

Colliders study session

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Luminosity of LHC

- Calculate the average luminosity of LHC
- Machine parameters
 - $k_b = 1000$
 - $F_{\text{Rev}} = 11245$
 - $I_{\text{bunch}} = 1.1 \cdot 10^{11}$
 - $\epsilon_{x,y}^* = 3.5 \mu\text{m}$
 - $\beta^* = 1.5 \text{ m}$
 - $E = 3500 \text{ GeV}$

p-p events

- Calculate the total rate of p-p events
- Calculate the number of p-p events per bunch crossing

$$\sigma_{\text{tot}} = 100 \text{ mb}$$

Beam size LHC

- The beam and optics parameters at the synchrotron light telescope of LHC are:
 - $\varepsilon_{x,y}^* = 3.5 \mu\text{m}$
 - $\beta_x = 176 \text{ m}$
 - $\beta_y = 204 \text{ m}$
 - $E = 3500 \text{ GeV}$
- Calculate the beam sizes
- Knowing that the telescope magnification is 0.3 calculate the image size on the camera
- Will the image size suite a CCD camera

Synchrotron light LHC

- Calculate the total synchrotron light power collected by the telescope.
 - $k_b = 1000$
 - $f_{\text{rev}} = 11245$
 - $I_{\text{bunch}} = 1.1 \cdot 10^{11}$
 - Bending radius = 6 km
 - $E = 3500 \text{ GeV}$
 - Telescope aperture = 5mm (horizontal)
 - Telescope distance = 24m
- Calculate the critical wavelength
- Repeat the exercise for $E = 450 \text{ GeV}$
- What conclusion can one take?

Wire scanner

- Consider adding a wire scanner at the location of the synchrotron light telescope
 - $\Phi_{\text{wire}} = 10\mu\text{m}$
 - Speed = 10m/s
- How long does a scan take
- How many points do you get with a single bunch
- What is the fluence of protons on the wire per scan?

BPM

- Calculate the pulse height on a button PU in LHC for a nominal bunch (assume $\Phi_{\text{button}}=25\text{mm}$, $\sigma_s=1\text{ns}$)
- Assume a beam pipe diameter of 40mm
- Do the same for a strip-line $L=12\text{cm}$
 $w=10\text{mm}$