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RICHONE: a software package for the analysis of COMPASS RICH-1 data

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Abstract

RICHONE is the pattern recognition and PID code for COMPASS RICH-1. RICHONE is part of CORAL, the COMPASS software system, a C++ framework developed within the collaborations using up-to-date techniques and tools.

Keywords: COMPASS; Pattern recognition; RICH

RICHONE is the pattern recognition and PID code for the COMPASS [1] RICH-1 [2]. RICHONE pattern recognition method is based on a recipe for the Cherenkov angle reconstruction from literature [3]. The method assumes that the particle trajectory is known at the RICH entrance. The raw data are first reduced by a clustering procedure; then, in two consecutive steps, the ring recognition and then the PID, based on χ^2 or on Likelihood selection, known as the particle momentum, are performed. The whole code has been developed and optimised with Monte Carlo data and, recently, applied to the first available physical data.

Preliminary information obtained from calibration data collected at low beam intensity is presented. Fig. 1 shows the distribution of the difference between the measured angles Θ_{photon} (on the reconstructed *ring*) and their *ring* average value (Θ_{ring}) (mrad), after a best-fit to a circle; the standard deviation σ is 1.37 mrad; to be compared with the MC expectation of 0.78 mrad (Fig. 2). The discrepancy can be well accounted by the fact that the RICH geometry (mirrors and photon detectors) has not yet been calibrated. The lower plot in Fig. 1 shows the distribution of the number

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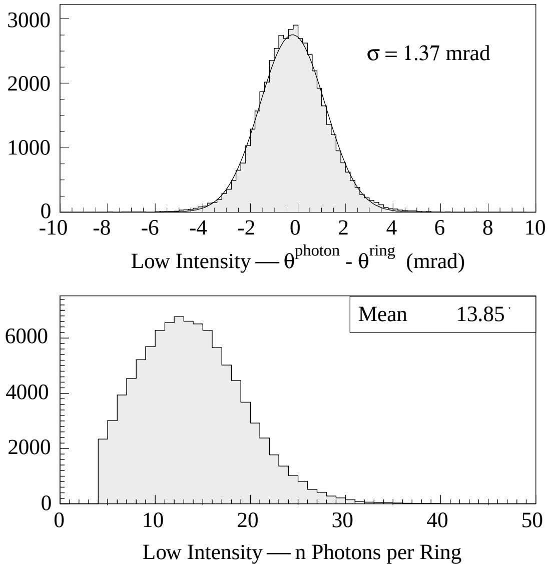

Fig. 1. The upper plot shows the photon Cherenkov angle accuracy for photons belonging to reconstructed *rings*. The lower plot shows the distribution of the number of photons per reconstructed *ring* (after clusterization).

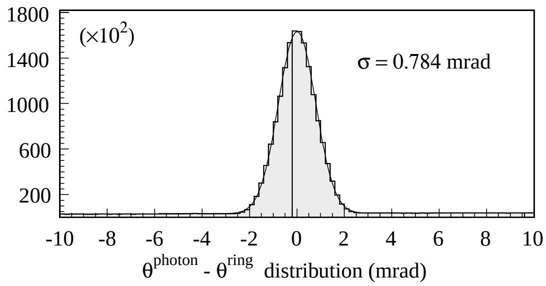

Fig. 2. MonteCarlo data; the distribution of $\theta^{photon}_{rec} - \theta^{ring}_{rec}$, for each particle for all the photons processed in the *ring* recognition. The fit is to a gaussian distribution plus a linear background.

of photons per reconstructed *ring* (after clusterization); this number is in reasonable agreement with the expected one, taking into account the reduced fraction ($\sim 80\%$) of C_4F_{10}, the RICH-1 design radiator gas, present in the RICH vessel.

Fig. 3 shows the distribution of the measured Θ_{photon} belonging to reconstructed *rings*, together with the estimated background (top) and the photon signal after subtraction (bottom); Fig. 4 shows the same distributions for the reconstructed Θ_{ring}.

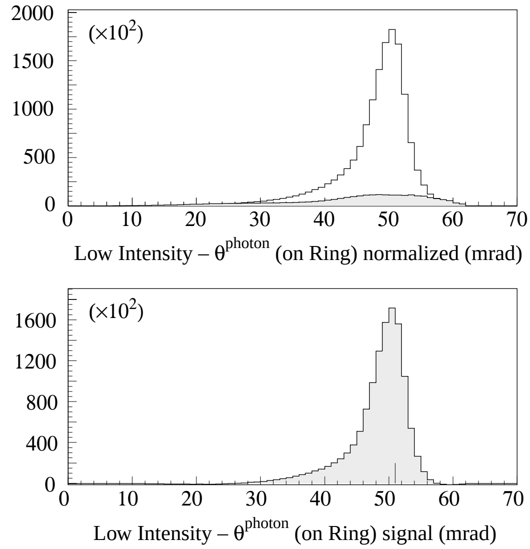

Fig. 3. The plots show the distribution of the measured Θ_{photon} belonging to reconstructed *rings*; in the upper plot, the distributions for Θ_{photon} and the normalised background are shown; in the lower one, the signal after background subtraction is presented. In both plots, no particle momentum selection is applied.

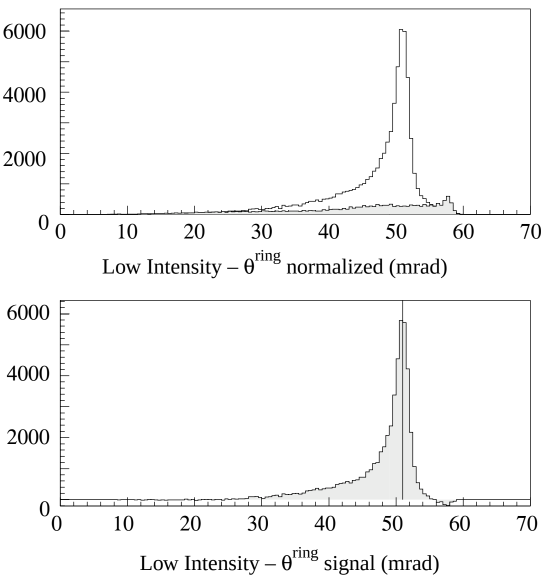

Fig. 4. The plots show the distribution of the Θ_{ring} for the reconstructed *rings*; in the upper plot, Θ_{ring} and normalized background distributions are presented; in the lower one, the signal distribution after background subtraction is given. In both plots, no particle momentum selection is applied.

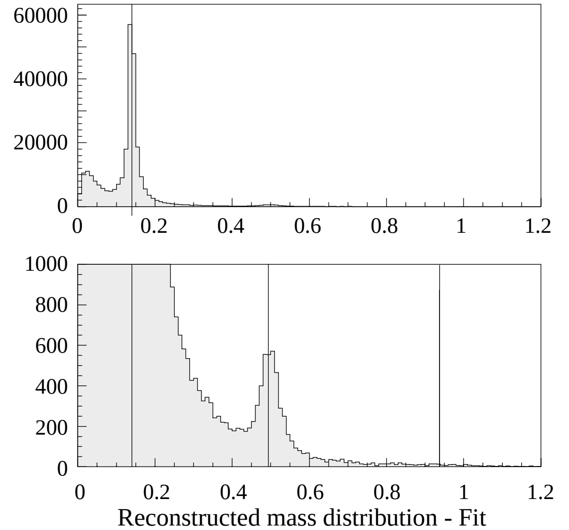

Fig. 5. The particle mass spectrum computed from the measured Cherenkov angle and the particle momentum; in the upper part, the total spectrum; in the lower, the K mass region enhanced; the vertical lines are the correct mass values.

The particle mass distribution as reconstructed from the measured Cherenkov angle and the particle momentum is shown in Fig. 5; the amount of background, in particular under the kaon peak is still relevant, but all the analysis are very preliminary; note that the mass values are correctly reconstructed.

Fig. 6 is an example of the monitoring of the refractive index of the radiator gas, a parameter

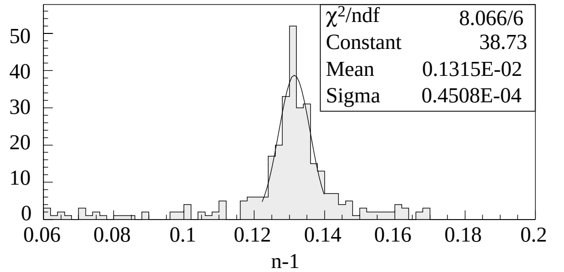

Fig. 6. Example of monitoring of the refractive index ($n-1$) of the radiator gas using high momentum particles at large angles.

which will be constantly needed and has to be extracted from data.

In conclusion, the very first data analysed confirms that COMPASS RICH-1 is performing well, not far from the design figures.

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