Luminosity Measurement (precision of..)

- Previous Discussion:
  - Gerry Bunce- 1) relative luminosity (spin) and 2) Experiment Specific Requirements on scaling,bookkeeping -req. 10^{-4} error (relative) , saturation of Int.Prob/crossing
  - Last “MAC” review-1)Lum Monitoring for AuAu(SNW) and 2) Status of L from Machine params (W.McKay)
  - workshops...

Today's Issue

- Absolute Determination of L
- Sequence
  - » $L_{AuAu}=R/\sigma_{calculated}$
  - » L_{AuAu} from Machine Params
  - » L_{pp} from Machine params

Luminosity as used by experiment

- $\sigma_{(AuAu->b+X)}=N_{(AuAu->b+X)} * \sigma_{mon}/N_{mon}$

- σ_{mon}=11 barns {(>=1neutron)$_{blue}$*()$_{ye}$l}
- see Nucl Instr Meth 12/1/98 p1
- (other monitors calculated for cross check)

Considerations on Day--1

- L= (1-10%)* L_{design}
- I.R. vacuum <>~ 10^{-9} torr. R_{bg}~ 10^{3}
- Need to distinguish beam gas and $(bg)^2$ from luminosity

- Luminosity Display Application
  - » Strip Chart with $R*(11*10^{-24}\ cm^2)^{-1}$ as well as background rates)

Machine Derived Luminosity

- $L_m = f_0 \Sigma_{Nb} N_1 N_2 / (4\pi \sigma_x * \sigma_y$
  - σ_x, σ_y = 120- 250 μm during store
    - N_1, N_2= 10^9/ bunch
- measure $N_{1,2}$ with Wall Current Monitor
- measure $\sigma_{x(s)}$ with Ionization Profile Mon
- then calcuate $\sigma_{x(0)}$ at interaction point
  - $\sigma_x^2 = \varepsilon_x(\beta^* - 2\alpha^* s + \gamma^* s^2) + \eta^2(\sigma_p/p)^2$

Van der Meer Method

- Errors in L due to uncertainties in $\beta(s)$ can be eliminated by directly measuring $\sigma(0)$. Beam Displacement scannned along x
  - » $R \sim \exp(-(\Delta_x)^2 / 2(\sigma_{x1}^2 + \sigma_{x2}^2))$
- Other Considerations- checks on N/bunch using calibrated DC current xformer, Van der Meer scan distorts beam

Luminosity in pp running

- No analogous full acceptance detector for pp. σ_{bbc} ~40 mb (UA4, CDF(540))
- BBC useful for low lum
  - » ie $L\sigma < 1$ Mhz or $L < 2 * 10^{31}$
- Additional monitors for high luminosity running- small aperture telescopes (CDF), Calorimetry,...

Conclusions

- During year 1 should achieve ~5-10% absolute luminosity using monitor calculated cross sections and machine parameters.
- Van der Meer scan should provide an accurate normalization
- Au beam experience crucial to prepare for pp running

figures

- CDF lbbc vs lacc, z distribution
- something on zdc monitoring
- waldo van der meer scan