R. F. Requirements for Matching the Precooler

π Bunches into the Booster

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The non-accelerating π bunches in the Precooler must be extracted and matched into the Booster decelerating R.F. buckets. In this report it has been assumed that the Booster is operating between .2 GeV and 8 GeV (kinetic energy) at 15 Hz and that the R.F. system is using the 84th harmonic.

It is impossible to match exactly non-accelerating bunches into accelerating R.F. buckets. However, the larger is the ratio of the R.F. bucket area to the bunch area, the better the match. Unfortunately, the larger this ratio becomes, the smaller the bunching factor of the π bunches becomes, leading to extremely large bunching voltages in the Precooler. A ratio of 2 is about as low as one can permit.

For this study it has been assumed that the area of the 84 π bunches is 2 eVs and that these are sufficiently bunched by the Precooler voltage system to be nearly matched into 4 eVs Booster R.F. buckets. For a given π energy assumption one first assumes that the Booster voltage has been adjusted to produce 4 eVs buckets. One then finds the amount of Precooler voltages required to produce the same bunch length as that of 2 eVs area contour in the Booster. (The maximum momentum spread in the π bunches turns out to be about 1.5% smaller than that of the 2 eVs Booster area contours.)

The voltage required in the Precooler is also proportional to

$$\eta = \left( \frac{1}{\gamma^2} - \frac{1}{\gamma_T^2} \right)$$

for the Precooler. The figure shows v/η vs. π energy. The generally accepted value of η is about .02 (cooling requirements). The figure shows clearly that π energies in the neighborhood of the Booster 4.15 GeV transition energy should be avoided.