DIRAC tracking resolution

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This report is dedicated to calculate a value for the Q_x, Q_y and Q_L resolution of the DIRAC spectrometer. The procedure to perform the calculation is described next:

- We have generated a Monte Carlo atomic pair sample [1].
- We have run it through the geant-dirac program [2] to create a buffer file.
- We have reconstructed the events with the ariane program [4].
- For the well reconstructed events we have subtracted the corresponding relative momentum component of every pair after the target (Q_x^i, Q_y^i, Q_L^i) from the reconstructed momentum one (Q_x^R, Q_y^R, Q_L^R).

The resulting distributions of this analysis are shown in figures 1 and 2 for the ariane standard tracking [6] and in figures 3 and 4 for the Basel tracking [5]. The estimation does not take into account the MSGC detector [7]. The Q_x and Q_y distributions show a characteristic background shape due to mismatched events in the Scintillating Fiber Detector. In these events the positive charged particle is wrongly assigned to the hit corresponding to the negative one and vice-versa roughly producing a change on the sign of the reconstructed value ($Q_{x,y}^R \sim -Q_{x,y}^i$). In the bottom plots of figure 1 we can see a subsample of the atomic pairs with the cut $|Q_{x,y}^i| > 2.5\ MeV/c$. We can check that the mismatched events are clustered around $4MeV/c \sim \pm(|Q_{x,y}^R| + |Q_{x,y}^i|)$.

The calculation of the resolution is slightly different for the two different tracking methods. For the standard ariane tracking we have selected the central part of the distribution and fitted it to a gaussian. The result is in agreement with that of the not mismatched events for the $|Q_{x,y}^i| > 2.5\ MeV/c$ subsample. In the case of Basel tracking we have used a fit with two gaussians. One would account for the events with the correct choice of the SciFi hit and the other will parameterize the mismatched events background. The narrowest sigma of the two gaussians will be chosen as the resolution. In table 1 the results are summarized.

Table 1: Summary of the different Q components resolution.

	Ariane tracking	Ariane tracking (no mismatched events)	Basel tracking
σ_{Q_x} (MeV/c)	0.4924	0.4903	0.4949
σ_{Q_y} (MeV/c)	0.4816	0.4751	0.5221
σ_{Q_L} (MeV/c)	0.4798		0.5019

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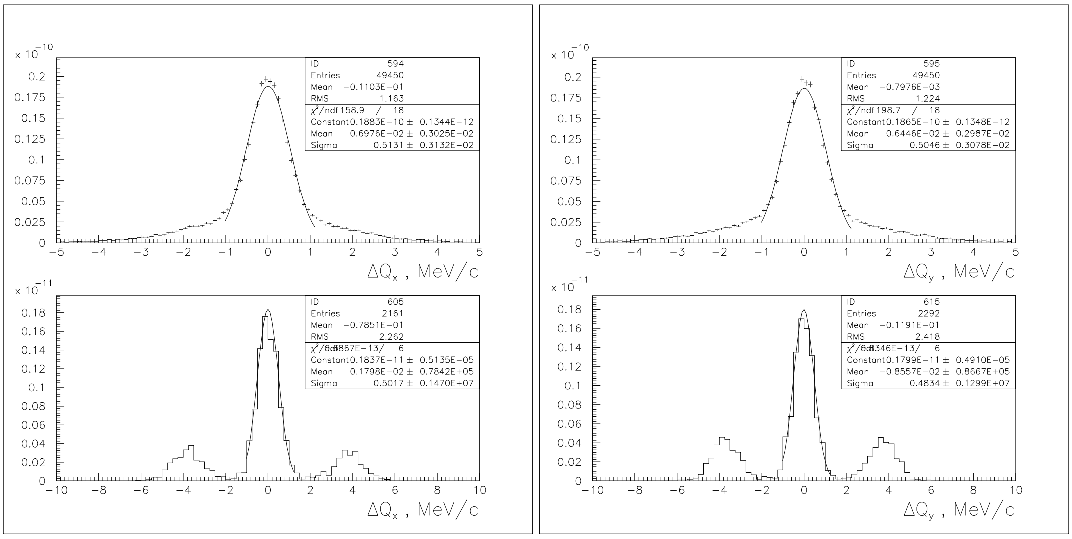

Figure 1: Q_x and Q_y resolution determination with the standard ariane tracking. The sample is Monte Carlo atomic pairs. The lower plots show a subsample with $|Q^i_{x,y}| > 2.5 MeV/c$, where $Q^i_{x,y}$ are the transverse components of the relative momentum of the atomic pairs after the target. In these two plots the mismatched events form two peaks away from the central correct distribution.

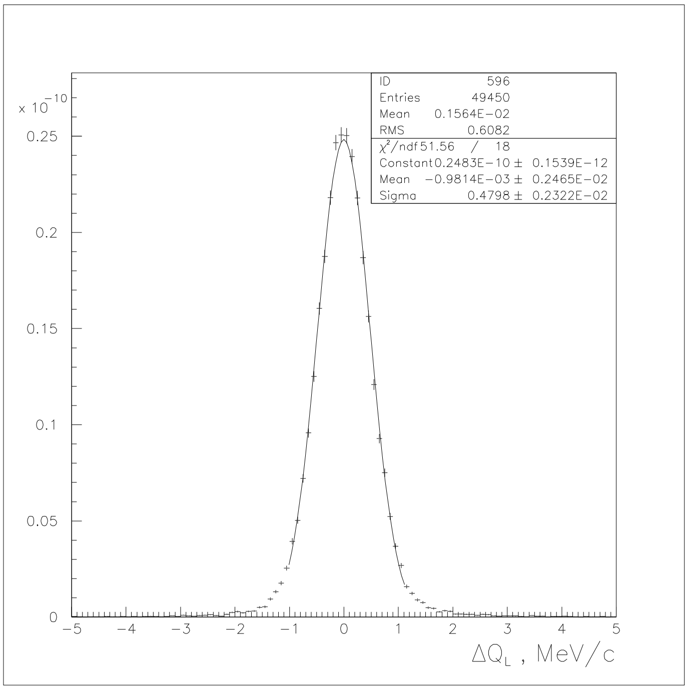

Figure 2: Q_L resolution determination with the standard ariane tracking. The sample is Monte Carlo atomic pairs.

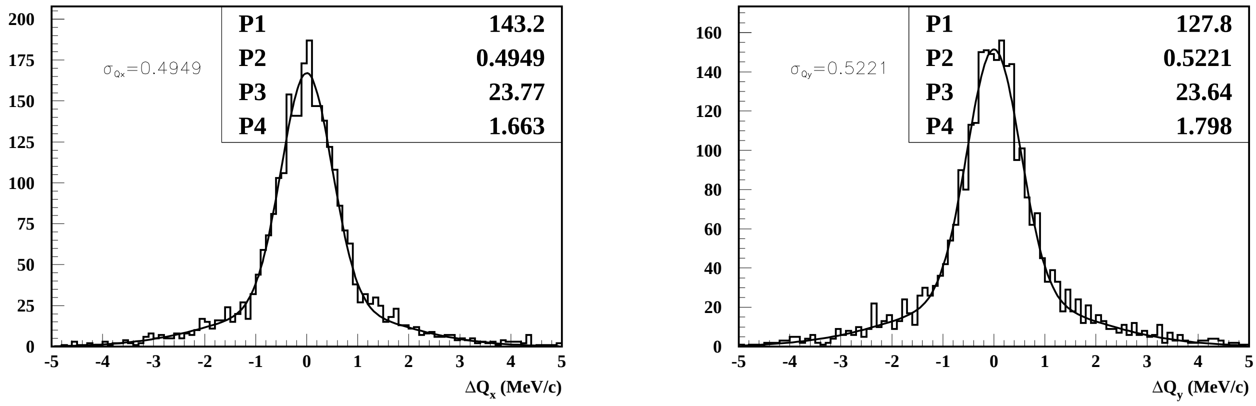

Figure 3: Q_x and Q_y resolution determination with the Basel tracking.

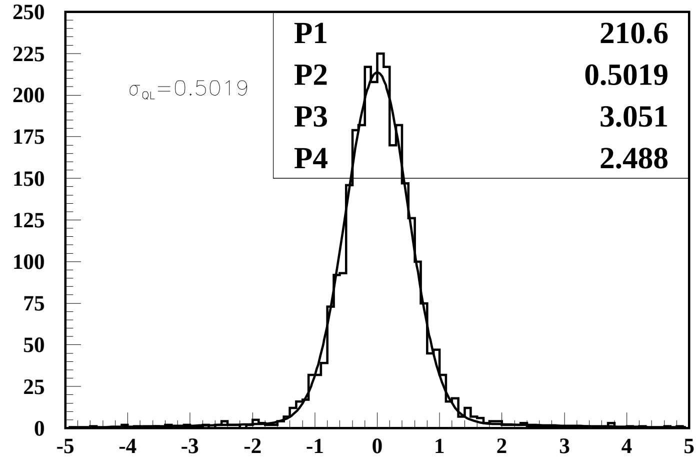

Figure 4: Q_L resolution determination with the Basel tracking.

References

[1] O. Gortchakov, *Some Monte-Carlo results on the ratio between Coulomb pair number and the number of atomic pairs*, DIRAC internal note 01-05 (2001). C. Santamarina *DIRAC events generator*, to appear as a DIRAC internal note.

[2] P. Zrelov and V. Yazkov, GEANT version 3.21 adapted to the DIRAC experiment in its current version 2.63, `http://zrelov.home.cern.ch/zrelov/dirac/ monte-carlo/instruction/instruct26.html`.

[3] Detector and trigger simulation package which is included in the current version of ARIANE 304-29.

[4] ARIANE version 304-29.

[5] Ch. P. Schütz and L. Tauscher, *The BASEL tracking algorithm in the DIRAC experiment*, DIRAC internal note 03-06 (2003).

[6] V. Yazkov, `http://dirac.web.cern.ch/DIRAC/offlinedocs/vertexfltup.ps`, `http://dirac.web.cern.ch/DIRAC/offlinedocs/kalmflt.ps`.

[7] B. Adeva, A. Romero, O. Vazquez Doce, *A tracking system for upstream detectors in DIRAC,* DIRAC internal note 03-08 (2003).