Chapter 7

Analysis of Ultraperipheral collisions in ALICE experiment with Dimuon Photoproduction

In chapter 6 it was mentioned the signals, variables and the methology taken for Data Analysis. In this chapter we take the tools given and analyze certain data of our interest. The data that is analyzed are runs from the year 2011. The collisions of our interest are lead-lead. We also use the information given in chapter 5, since we make a selection of events depending of the signals recieved with the detectors. After we have a set of runs to analyze, we make kinematical cuts to the extracted data.

7.1 Selection of Events

The data was taken from CERN data base (Monalisa Grid Repository) using GRID for compiling the macros that extracted the data. The data we analized were runs from the year 2011 and the colission were lead-lead(Pb-Pb). It were 130 runs that we analyzed and each of them belonged to the period h. The data from the so called MUON pass1 in AOD083 format were used. The trigger used was **CMUP1-B-NOPF-ALLNOTRD**. This trigger required the existence of a single muon trigger with $pT > 1$GeV/c in the muon spectrometer coupled to a signal in the V0C and the absence of signal in the beam-beam window of the V0A. This requirement becomes important because it ensures that the colission took place in the interaction point. Furthermore, we ensure that the produced particles only go to the frontal zone of ALICE. Also any backgound for the analysis as cosmic rays are eliminated, since any cosmic ray that travels from the back zone to the frontal zone , it would hit both V0's. Another two requirements are demanded.

- Firstly, at least two hits in the SPD detector.
- Secondly, the energy in each one of the neutron ZDC had to be less than

6 TeV. The purpouse of the last requirement was for avoiding extremly peripheral collisions. The number of the runs that were used are shown in Table D.1

7.2 Selection of Tracks

After the data was extracted from the runs shown in Table D.1, different cuts were applied. The cuts applied were:

- 1) Detection of one single dimuon at the muon spectrometer. This requirement vanishes different decays possibilities. This cut makes the sample clean of possible decays of many bodies, which would make more difficult our analysis.
- 2)It fulfilled the pXDCA requirement. It is one of the most important cuts against background. It reconstructs the tracks coming from the interaction point. The distance between the vertex and the track extrapolated to the vertex transverse plane(DCA) is described by a Gaussian function. The beam induced background does not follow this trend and can be rejected by applying a cut on pXDCA at 6 times the standard deviation of the dispersion.
- 3)$17.5cm < Rabs < 89.5cm$, Rabs radial position of the track at the entrance of the absorber.
- 4)Opposite charges of the muons.(μ+ μ-).
- 5)At least one of the muon tracks was matched to a trigger track. In order to obtain the specifications defined in the selection of events.
- 6)Transverse Momentum of the Dimuon $pT <$ 300MeV. The sample cleans against background, since decays of other particles are very energetic. However, the J/Ψ photoproduction is much more probable within low energy decays.
- 7)Pseudorapidity $-3.7 < \eta < -2.5$. This cut was applied in order that V0C and the muon spectrometer were within the acceptance of both.
- 8)Rapidity of the dimuon $-3.6 < y < -2.6$.

In Table 7.1 are shown the cuts applied to all the sample and the remaining events. In figure are shown the reconstruction of the events of our interest. The cuts made to all the runs give as a result that every event of analysis will be as it is plasmed in the image 7.1 As it can be notice, there is no interaction of the dimuons with the TPC, only with the dimuon spectrometer.

Selection	Number of Remaining Events
Number of triggered events	4,249,399
Number of events with 2 charged tracks	2,074,302
Number of events Muon pxDCA cut	542,735
Number of events RPC muon matching	25,432
Number of events -3.7 $< \eta_\mu <$ -2.5	10,534
Number of events 17.5 $< Rabs <$ 89.5	10,512
Number of events $-3.6 < Y_{dimuon} < -2.6$	10,155
Number of events 1 dimuon	2,029
Number of events 2.8 $< dimuon_{mass} <$ 3.4	493
Number of events $dimuon_{pT} <$ 0.3GeV	156

Table 7.1: The remaining events after the cuts applied

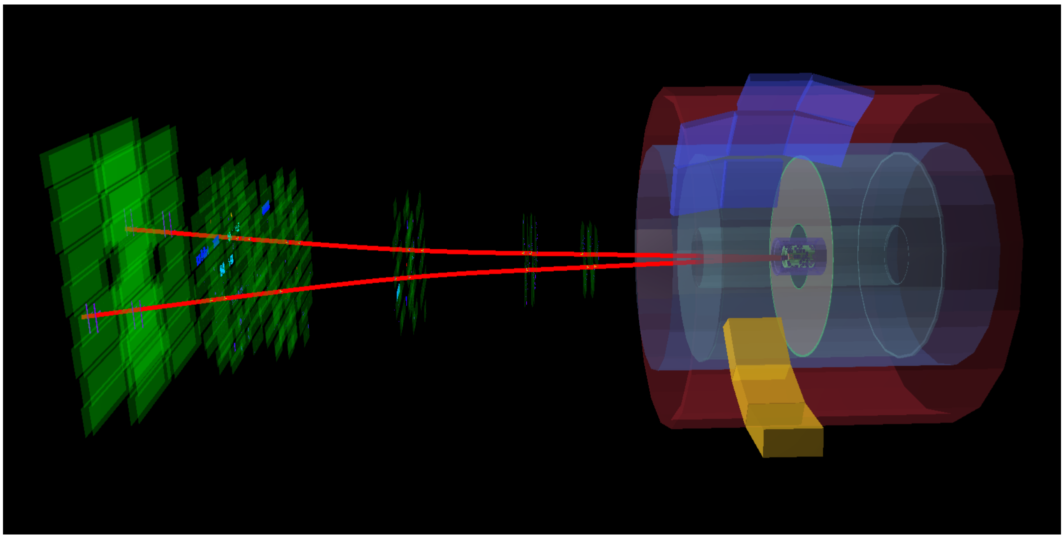

Figure 7.1: The dimuon reconstruction.

7.3 Analysis

After the cuts applied to the runs, we are interested in finding the signal obtained. In figure 7.2 are shown the different plotings of invariant mass obtained after the cuts applied in the section above.

The standard desviation σ is 0.084 ± 0.014(width of the peak found). The invariant mass found is $3.123 \pm 0.011[\mathrm{GeV}/c^2]$, which is in good acordance to the already defined mass of the $J/\Psi(3.096\ [\mathrm{GeV}])$ [37]. In figure 7.3 is shown the J/Ψ signal with the crystal ball fit.

As it was mentioned in chapter 6 the photoproduction can be of differet ways. The photoproduction can be by coherent, incoherent, $\gamma\gamma$ interectasions . Therefore it is of our interest to know which were the contributions of the signals found at muon spectrometer. Therefore we used a MonteCarlo Simulation (STARlight) to know the contribution of the coherent, incoherent and $\gamma\gamma$ contributions. By this way we can know approximately the background generated in ultra-peripheral collisions with decay of dimuons. We make the substraction of the data from the MonteCarlo simulation and make comparison of number of events and the transverse momentum pT, since our analysis is focused in low pT events. In figure 7.4 is shown the different contributions depending of the process that could take place.

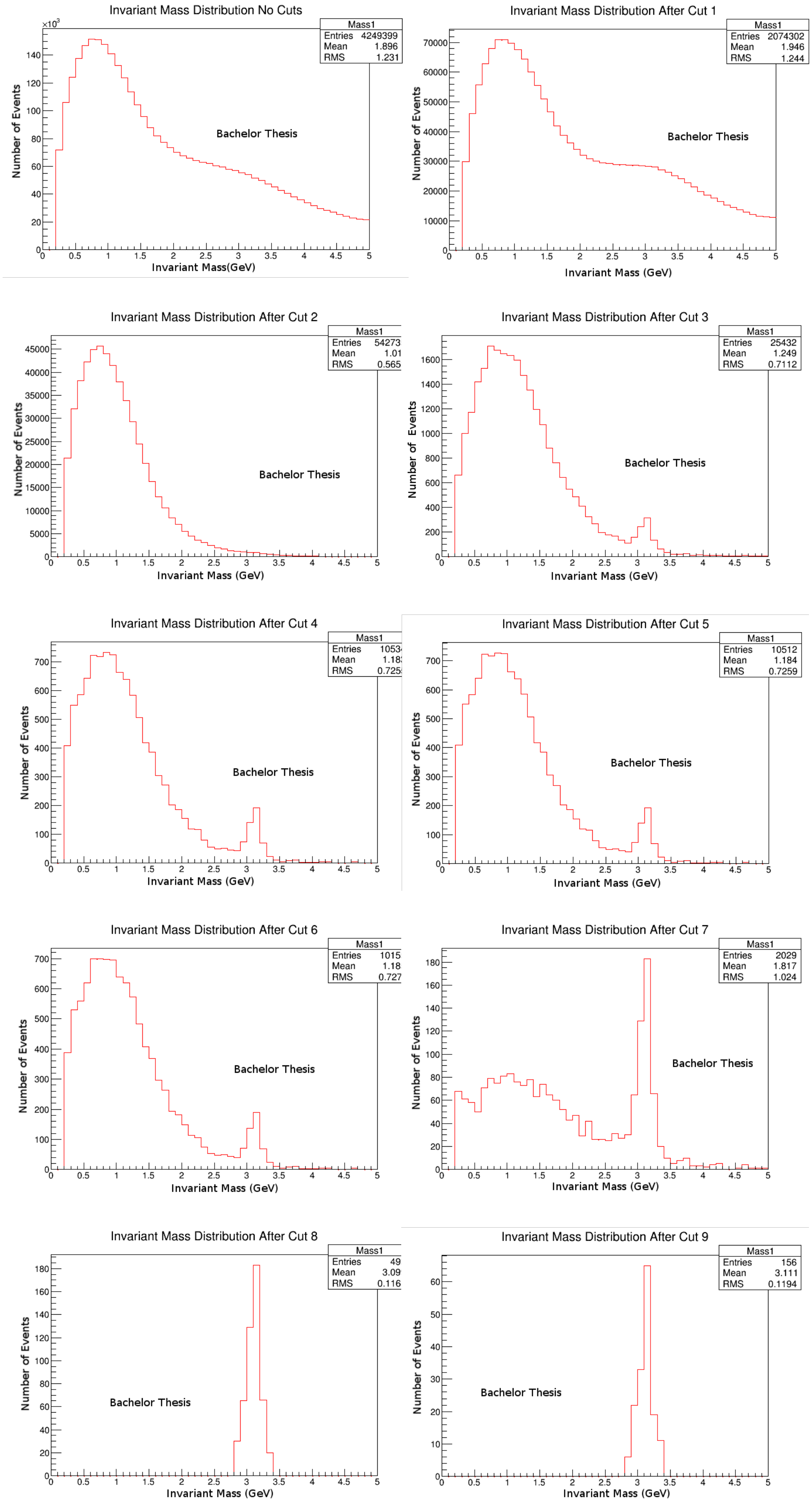

Figure 7.2: Mass Distribution after each cut applied in Table. 7.1.

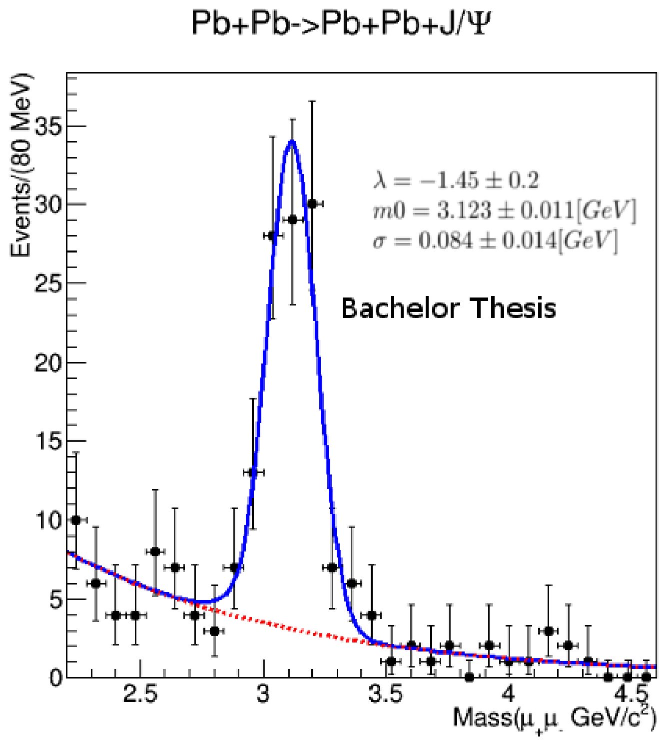

Figure 7.3: Invariant Mass Distribution. It is normalized by a factor of 80 MeV. Crystal Ball parameterization for the for the signal and an exponential for the background.

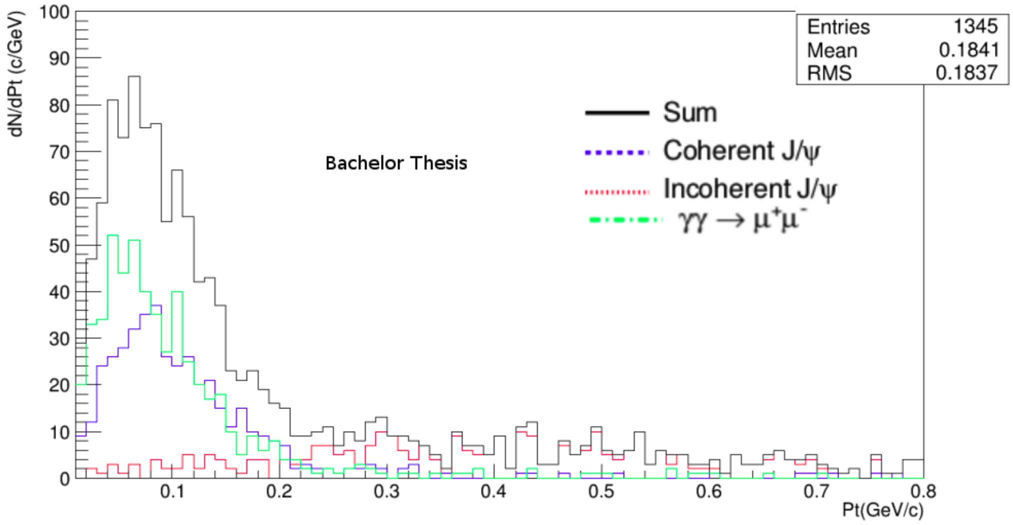

Figure 7.4: Contribution of the different possile processes(coherent,incoherent and $\gamma\gamma$).The STARLIGHT MonteCarlo was used for this analysis.