Trigger capabilities of ALICE TOF for the ultra-peripheral collisions (UPC)

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The ALICE TOF detector is a natural candidate to address UPC selection. The fast response of the MRPC, the large area covered at $|\eta|< 1$ and the high segmentation make the TOF well suited for triggering at L0 level in the central region . Each Front End card (FEA) reads 24 MRPC pads and makes their OR. Such OR is daisy chained with the OR of the closer FEA. The resulting signal (hereafter TOF-OR), made by the ORs of 48 pads, (i.e. $\simeq$ 500 cm^2) is sent to the first TOF trigger layer, a VME board called Local Trigger Module (LTM). Each of the 72 TOF VME crates contains a LTM module, sending 24 bits in parallel to the Cosmic and Topology Trigger Module (CTTM), located 60 m far away, close to the ALICE CTP. The CTTM is expected to take the L0 trigger decision and to send it to the CTP.

UPC can produce lepton pairs in $\gamma\gamma$ interactions, vector mesons in photonuclear reactions and jets in photoproduction events. When triggering on the exclusive production of vector mesons, the most important parameter to face is the fake trigger rate (FTR), due to combinatorial background. In fact such events show up as few tracks in an otherwise empty detector. The key ingredient when computing the FTR, is the MRPC noise, whose measurement gives 0.5 Hz/cm^2. Such noise is mainly due to ionizing particles in the chamber. A guess on the noise that the TOF will experience when running in ALICE is not straightforward: as a safety margin we will use for the prediction reported below a MRPC noise of 2.5 Hz/cm^2. The FTR, when selecting a number of fired $N_{TOF-OR} \geq 5$ is $\simeq$ 1 Hz, while the FTR for $N_{TOF-OR} = 2$ is 200 kHz. Such high rate, unmanageable also at L0 level, can be further reduced by using the vector meson decay topology. We simulated the J/$\Psi \to l^+l^-$ and the $\rho{\to}\pi\pi$ decay, using the starlight Monte Carlo code. The particles produced in the decay were traced in a empty cylinder in a B=0.5 T magnetic field. We found an efficiency for containing both the decay products of $\epsilon^{J/\Psi}_{cont}$=16.7% and ϵ^{ρ}_{cont}=8.3% respectively. A full simulation is in progress. Taking advantage of the produced particle topology in the J/Ψ decay, by selecting only the TOF-OR pairs in a $150^o{\leq}\Delta\phi{\leq}170^o$ window the FTR can be reduced by a factor 18. For the pions from ρ decay. by selecting only the TOF-OR pairs in a $70^o{\leq}\Delta\phi{\leq}110^o$ window, the FTR can be reduced by a factor 9, while keeping 60% of the signal. A further FTR reduction can be obtained for both vector mesons decay considering that in Pb-Pb interaction, despite a bunch crossing length of 125 ns, the TTC will distribute a 40 MHz clock. Since the OR signal has a 20 ns length, we can align this signal so that the positive edge of the TTC clock is well inside it. By enabling the latching only in the edge effectively corresponding to the bunch crossing, we can reduce the noise by a factor of 5. In the combinatorial background, for N_{TOF-OR}=2, this corresponds to a factor 25, giving:

$$FTR_{L0} < 200kHz/18/25 = 440Hz \ \ for J/\Psi \to l^+l^- and \tag{1}$$

$$FTR_{L0} < 200kHz/9/25 = 880Hz \, for \, the \, \rho \to \pi\pi. \tag{2}$$

Such FTR at L0 level has to be compared with the genuine rate:

$$Rate_{J/\Psi} = L \cdot \sigma \cdot \epsilon^{J/\Psi}_{cont} \cdot \Gamma = 0.32Hz \tag{3}$$

and with that of $\rho{\to}\pi\pi$ rate:

$$Rate_{\rho} = L \cdot \sigma \cdot \epsilon^{\rho}_{cont} \cdot \epsilon_{\Phi} = 130Hz. \tag{4}$$

These L0 rates could be reduced by requiring a coincidence with the L0 triggers from other central subdetectors.