Impact Parameter

First we start with the basics. The cross section for interaction with our trigger setting is

$$\begin{aligned} \sigma &= \frac{R}{I * N} && (1) \\ I &= IncidentFlux \\ N &= NumberofScatteringCenters \\ R &= ScatteringRate \end{aligned}$$

First to get N.

$$\begin{aligned} N &= \frac{\rho N_a}{Aw} Target\,Thickness && (2) \\ \rho &= 19.299\,(g/cm^3) \\ N_a &= 6.022x10^{23}\,(part/mole) \\ Aw &= 197\,(g/mole) \end{aligned}$$

We had three Au targets of varying thickness. I have compiled here the various numbers.

Target	Thickness (cm)	N^*	N
10 mil	.0254	$5.899x10^{-2}$	$1.498x10^{-3}$
20	.0508	-	$2.997x10^{-3}$
30	.0762	-	$4.495x10^{-3}$

In order to get the incident flux we need to use the scalers generated from the upstream scintillators. The problem is that these were not very well maintained and therefore are this is not as straight forward as I would have liked. The scalers also changed in their makeup from one year to the next.

For the 2 and 4 GeV

On page 202 of the E895 I logbook you can find a listing of the scalers being recorded during the 2 and 4 GeV runs. I ran run 1205 for the 2gev and series 1140,1141,1142,1143,1144,1145 for the 4gev.

NOTE that in the 4gev run scaler 6 was moved to scaler 11.

The quantity we want is the number of good incident beam particles while the DAQ was active. Therefore the LIVETIME is

$$\begin{aligned} LIVETIME &= \frac{Scaler\ 6}{Scaler\ 9} \\ \sigma &= \frac{\int Scaler\ 9}{\int Scaler\ 8\ LIVETIME\ N} \end{aligned} \tag{3}$$

Now there is an additional complication. The scalers were free running through the entire spill. That is they were NOT zeroed after each event was taken. Therefore, all of the scalers continue to accumulate over several events. We made a cut when integrating the scalers on master triggers. The master trigger was the event number during the spill, therefore,a master trigger of 2 meant that two events had been taken when the scalers were saved. In this cas the cross section must be divided by 2. Note Master trigger 1's went to que0, 2's to que2 and 3's to que4 etc.

6 and 8 GeV

For the 6 and 8 GeV the same prescription was fallowed except the scalers were changed again. The relevant list is on page 19 of the e895 II log book.

Impact parameter

Once you have the σ_{trig} from above you can calculate the impact parameter. First choose a impact parameter range. Say 2 - 4 fm. Then I followed the procedure below to find the cuts at 2 and 4 fm.

$$\begin{aligned} \sigma_{geo} &= \pi r^2 \\ \frac{\sigma_{geo}}{\sigma_{trig}} &= \frac{\int_{max}^{cut} mult}{mult} \end{aligned} \tag{4}$$

The integration is from the maximum multiplity down to that needed for a cut giving the your predetermined impact parameter selection. This was done iteratively until the proper ratio was obtained.