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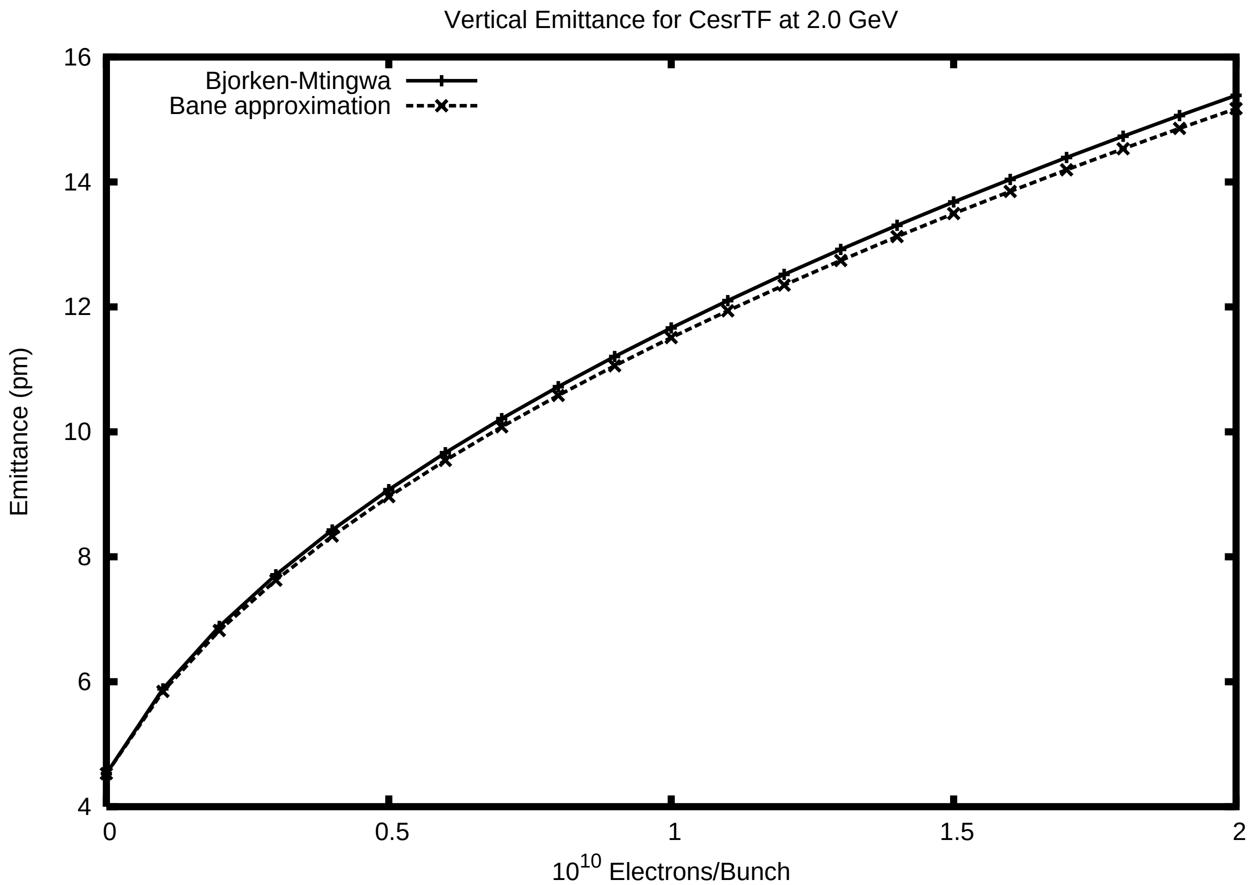
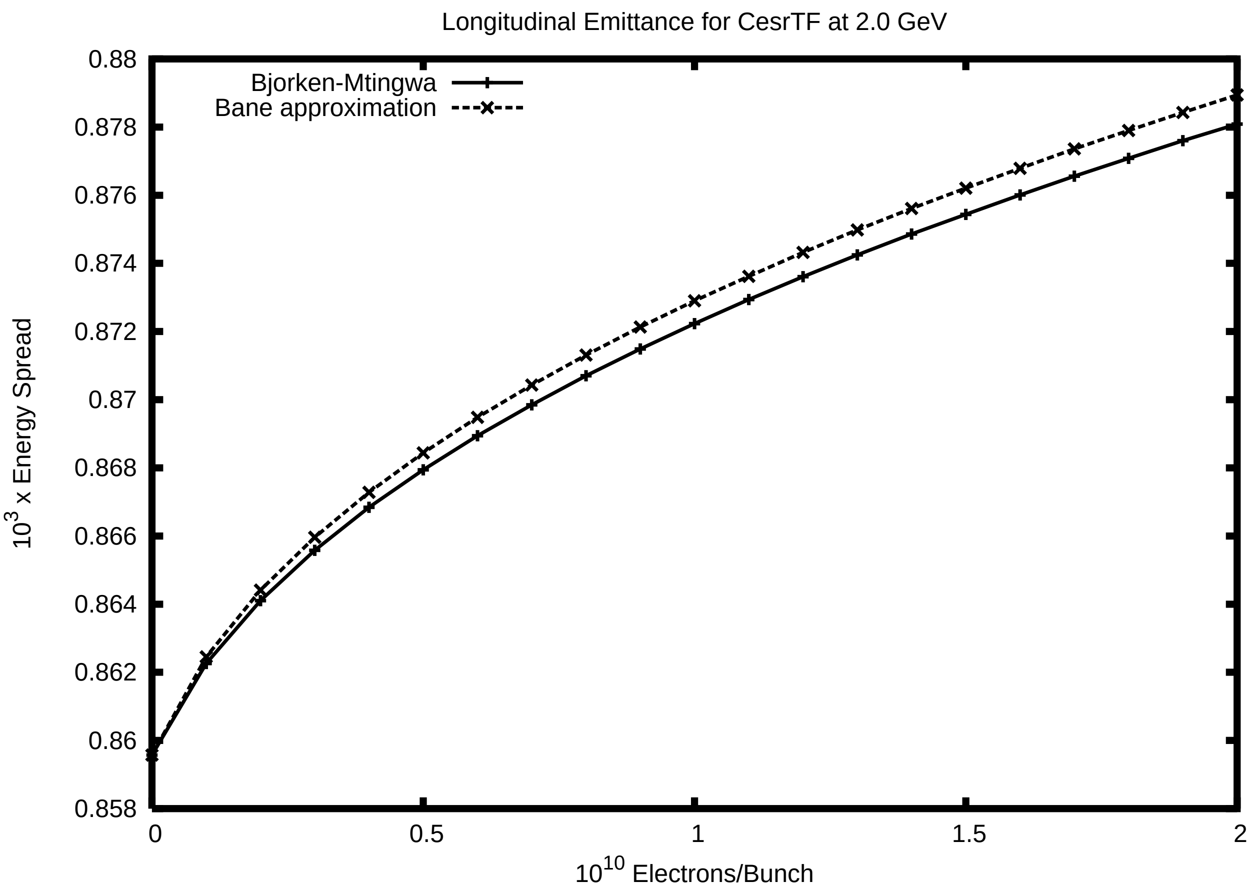
Memo for Monday weekly ILC meeting

Comparison between Bjorken-Mtingwa and Bane implemented in BMAD

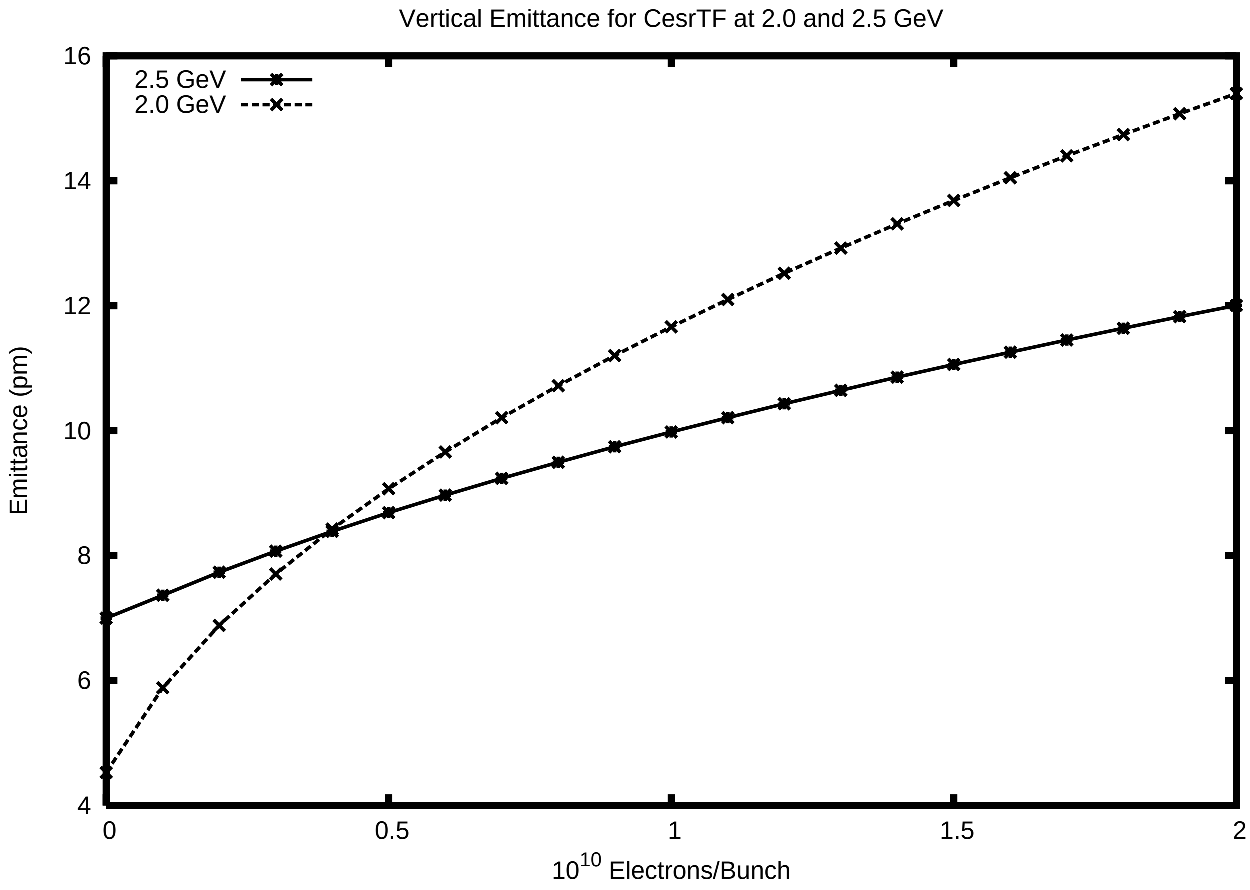
The plots below show that the general Bjorken-Mtingwa and Bane approximagion IBS equations implemented in BMAD give results that agree very well with eachother.




Longitudinal Emittance for CesrTF at 2.0 GeV
Bjorken-Mtingwa
Bane approximation
10^3 x Energy Spread
10^{10} Electrons/Bunch
0.858
0.86
0.862
0.864
0.866
0.868
0.87
0.872
0.874
0.876
0.878
0.88
0
0.5
1
1.5
2

Equilibrium emittance of CesrTF at 2.5 GeV

To lower the equilibrium emittance of CesrTF the beam energy was raised from 2.0 to 2.5 GeV. This resulted in a slightly higher natural emittance, but lower equilibrium emittance. IBS rates have approximately a γ^{-4} dependance.



Mtingwa-Tollerstrup T-ratio

Calculations in BMAD show that CesrTF has a large horizontal emittance growth but small longitudinal emittance growth. One possible explanation for this difference in rates can be found by examining an IBS formulation derived by Mtingwa-Tollerstrup.

The Mtingwa-Tollerstrup formulation can be written as follows:

$$\frac{\mathbf{1}}{\tau_{\mathbf{V}}} = \mathrm{F(lattice\ functions)}$$

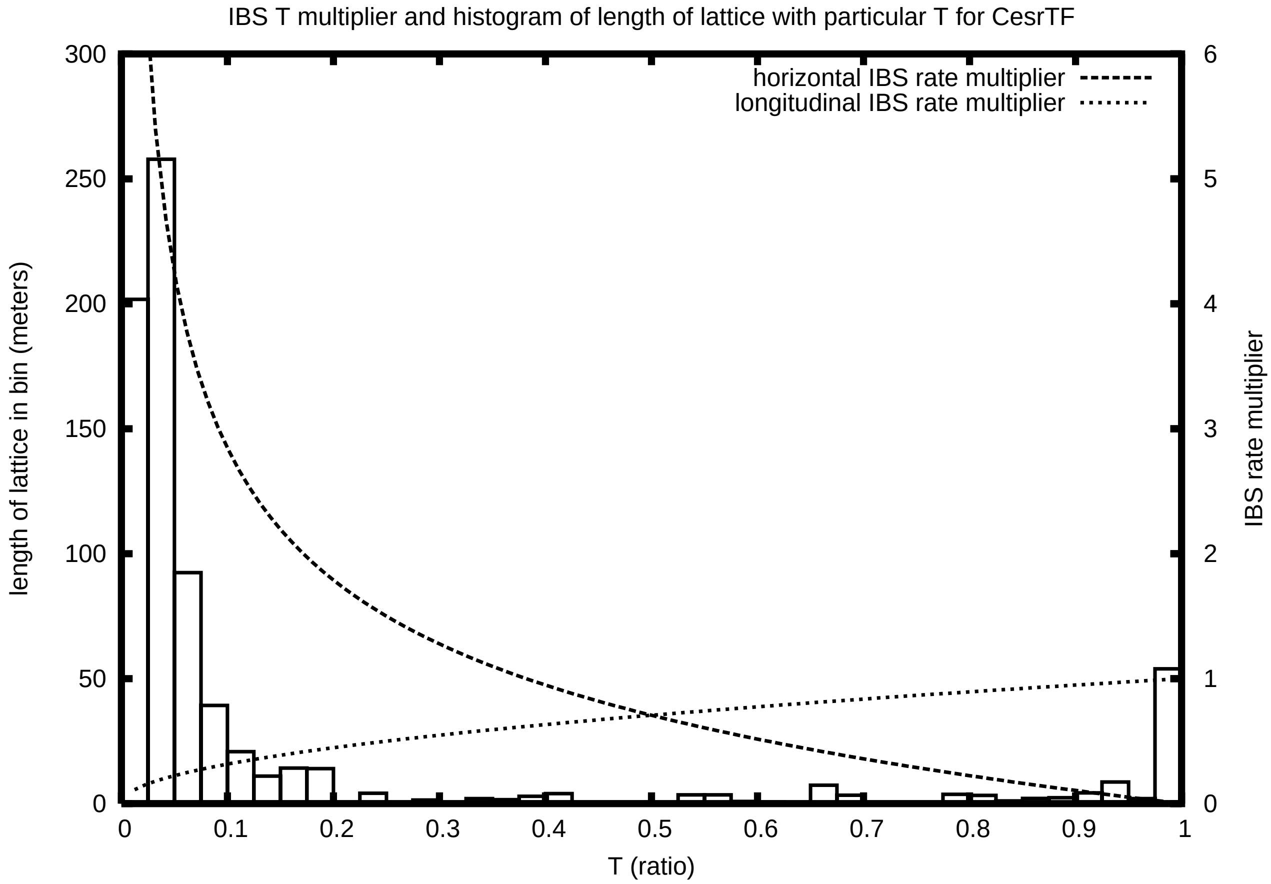
$$\frac{\mathbf{1}}{\tau_{\mathbf{H}}} = \frac{\mathbf{(1-T)}}{\sqrt{\mathbf{T}}}\ \mathrm{G(lattice\ functions)}$$

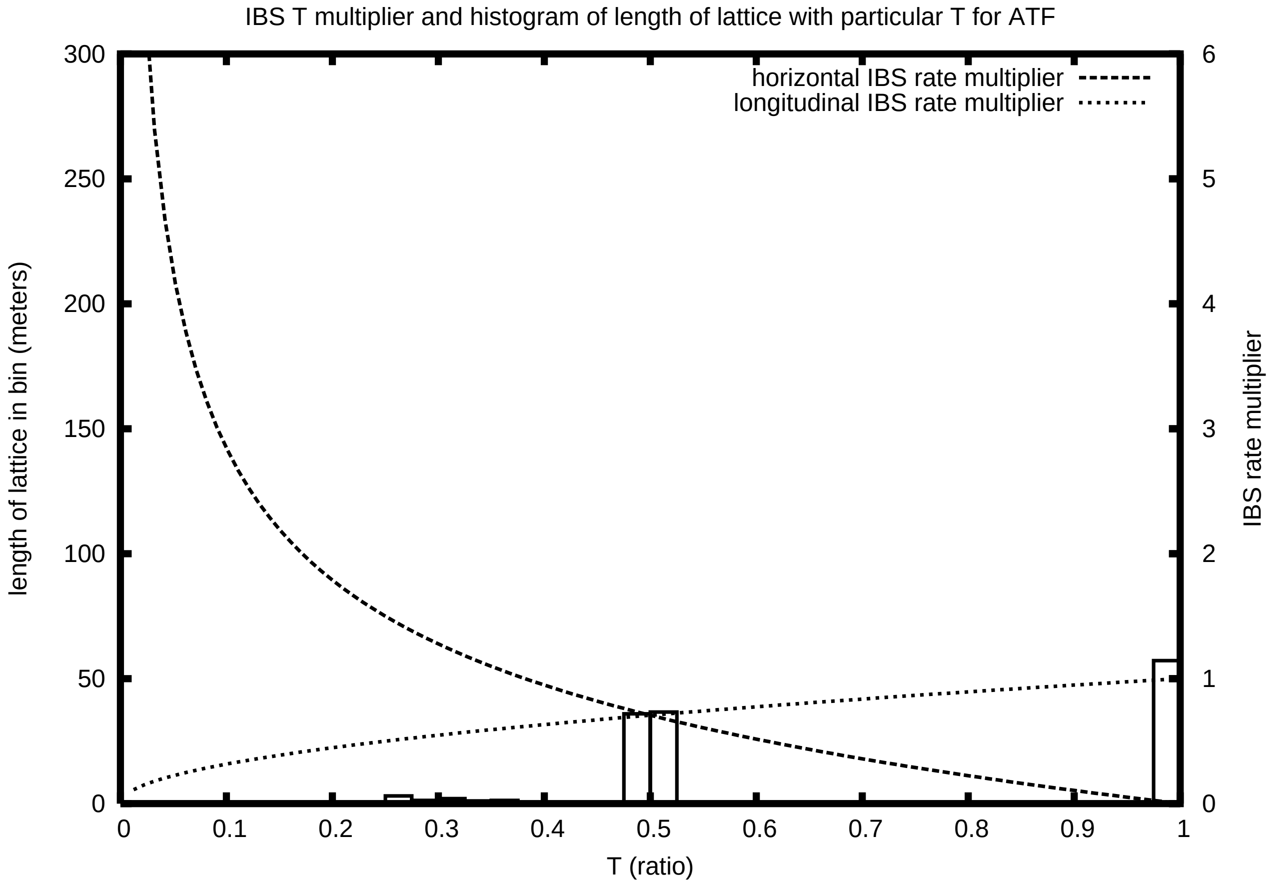
$$\frac{\mathbf{1}}{\tau_{\mathbf{P}}} = \sqrt{\mathbf{T}}\ \mathrm{G(lattice\ functions)}$$

where,

$$\mathrm{T} = \frac{\sigma^{\mathbf{2}}_{\mathbf{H}\beta}}{\sigma^{\mathbf{2}}_{\mathbf{H}\beta} + \eta^{\mathbf{2}}\sigma^{\mathbf{2}}_{\eta}},\ \text{note: } 0 < \mathrm{T} < 1$$

The figures below plot the effect of T on horizontal and longitudinal IBS rates as well as the total length of lattice with that particular value of T. The fisrt plot shows the results for CesrTF, where horizontal growth rates are much larger than longitudinal growth rates. For comparison the same plot is done for ATF, where horizontal and longitudinal IBS rates are almost identical.


IBS T multiplier and histogram of length of lattice with particular T for CesrTF
horizontal IBS rate multiplier
longitudinal IBS rate multiplier
length of lattice in bin (meters)
IBS rate multiplier
T (ratio)
0
50
100
150
200
250
300
0
1
2
3
4
5
6
0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.9
1


IBS T multiplier and histogram of length of lattice with particular T for ATF
horizontal IBS rate multiplier
longitudinal IBS rate multiplier
length of lattice in bin (meters)
IBS rate multiplier
T (ratio)
0
50
100
150
200
250
300
0
1
2
3
4
5
6
0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.9
1

Horizontal IBS contribution and T ratio around ring for CesrTF

The plot below shows the horizontal IBS rate contribution and T ratio around the CesrTF lattice. Note that the horizontal contribution varies inversely with the T ratio.