Calculating Emittance from Lumi

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1 General Formula

The specific luminosity is defined by:

$$\mathcal{L}_{\mathrm{spec}} = \frac{1}{4\pi f_o e^2 \sigma_x^* \sigma_y^*} = 6.55 * 10^{25} \frac{1}{\sigma_x^* \sigma_y^*} \mathrm{mA}^{-2}\mathrm{s}^{-1} \tag{1}$$

where f_0 is the revolution frequency and $\sigma_x^* \sigma_y^*$ are the effictive beam sizes at the Interaction Points in the transverse planes, defined by:

$$\sigma_x^* = \frac{1}{\sqrt{2}} \sqrt{\sigma_{x_i e}^{*2} + \sigma_{x_i p}^{*2}} = \frac{1}{\sqrt{2}} \sqrt{\beta_{x_i e}^* \epsilon_{x_i e}^* + \beta_{x_i p}^* \epsilon_{x_i p}^*} \tag{2}$$

Average values for 95:

Protons: $\sigma_{x_i p}^{*2} = 0.185\mathrm{mm}$, $\sigma_{y_i p}^{*2} = 0.0584\mathrm{mm}$

Electrons: $\sigma_{x_i e}^{*2} = 0.239\mathrm{mm}$, $\sigma_{y_i e}^{*2} = 0.0551\mathrm{mm}$

lead to an average initial specific luminosity in 1995:

$$\mathcal{L}_{\mathrm{spec}} = 5.4 * 10^{29} \mathrm{mA}^{-2}\mathrm{cm}^{-2}\mathrm{s}^{-1}$$