Luminosity Measurements for E91-011

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last updated November 14, 2000

Luminosity monitoring for E91-011 was done by plotting run number versus $\frac{\text{T1}}{\text{current}}$. The strobe rate for all runs beginning with run 2012 were written into the data stream allowing for deadtime corrections to be added for these runs. For a detailed explanation of the strobe rate and deadtime, see Mark Jones' "Report on Electronic Deadtime."

Figure 1 is the luminosity monitor of runs 1220 to 2011. The plot shows

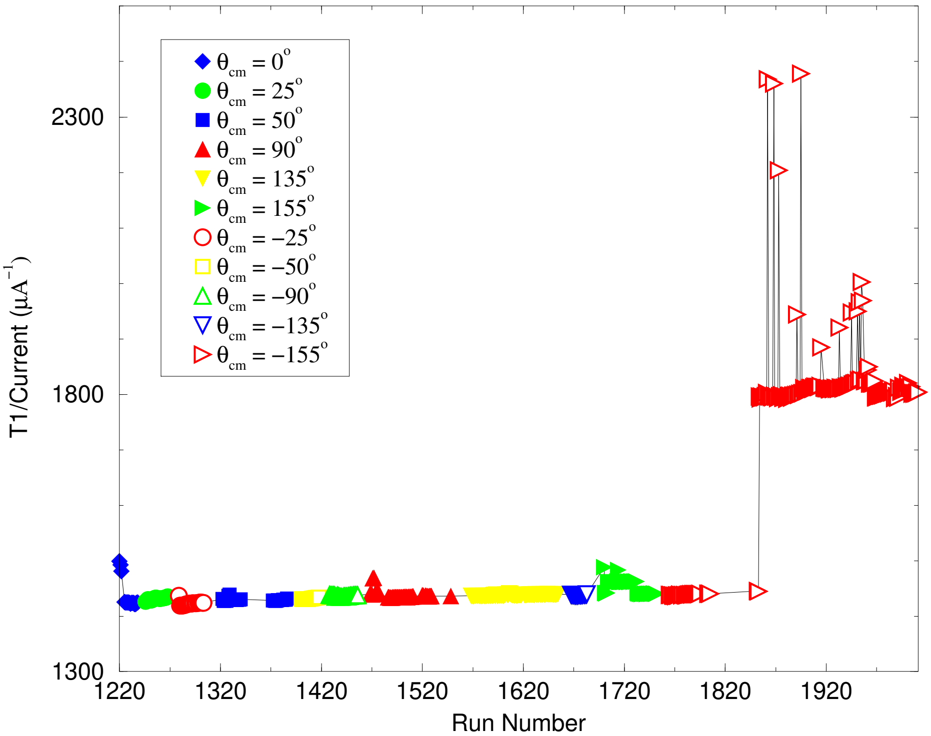

Figure 1: Luminosity monitor of pion production runs 1220-2011.

$\frac{\text{T1}}{\text{current}}$ for all good pion productions runs. All runs prior to 1854 were taken with a 6 msr collimator in each spectrometer arm. Beginning with run 1854, the 6 msr collimator was removed, except for runs to measure the spectrometer pointing and one or two pion production runs at the beginning of each new spectrometer setting. The removal of the 6 msr collimator before run 1854 lead to the discontinuity at that point on figure 1. Many runs during measurements at $\theta_{cm} = -155°$ (runs 1862, 1867, 1873, 1891, 1895, 1933, 1945, 1951, 1953, 1955-1956, 1988, 1992, and 2001) ended due to quenches of the electron arm Q3. This resulted in the sharp increases in $\frac{\mathrm{T1}}{\mathtt{current}}$ seen at this setting. Figure 2 shows the average beam current for the same range of run numbers as shown

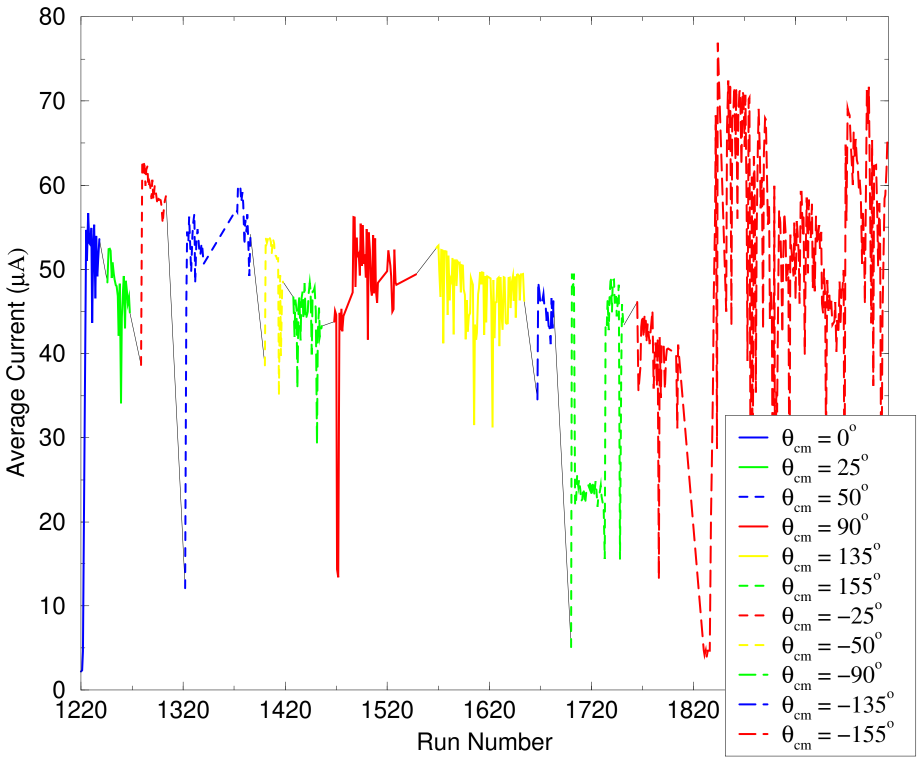

Figure 2: Average beam current for runs 1220-2011.

in figure 1. Notice that slight fluctuations in $\frac{\mathrm{T1}}{\mathtt{current}}$ are due to large changes in the beam current. Another thing to note, the average current used in figures 1 and 2 does not take into account short beam trips during the run.

For runs 2012 and higher, strobe rates for both the electron and hadron arm were written into the data stream. Assuming the electron strobe rate versus electronic deadtime has the same shape as the hadron plus electron strobe rate versus electronic deadtime, the electronic deadtime can be calculated using the following equation, from Mark Jones' "Report on Electronic Deadtime."

$$\mathrm{EDT} = 0.0190 * \mathrm{strobe} \tag{1}$$

Figure 3 is the luminosity monitor of runs 2017 to 4034 where the deadtime

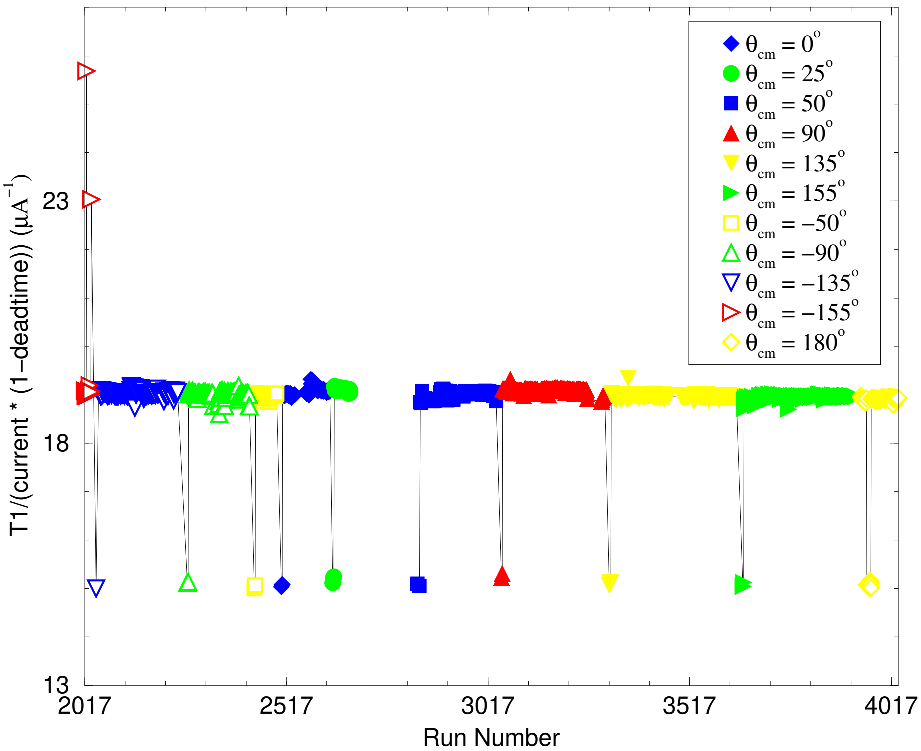

Figure 3: Luminosity monitor of pion production runs 2017-4034.

correction and short beam trips have been accounted for. The plot shows $\frac{\text{T1}}{\text{current}(1-EDT)}$ for all good pion production runs. The large gap from run number 2675 to 2842 exists because runs taken during the facility development time in the middle of the experiment are not being considered here. All sharp drops in $\frac{\text{T1}}{\text{current}(1-EDT)}$ correspond to runs taken with the 6msr collimator in at the beginning of each new spectrometer setting. Figure 4 is the same figure only zoomed in on a range of 18.5 μA^{-1} to 19.5 μA^{-1} of $\frac{\text{T1}}{\text{current}(1-EDT)}$ to see the fluctuations in more detail. Figure 5 shows the average beam current for the same set of run numbers as figures 3 and 4 where short beam trips have been accounted for.

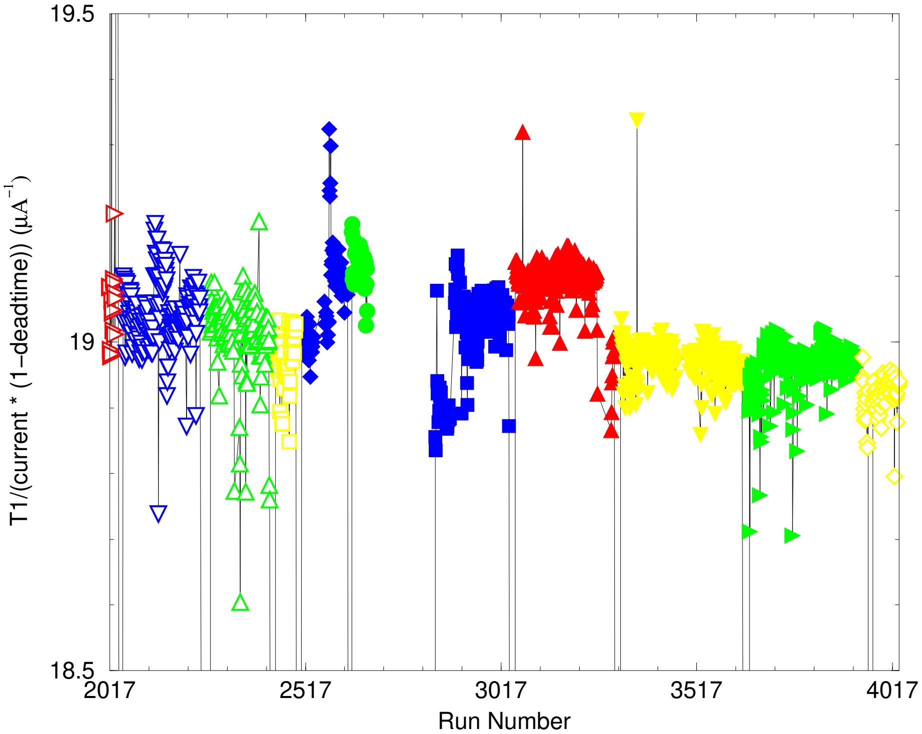

Figure 4: Luminosity monitor of pion production runs 2017-4034.

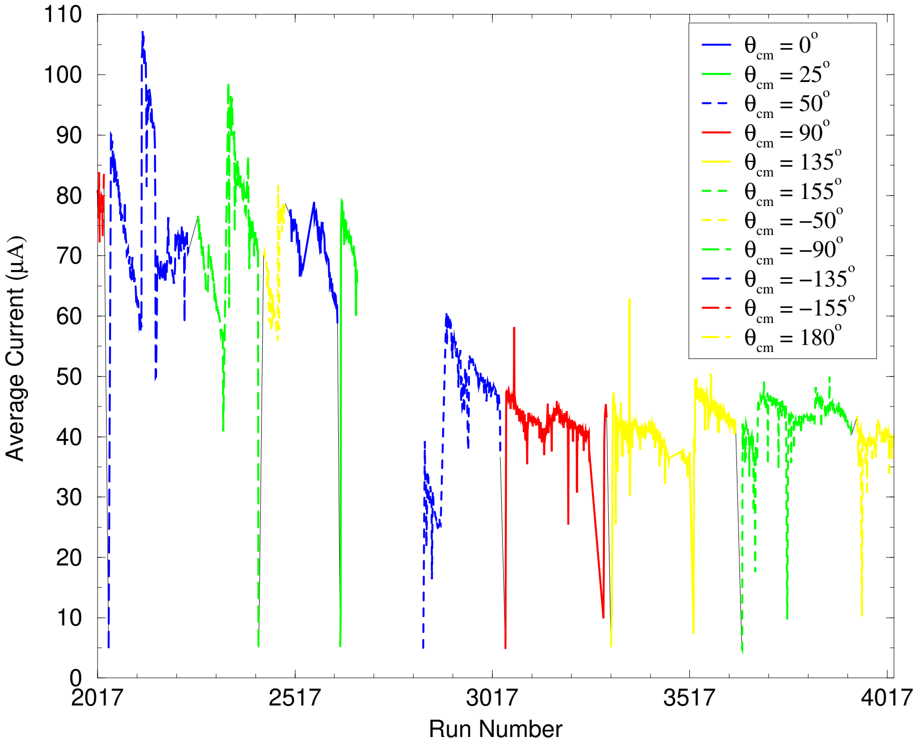

Figure 5: Average beam current for runs 2017-4034.