

EXERCISES FOR THE COURSE ON LUMINOSITY (LUND 2013)

- 1) Derive the general equation of the available energy in the CM (Centre of Mass) to create new particles (first equation of page 2) and check the numerical application of page 3 for both modes of operation (collider and fixed target).
- 2) What would be the nominal LHC peak (initial) luminosity in the absence of crossing angle (check the numerical value of page 14)? Reminder: the usual unit for luminosity is $\text{cm}^{-2}\text{s}^{-1}$.
- 3) Why do we need a crossing angle? What are all the possibilities (in the presence of crossing angle) to compensate for the luminosity loss introduced by the crossing angle?
- 4) How can we centre the 2 beams in practice to be sure that the collisions are Head-On (and therefore that the luminosity is maximum)?
- 5) Assuming that the betatron function is reduced to increase the luminosity, what could then be the problem if it becomes too small?
- 6) Is the hourglass effect a worry for the nominal LHC?
- 7) What can we do to improve the integrated luminosity?
- 8) Compute the pile-up for the nominal LHC peak luminosity and assuming a cross section of 60 mbarns at 7 TeV (as assumed in the past) and 85 mbarns as estimated from last year's measurements. What would happen if the pile up were limited (by the experiments) to 20? What would happen if the bunch intensity were multiplied by a factor 2 and how could we optimize the physics fills?
- 9) What should be done to reach the highest luminosities? What could then be the possible issues?