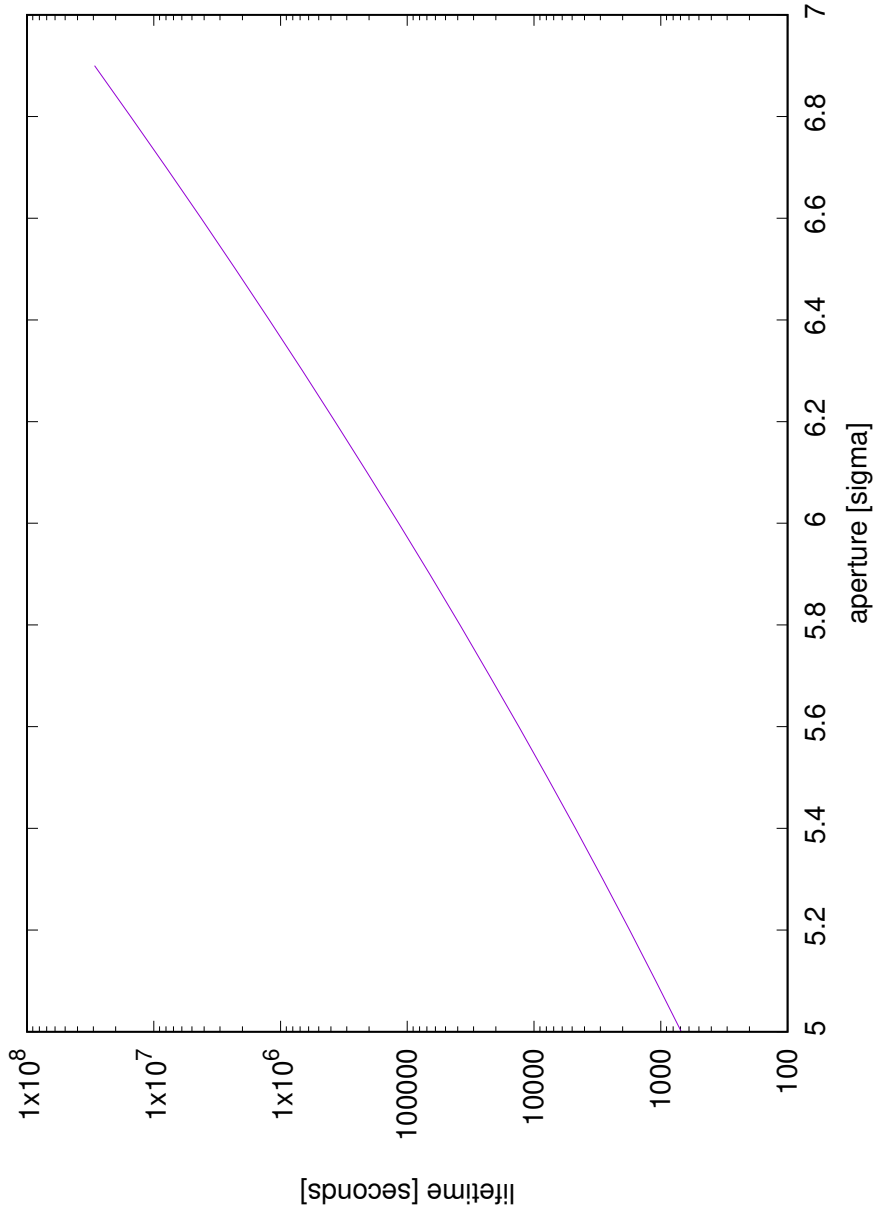
with

$$r_{\beta} = \frac{1}{2} \left(\frac{x_{\beta}}{\sigma_{\beta}} \right)^2$$
$$\frac{1}{a_{\beta}} = \tau_{\text{damping}}$$

x_{β}/σ_{β} is the limiting aperture in σ

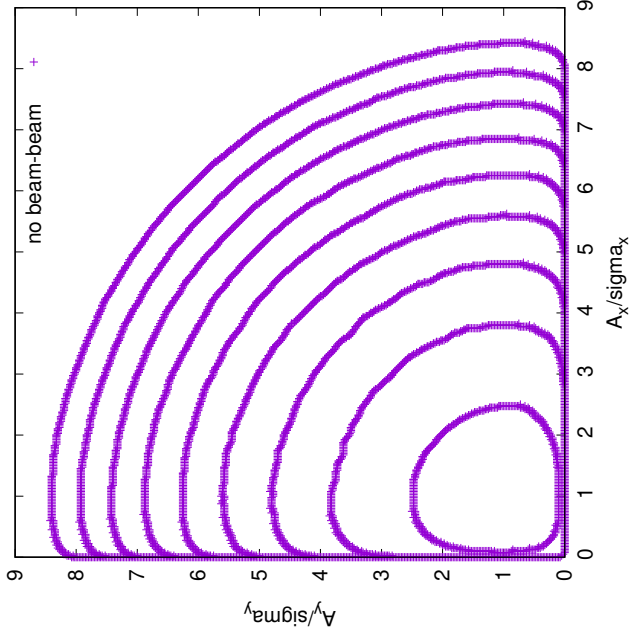
For eRHIC, $\tau_{\text{damping}} = 65$ msec at 10 GeV

Lifetime of a 10 GeV eRHIC beam



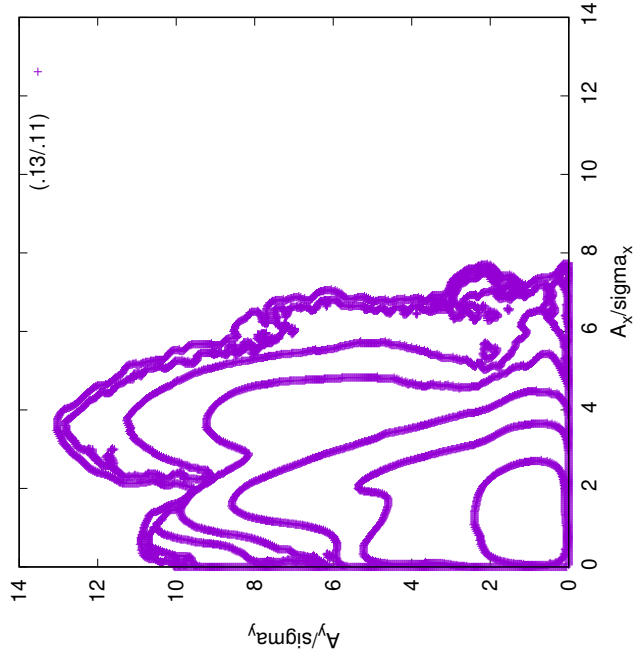
For a Gaussian beam, 6σ would yield ≈ 30 h lifetime

Simulation results without beam-beam



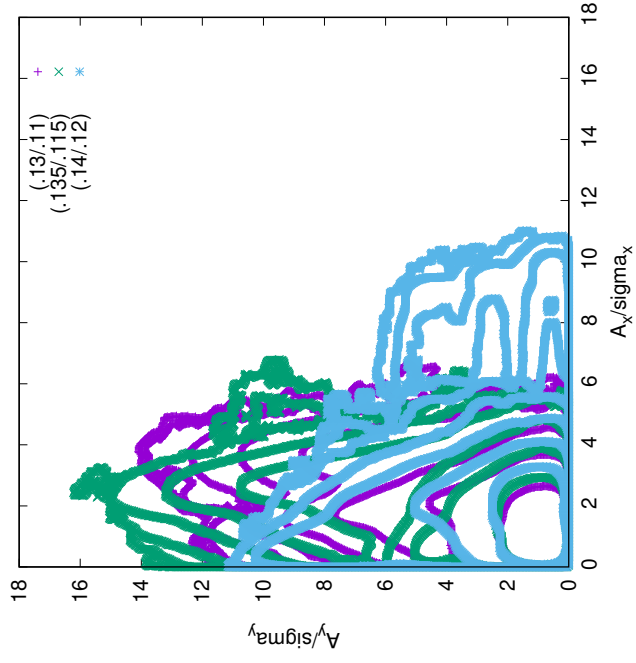
Contour plot of a perfectly Gaussian beam, distance between contours is $2e$
Note that the 5th contour line just about fits inside 6σ , which yields 30 h lifetime

Example for moderate lumi, divergence



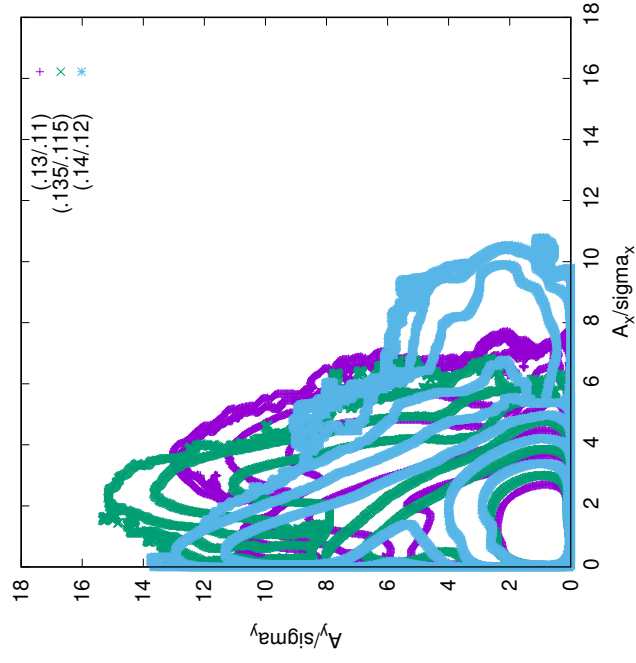
15 σ nominal aperture accomodates “all” tails
How to interpret tails beyond 4th contour line?

Moderate lumi, high acceptance



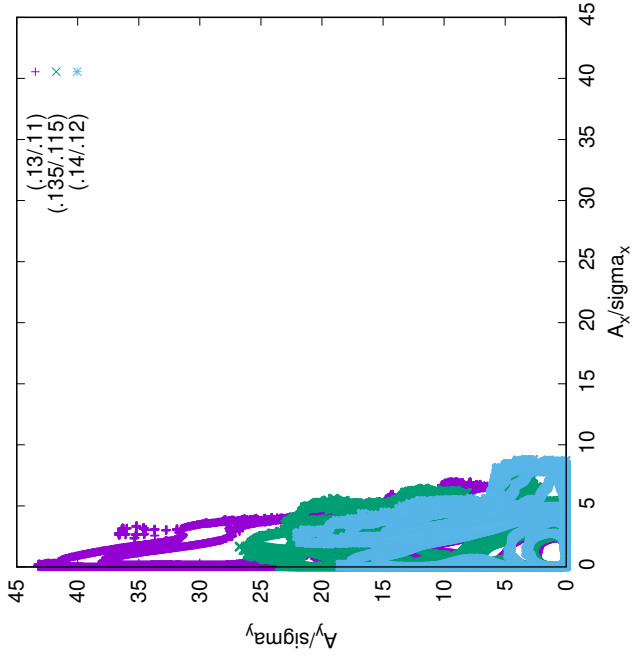
Small tune variations yield very different tails
 15σ nominal aperture accommodates “all” tails

Moderate lumi, high divergence



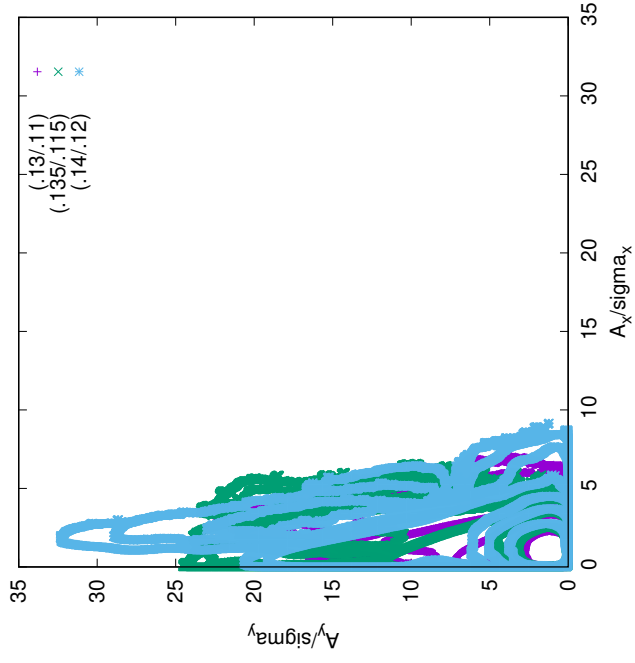
Small tune variations yield very different tails
 15σ nominal aperture accommodates "all" tails

Full lumi, high acceptance



Significant non-Gaussian vertical tails
Small tune variations yield very different tails

Full lumi, high divergence



Significant non-Gaussian vertical tails
Small tune variations yield very different tails

Summary

- Simulated transverse tails for 10 GeV electrons against 275 GeV protons
- Small tune variations can result in very different tail distributions
- Not sure how to interpret some of the results...