

1-A detector has a dead time of 50 microseconds.

-Given a measured rate "a", which is the fraction of time the detector is dead?

-If this detector is a charged particles counter and is of similar size and at a similar location of an LHC experiment tracker with 1 % occupancy/event read at L1 rate of 100 KHz, which is the rate it would measure?

-if it would be triggering detector what would be its inefficiency?

2-Suppose the LHC envisages an upgrade of its accelerator system that allows for an increase of its bunch crossing frequency from 40 Mhz to 800 MHz, keeping luminosity per bunch constant. If a typical tracker silicon detector signal lasts for $O(10 \text{ ns})$, what would be the expected occupancy increase? Can you recover the occupancy just by reading faster an equally slow detector?

3-Suppose the HL-LHC operates for 20 years with a $5E34 \text{ cm}^{-2} \text{ s}^{-1}$ integrating 3000 fb⁻¹.

-What would be the integrated luminosity per bunch crossing in picobarns?

-if the inelastic xsec is 85 milibarn, what is the expected average pileup?

-If the Z xsec is $O(10 \text{ nb})$, the quarkonia reaching the detector $O(\text{microbarn})$ and the ZZ xsec is $O(10 \text{ pb})$ [the $H \Rightarrow ZZ \sim \text{half pb}$ for the record], what is the background fraction of 4 lepton events (from superposition of Z+quarkonia) piling up in the same event over ZZ events?

-And if HL-LHC could increase lumi/bx a factor of 10 thus operating during 2 year?