Backtracking algorithm for lepton reconstruction with HADES *

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Events recorded in Au+Au collisions at a beam energy of 1.23 GeV/u have the highest multiplicities measured with HADES [1]. The track reconstruction and particle identification in the high track density environment are challenging. In case of dileptons: (i) A Ring Imaging Cherenkov detector (RICH) [2] is essential since it is the most important detector component for single lepton identification; (ii) one has to cope with large combinatorial background stemming from γ conversion and π^0 Dalitz decays.

In order to further improve the purity and efficiency of an electron sample, a new backtracking algorithm using information provided by tracking and Time-of-Flight detectors is applied. Furthermore in the special case of close tracks, with opening angles smaller than 4°, rings are overlapping and do not have a perfect ring shape. Thanks to its excellent double hit resolution, by using the expectation of nearby tracks backtracking will be able to resolve such patterns and identify both leptons.

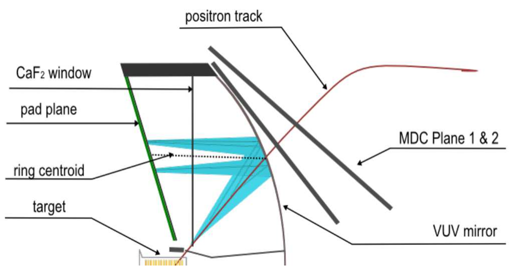

Figure 1: Schematic side view of the RICH detector. A positron track shows usage of angular information to determine a ring center.

In detail, only tracks preselected by velocity information provided by Time-of-Flight detectors and energy loss measured in Multi-wire drift chambers are used as possible lepton candidates. Those candidates are used to predict a possible ring on the RICH pad-plane based on angular track information (see Fig.1). Out of it the centroid position on the RICH photon detection plane is fixed. Using a simulation based ring parametrization, potential areas with a high photon hit probability are predicted.

An example of a ring prediction is shown in Figure 2. Two predicted rings and photon hits measured by the photon detection plane are plotted. The most basic observables are the sum of charge, pads and clusters. Pads where horizontal and vertical neighbors have a lower charge than the pad itself are called maxima and are summed up as well. Additionally a ring quality based on the difference between the actual photon hit and the most probable hit position is calculated. For special cases of overlapping rings, information of shared maxima is also considered. An application of

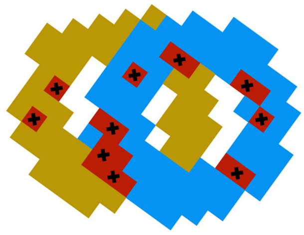

Figure 2: Overlapping rings predicted by ring parametrization. Fired RICH Pads are indicated by dark red boxes and the maximum position of clusters is marked with crosses.

the backtracking algorithm to simulated and real data has shown that the number of pads per ring and maxima per ring are the most powerful to distinguish between leptons and hadrons. Especially maxima are a good measure since they correspond to the number of photons per ring.

Finally, backtracking was also tested for close pair rejection in simulated data. Above 2° ring predictions are not overlapping anymore. Therefore backtracking information is useful to identify the close partner of a lepton in order to reject close pairs. Figure 3 demonstrates a further rejection of combinatorial background due to a reduction of close pairs. In contrast the signal of ω pairs is not reduced significantly.

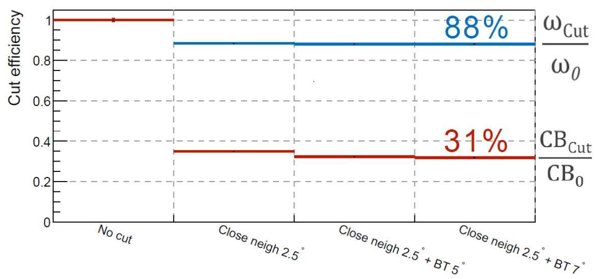

Figure 3: Cut efficiency of close pair cuts. Additionally to a close neighbor cut demonstrated in the second column backtracking information is used in columns 3 and 4 for further close pair rejection.

References

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[2] K. Zeitelhack and the HADES collaboration, Instr. Meth. A 433 (1999) 201-206

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