# Summary of Data Quality Checks for PID Detectors for E08-027

Melissa Cummings
The College of William and Mary
melissac@jlab.org

July 26th, 2013

## 1 Introduction

Data quality checks are important to test the consisitency of the calibrations and PID cuts for all production runs. In addition, it allows a chance to identify individual runs that have problems. This document will describe the process for the data quality checks for the PID detectors. The runs shown here include all $g_2^p$ production runs. The tables at the end of the document list the individual runs that were found to have issues.

## 2 Relevant Quantities

A series of variables/quantities were checked for both arms of the HRS:

- Location of single photoelectron peak in gas Cherenkov
- Location of main peak in gas Cherenkov
- E/p for lead glass calorimeters
- Detector efficiencies for gas Cherenkov and lead glass
- Cut efficiencies for gas Cherenkov and lead glass
- Level of residual pion contamination

### 2.1 Cherenkov Peaks

There are two peaks in the Cherenkov ADC spectra; the single photoelectron peak and the good electron peak (or "main peak"). The single photoelectron peak is aligned during calibration, and should fall at channel 100. Due to the method used to isolate the single photoelectron peak, this quanity tends to shift the most in runs with low statistics ($\sim$1M events or less). This will not be a problem once these runs are combined together with other runs. The main peak will vary in location depending on the momentum of the scattered electron.

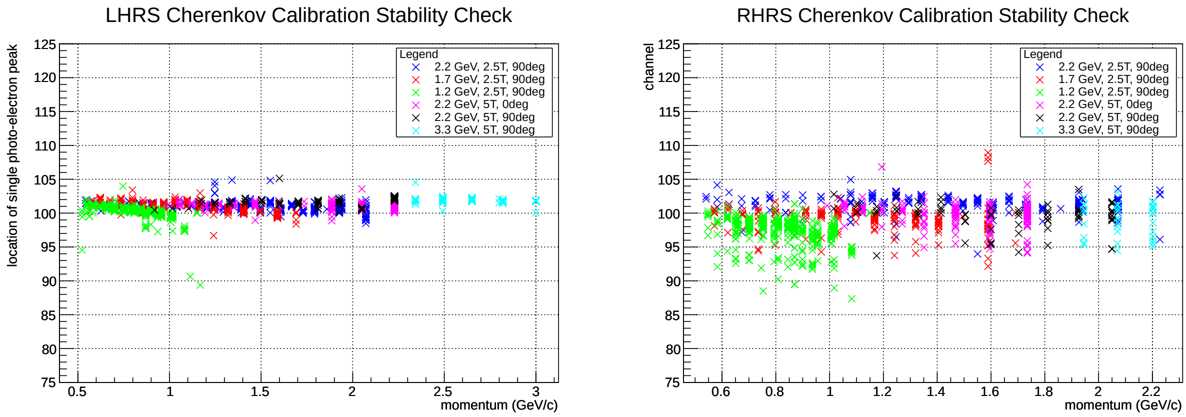


Figure 1: Location of single photoelectron peaks for the left and right HRS. The peak should be aligned to channel 100.

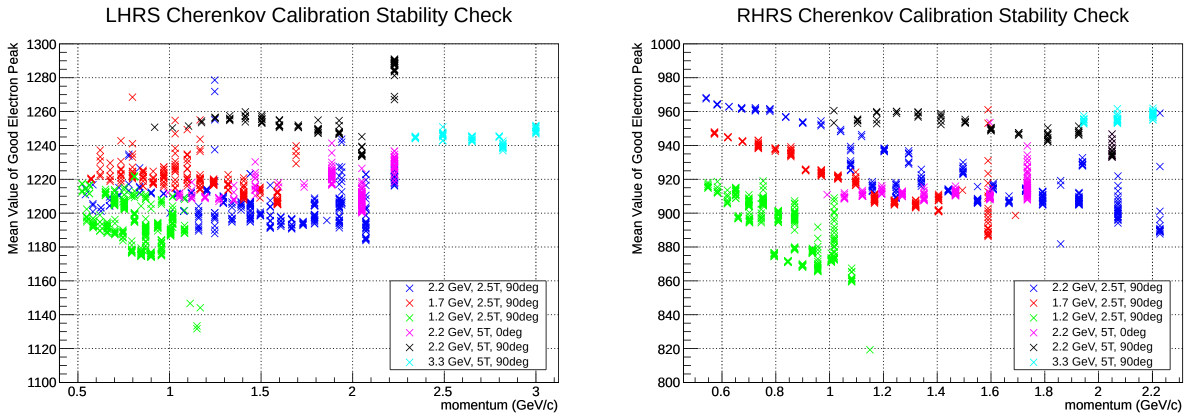


Figure 2: Location of the main peak in the Cherenkov sum spectrum for the left and right HRS. The location will vary depending on the momentum of the scattered electron, but should be consistent within a kinematic setting.

## 2.2 E/p

On the RHRS, the preshower/shower combination is thick enough to absorb the complete energy of a scattered electron. Therefore, the resulting distibution of the total energy divided by the central momentum should be centered around 1 for all kinematic settings. For the LHRS, the two layers of lead glass are of equal thickness, and does not ncessarily absorb the total energy of the scattered electron. This means the corresponding distibution of E/p varies depending on the kinematic setting.

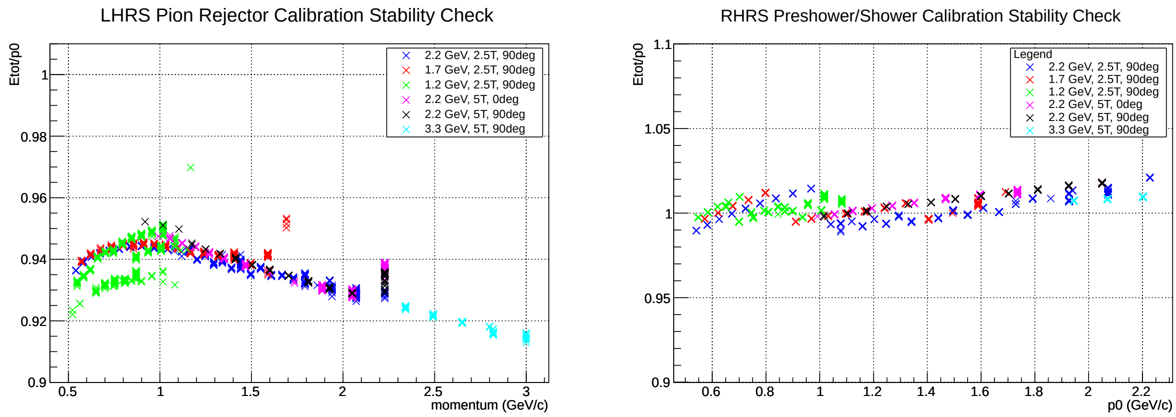


Figure 3: Central value of the E/p distribution for the left and right HRS. For the RHRS, the distribution should be centered around 1. For the LHRS, the central value will vary depending on the momentum of the scattered electron, but should be consisitent within a kinematic setting.

## 2.3 Detector Efficiences

The detector efficiencies will vary depending on the momentum of the scattered particle, but within a kinematic setting should remain fairly constant. The process for calculating detector efficiencies is described in [1].

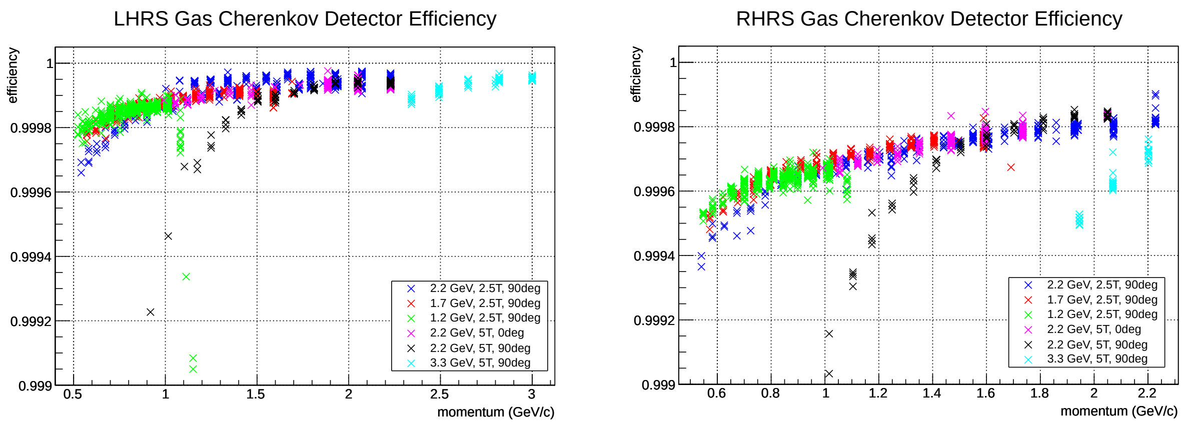


Figure 4: Detector efficiencies for the gas Cherenkov for the left and right HRS. The efficiency should be fairly high for all kinematic settings; $> 99.9\%$ for the left and right HRS.

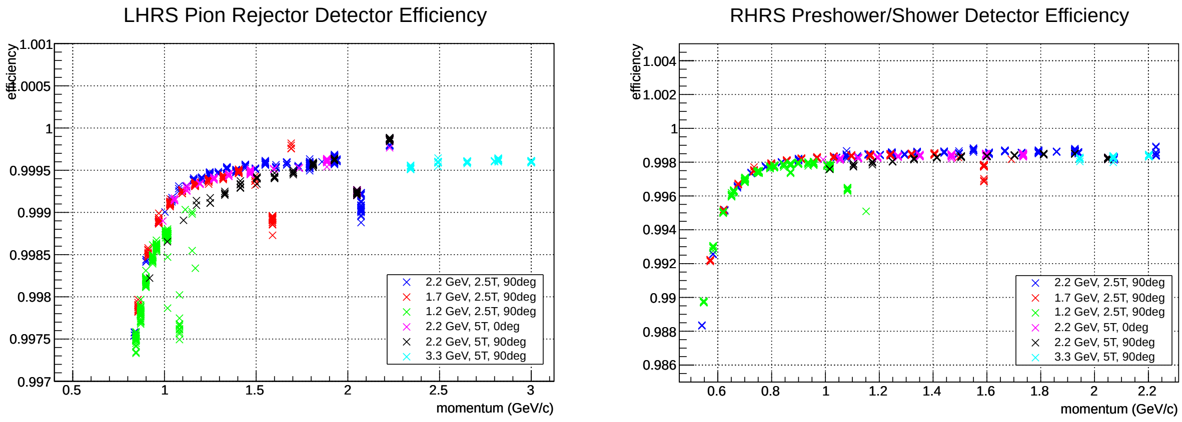


Figure 5: Detector efficiencies for the lead glass calorimeters for the left and right HRS. For the RHRS, the efficiency is $> 99.0\%$ for all kinematic settings. The efficiency is slightly better for the LHRS, with all kinematic settings having an efficiency $> 99.7\%$.

## 2.4 Cut Efficiencies

The cut efficiencies should be ∼99% or better for both the gas Cherenkov and the preshower/shower. The method for determining cut locations and the corresponding efficiencies is described in [1].

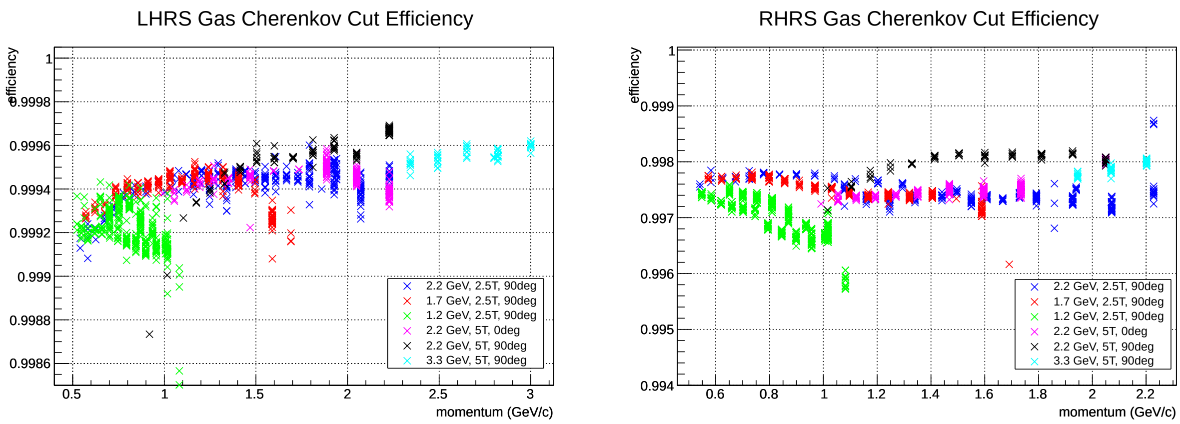


Figure 6: Cut efficiencies for the gas Cherenkov for the left and right HRS. For the RHRS, the efficiency is $> 99.5\%$ for all kinematic settings. The efficiency is slightly better for the LHRS, with all kinematic settings having an efficiency $> 99.8\%$.

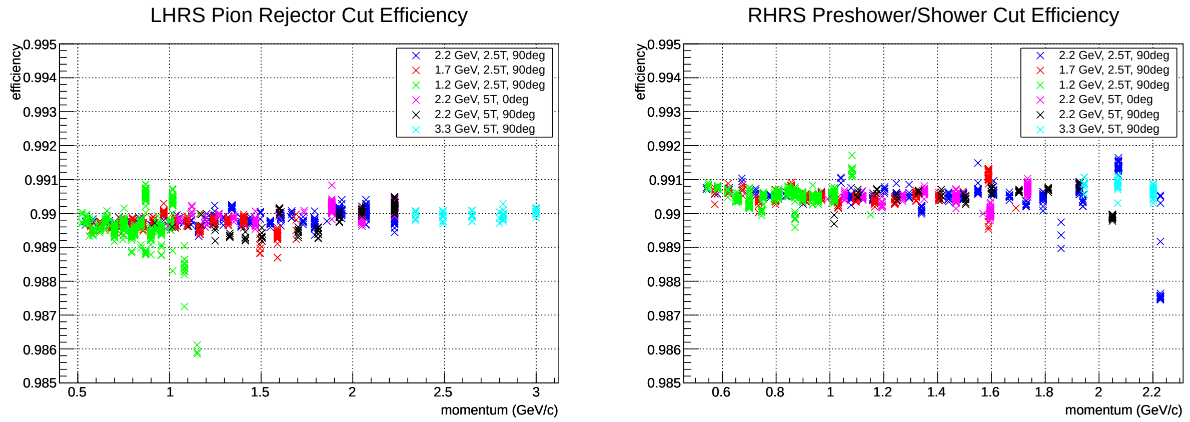


Figure 7: Cut efficiencies for the lead glass calorimeters for the left and right HRS. On both arms, the efficiency should be $\sim 99\%$.

## 2.5 Pion Contamination

The level of residual pion contamination is relatively consistent over all kinematic settings, falling between $0.004 < \pi/e < 0.005$ for both arms of the HRS.

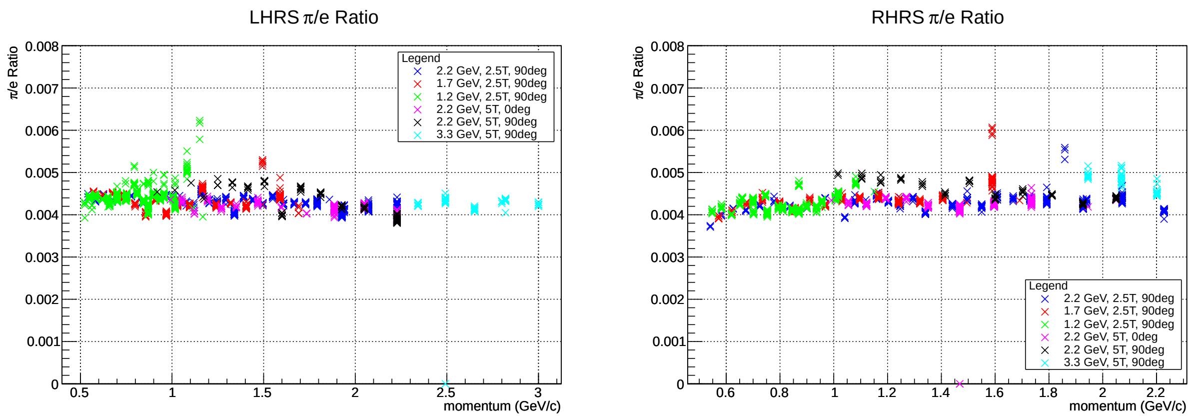


Figure 8: Level of residual pion contamination for the left and right HRS.

# 3 Problem Runs

The following tables list the individual runs that were found to have issues as a result of the data quality checks. The column labeled "Description" is an attempt to identify the problem with the run. For some runs it is unclear why a certain quantity changed for that run, so these runs should be handled with caution. Runs labeled "low statistics" will not have any problems once combined with other runs.

| Table 1: RHRS Production Runs with Issues | | | | | |
|---|---|---|---|---|---|
| Run # | $E_{beam}$ (GeV) | Target Field (T) | Target Config | p0 (GeV/c) | Description |
| 22368 | 2.2 | 2.5 | trans | 2.228 | Low statistics (<0.5M events) |
| 22477 | 2.2 | 2.5 | trans | 2.228 | Low statistics (<1M events) |
| 22477 | 2.2 | 2.5 | trans | 2.228 | Unstable septum |
| 22478 | 2.2 | 2.5 | trans | 2.228 | Unstable septum |
| 22478 | 2.2 | 2.5 | trans | 2.228 | Unstable septum |
| 22479 | 2.2 | 2.5 | trans | 2.228 | Unstable septum |
| 22480 | 2.2 | 2.5 | trans | 2.228 | Unstable septum |
| 22480 | 2.2 | 2.5 | trans | 2.228 | Unstable septum |
| 22534 | 2.2 | 2.5 | trans | 1.792 | Low statistics (∼1M events) |
| 22565 | 2.2 | 2.5 | trans | 1.55 | Low statistics (<1M events) |
| 22672 | 2.2 | 2.5 | trans | 1.078 | Low statistics (<0.5M events) |
| 22679 | 2.2 | 2.5 | trans | 1.078 | Low statistics (<0.5M events) |
| 22786 | 2.2 | 2.5 | trans | 1.859 | Possible gain fluctuation in Cherenkov PMT |
| 22794 | 2.2 | 2.5 | trans | 1.859 | Low statistics (<10K events) |
| 22795 | 2.2 | 2.5 | trans | 1.859 | Drop in detector/cut efficiency for Cherenkov |
| 22833 | 2.2 | 2.5 | trans | 1.496 | Low statistics (∼1M events) |
| 22940 | 2.2 | 2.5 | trans | 0.724 | Drop in detector efficiency for Cherenkov |
| 22949 | 2.2 | 2.5 | trans | 0.673 | Low statistics (∼1M events) |
| 23191 | 1.7 | 2.5 | trans | 1.589 | Drop in detector/cut efficiency for preshower/shower |
| 23192 | 1.7 | 2.5 | trans | 1.589 | Drop in detector/cut efficiency for preshower/shower |
| 23193 | 1.7 | 2.5 | trans | 1.589 | Drop in detector/cut efficiency for preshower/shower |
| 23194 | 1.7 | 2.5 | trans | 1.589 | Drop in detector/cut efficiency for preshower/shower |
| 23195 | 1.7 | 2.5 | trans | 1.589 | Drop in detector/cut efficiency for preshower/shower |
| 23196 | 1.7 | 2.5 | trans | 1.589 | Low statistics (∼1.5M events) |
| 23196 | 1.7 | 2.5 | trans | 1.589 | Drop in detector/cut efficiency for preshower/shower |
| 23695 | 1.2 | 2.5 | trans | 1.017 | Low statistics (<1M events) |
| 23696 | 1.2 | 2.5 | trans | 1.017 | Low statistics (<1M events) |
| 23730 | 1.2 | 2.5 | trans | 0.956 | Low statistics (<1M events) |
| 23902 | 1.2 | 2.5 | trans | 1.082 | Low statistics (∼1.7 M events) |
| 23945 | 1.2 | 2.5 | trans | 0.936 | Low statistics (<1M events) |
| 23974 | 1.2 | 2.5 | trans | 1.589 | Drop in detector/cut efficiency for preshower/shower |
| 23975 | 1.2 | 2.5 | trans | 1.589 | Drop in detector/cut efficiency for preshower/shower |
| 23976 | 1.2 | 2.5 | trans | 1.589 | Drop in detector/cut efficiency for preshower/shower |
| 23977 | 1.2 | 2.5 | trans | 1.589 | Drop in detector/cut efficiency for preshower/shower |
| 23978 | 1.2 | 2.5 | trans | 1.589 | Drop in detector/cut efficiency for preshower/shower |
| 23979 | 1.2 | 2.5 | trans | 1.589 | Drop in detector/cut efficiency for preshower/shower |
| 24360 | 2.2 | 5.0 | long | 1.735 | Low statistics (<0.5M events) |
| 24447 | 2.2 | 5.0 | long | 1.596 | Low statistics (<1M events) |
| 24491 | 2.2 | 5.0 | long | 1.468 | Low statistics (∼25K events) |
| 24491 | 2.2 | 5.0 | long | 1.468 | Low statistics (<25K events) |
| 24500 | 2.2 | 5.0 | long | 1.468 | Low statistics (<0.5M events) |
| 24721 | 2.2 | 5.0 | trans | 1.175 | Low statistics (∼2M events) |
| 24744 | 3.3 | 5.0 | trans | 2.202 | Small increase in $\pi/e$ ratio |
| 24754 | 3.3 | 5.0 | trans | 2.07 | Low statistics (<60K events) |
| 24759 | 3.3 | 5.0 | trans | 2.07 | Small increase in $\pi/e$ ratio |
| 24760 | 3.3 | 5.0 | trans | 2.07 | Low statistics (<0.5M events) |
| 24761 | 3.3 | 5.0 | trans | 2.07 | Small increase in $\pi/e$ ratio |
| 24770 | 3.3 | 5.0 | trans | 1.945 | Small increase in $\pi/e$ ratio |

| Table 2: LHRS Production Runs with Issues | | | | | |
|---|---|---|---|---|---|
| Run # | $E_{beam}$ (GeV) | Target Field (T) | Target Config | p0 (GeV/c) | Description |
| 3596 | 2.2 | 2.5 | trans | 1.247 | Possible gain fluctuation in Cherenkov PMT |
| 3597 | 2.2 | 2.5 | trans | 1.247 | Possible gain fluctuation in Cherenkov PMT |
| 3600 | 2.2 | 2.5 | trans | 1.247 | Possible gain fluctuation in Cherenkov PMT |
| 3601 | 2.2 | 2.5 | trans | 1.247 | Possible gain fluctuation in Cherenkov PMT |
| 3602 | 2.2 | 2.5 | trans | 1.247 | Possible gain fluctuation in Cherenkov PMT |
| 4385 | 1.7 | 2.5 | trans | 1.167 | Possible gain fluctuation in Cherenkov PMT |
| 4497 | 1.7 | 2.5 | trans | 0.798 | Possible gain fluctuation in Cherenkov PMT |
| 4523 | 1.7 | 2.5 | trans | 0.735 | Low statistics (<0.8M events) |
| 4560 | 1.7 | 2.5 | trans | 1.59 | ~1% shift in E/p |
| 4561 | 1.7 | 2.5 | trans | 1.59 | ~1% shift in E/p |
| 4562 | 1.7 | 2.5 | trans | 1.589 | ~1% shift in E/p |
| 4788 | 1.2 | 2.5 | trans | 1.017 | Low statistics (<0.8M events) |
| 5025 | 1.2 | 2.5 | trans | 1.168 | Cherenkov detector efficiency is a little low |
| 5029 | 1.2 | 2.5 | trans | 1.151 | Cherenkov detector efficiency is a little low |
| 5030 | 1.2 | 2.5 | trans | 1.113 | Cherenkov detector efficiency is a little low |
| 5138 | 1.2 | 2.5 | trans | 0.87 | ~2% shift in SPE peak location |
| 5139 | 1.2 | 2.5 | trans | 0.87 | ~2% shift in SPE peak location |
| 5140 | 1.2 | 2.5 | trans | 0.87 | ~2% shift in SPE peak location |
| 5141 | 1.2 | 2.5 | trans | 0.87 | ~2% shift in SPE peak location |
| 5142 | 1.2 | 2.5 | trans | 0.87 | ~2% shift in SPE peak location |
| 5143 | 1.2 | 2.5 | trans | 0.87 | ~2% shift in SPE peak location |
| 5846 | 2.2 | 5.0 | long | 1.468 | Low statistics (<0.5M events) |
| 6161 | 3.3 | 5.0 | trans | 2.492 | Low statistics (<30K events) |
| 6164 | 3.3 | 5.0 | trans | 2.492 | Low statistics (<0.5M events) |

## References

[1] M. Cummings. *Efficiency Studies and Cut Optimization for E08-027*. E08027 Technical note (2013).