A method for online multichannel inclusive reconstruction of pion induced reactions in HADES *

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During the HADES [1] campaign of pion induced reactions a method to produce the inclusive invariant mass spectra for all possible reaction channels was implemented. This tool is helpful in order to have a quick estimation of the data quality and to guide more detailed analyses later.

The general reconstruction strategy usually starts from a predefined reaction, or channel, of interest which is analysed in detail and filtered out from all events and particle traces. This strategy fits very well during data taking for checking the performance of the apparatus and to confirm or modify expectation values and adjust data taking for accomplishing the main goals of a certain experiment. Here we present a different approach, a method for making a general overview of the measured data. Its main goal is to allow a broader perspective of the collected data for a later more detailed and careful analysis.

As observable for identifying various cases we chose the invariant mass of a group of reconstructed particles, considering from 1 up to N possible particles in the final state. The method is implemented in an iterative way: first all the track candidates are selected and sorted. Then they are labelled as candidates with a certain ID, i.e. protons, electrons, pions and kaons. Then all the electromagnetic components are combined into π^0 and γ in case they meet the kinematical requirements. Those tracks are removed from the general list. Then the same strategy is applied to the hadrons. Once a single list is built, these particles are combined into sets of 2, 3, up to 5 particles. Then, those which fit to a certain abundant short lived particle like Λ, ϕ or ρ are added to the general list and their constituents are subtracted and all the combinations with these particles in the final states are produced once again, independently if those channels are forbidden or their cross section is very low. Finally, for the uncorrelated background calculation two methods are used: random rotation in the azimuthal direction of the particles in the event and by the event mixing technique. Before starting the procedure with a new event, all the lists are stored in buffers for later mixing. The produced histograms at the end are stored in a ROOT file and also printed to a document in order to provide a simpler and sorted presentation.

This method was applied systematically to the data taken by Hades on pion-induced reactions on tungsten, carbon and polyethylene during July of 2014. Clear spectra of broad resonances, both mesonic and baryonic, were clearly seen (Fig. 1) and used as a assessment of quality and analysis possibilities in this data beyond the programmed physics goals.

This method relies on a very high quality data set produced during data taking; that means that all the subsystem calibrations and geometrical alignment must be performed in a very short time and precise way [2].

The general conclusion about this method is that it provides a broad overview of the measured reaction and together with specific analyses helps for further data taking. Also, this method can be applied later to already measured data in order to unveil possible, not yet investigated hidden physics cases.

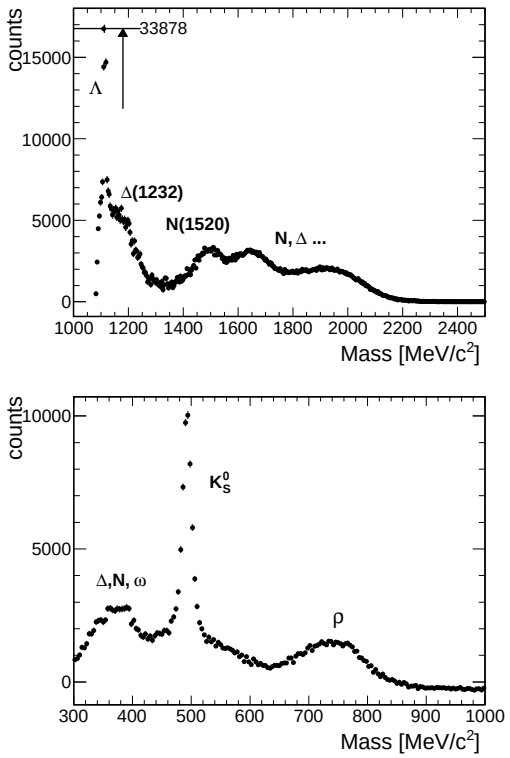

Figure 1: Upper panel: $p\pi^-$ inclusive invariant mass, lower panel: $\pi^-\pi^+$ inclusive invariant mass from 1.7 GeV/c π^-+C.

References

[1] P. Salabura, this Scientific Report.

[2] O. Pechenova et al., The alignment strategy of HADES, NIMA Volume 785, 2015

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