THE BASIC PRINCIPLE

The luminosity (L) can be calculated from the rate of all inelastic interactions (R_{in}) and the total inelastic cross section (σ_{in}) by using the simple relation:

$$L = \frac{R_{inel}}{\sigma_{inel}}$$

The inelastic interaction rate is given by the average number of inelastic interactions per bunch crossing (μ) and the bunch crossing rate (f_{BX}):

$$R_{inel} = \mu \times f_{BX}$$

where the bunch crossing rate is given by

$$f_{BX} = \frac{\text{The number of filled bunch crossings}}{3564} \times 40 \text{ MHz}$$

$$L = \frac{f_{BX}}{\sigma_{inel}} \times \mu$$

The average number of interactions per bunch crossing (μ) is estimated from a rate of events measured by the detectors.

Two main types of event rates are counted:

$N_{OR/BX}$: Events per BX with at least one hit anywhere in the two detectors.

$N_{AND/BX}$: Events per BX with at least one hit in each of the two detectors.

If $\mu << 1$:

$$N_{OR/BX} \approx \varepsilon_{sing}\ \mu$$

$$N_{AND/BX} \approx \varepsilon_{coin}\ \mu$$

$$L = \frac{f_{BX}}{\sigma_{inel}} \times \mu = \frac{f_{BX}}{\sigma_{inel}} \times \frac{N_{Events/BX}}{\varepsilon} = \frac{f_{BX} \times N_{Events/BX}}{\sigma_{vis}}$$

where ε_{sing} and ε_{coin} are the efficiency & acceptance of the detector to record an inelastic event when an OR- or an AND-requirement is made.