Normalization and Constraint Fits, Part II

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Abstract

A change of the relative number of $\overline{\mathrm{K}}^0$ events to K^0 events for different values of the 1C or 9C fit probability has been already discussed in a previous note. It was pointed out that a different cut in probability for different decay times results in a shift of φ_{+-}. In this note we study the residual effect when using a constant probability cut due to a change of the probability distribution itself as function of the decay time. The data are studied separately for the two magnetic fields and for old and new trigger conditions. The old and new trigger data show the same behaviour whereas the Monte Carlo data show no change of normalization as function of the 9C or 1C fit probability. Using some basic assumptions, it can be shown that this effect can only shift the phase by $\approx 0.2°$.

1 Introduction

The study was done based on the new Nano data sets. The basic cuts for the common micros are described elsewhere (PPE/PS195/CT/96-001). The three cuts in addition are:

5% probability on 9C fit

transverse opening angle of secondaries ($-0.99 < \cos\theta < 0.98$)

appropriate trigger matching for each period

The data are corrected for the known normalization effects as function of the primary kaon and pion momenta using LUT.

2 Change of normalization as function of 1C and 9C fit probability

The change of normalization as function of the 1C and 9C fit probability is shown in fig. 1 separately for the two magnetic fields. Whereas the normalization changes very differently as function of the 1C fit probability for the two different fields, it changes equally as function of the 9C fit probability. The reason why the normalization changes at all with the probability of a constraint fit is still unknown. The Monte Carlo data do not show such a behaviour (fig. 2).

The effect seen on the 1C fit probability is not a reflection of the 5% cut on the 9C fit probability. By changing the cut on the 9C fit probability, the dependence remains the same.

3 Stability of the physics results against probability cut

By varying the cut of the 9C fit probability from 5% to 50% and recalculating the LUT, the measurements of η_{+-} and φ_{+-} remain stable (see fig. 3 and fig. 4) although the average normalization changes (fig. 6) significantly. The background changes as expected (fig. 5),

4 Simulation of the effect on the measurement of η_{+-}

Let us assume the normalization as function of the 1C and 9C fit probability shows for all lifetimes the same behaviour but the distribution of events as function of the 1C and 9C fit probability changes with the lifetime. This could change the average normalization as function of lifetime and therefore shift the value of φ_{+-}. Using the measured dependence of the normalization as function of the 1C and 9C fit probability (fig. 1) and the distribution of events as function of the 1C and 9C fit probability for different lifetime intervals ($\Delta\tau = 1\tau_S$), we can calculated the expected change of the normalization as function of the lifetime. As expected the distribution of events as function of the 1C fit probability is the same for all lifetimes and therefore no change of the normalization as function of lifetime is predicted (fig. 7 left). The 9C fit introduces a small change of the normalization as function of lifetime (fig. 7 right) which has to be compared to the LUT correction (fig. 8 left) or the total normalization correction including the regeneration correction (fig. 8 right).

Correcting the data for such a lifetime dependence of the normalization results in a shift of $\approx 0.2^\circ$ for the phase and $\approx 0.01 \times 10^{-3}$ for the modulo of the CP violation parameter η_{+-}.

5 Conclusion

Further understanding of the origin of the dependence of the normalization on the 1C and 9C fit probability is needed. Since the effect is not present in the Monte Carlo, it seems likely that the different dependence on the 1C fit probability for the two magnetic fields is due to a wrong detector geometry and/or wrong magnetic field value. No explanation for a direct dependence of the normalization on the constraint fit probability is known at the moment.

From the current study we can conclude that the effect on the phase is about 0.2°.

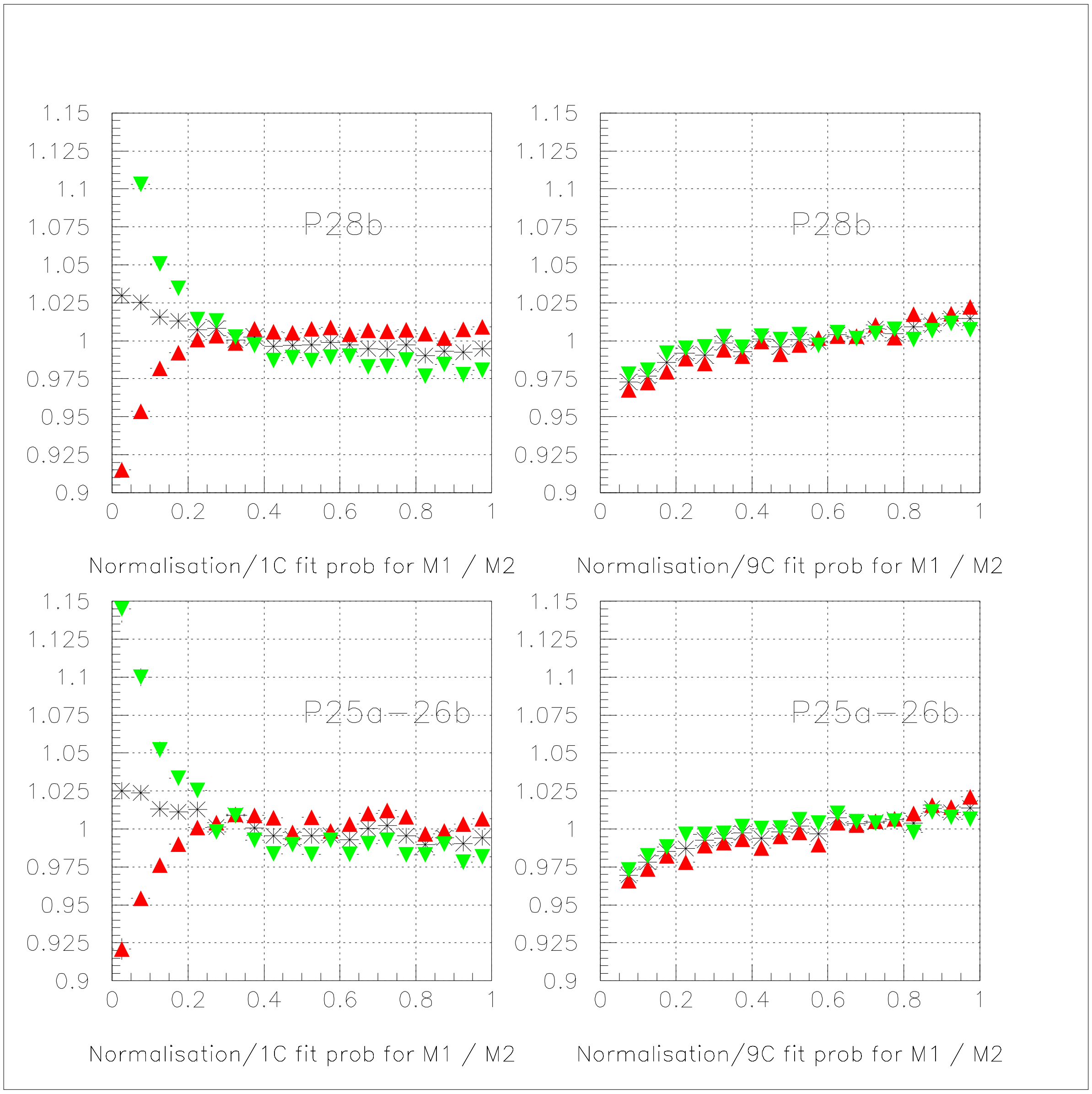

Figure 1: Normalization as function of the 1C and 9C fit probability for M1 and M2 separately. Old trigger data on top, new trigger data bottom.

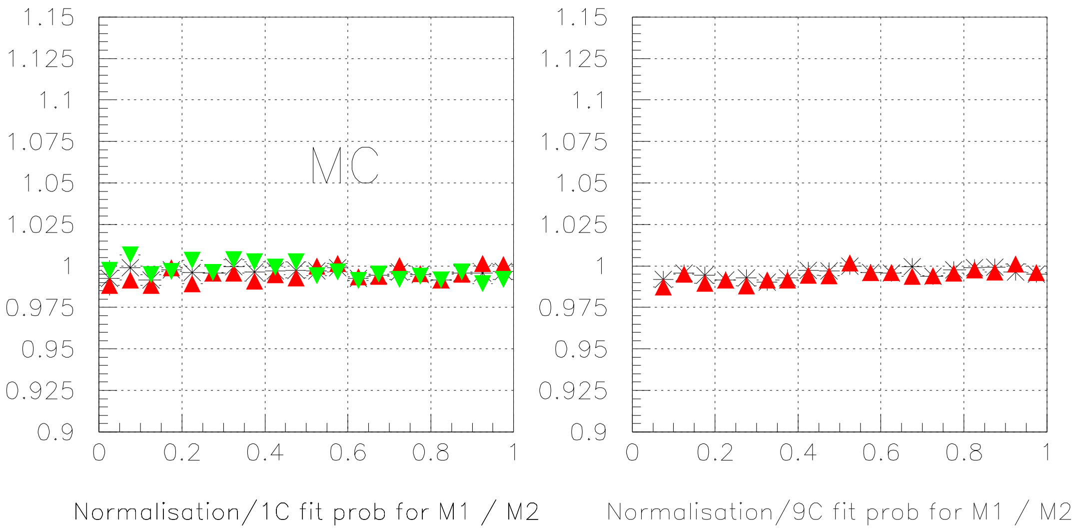

Figure 2: Normalization as function of the 1C and 9C fit probability for M1 and M2 separately. Monte Carlo data

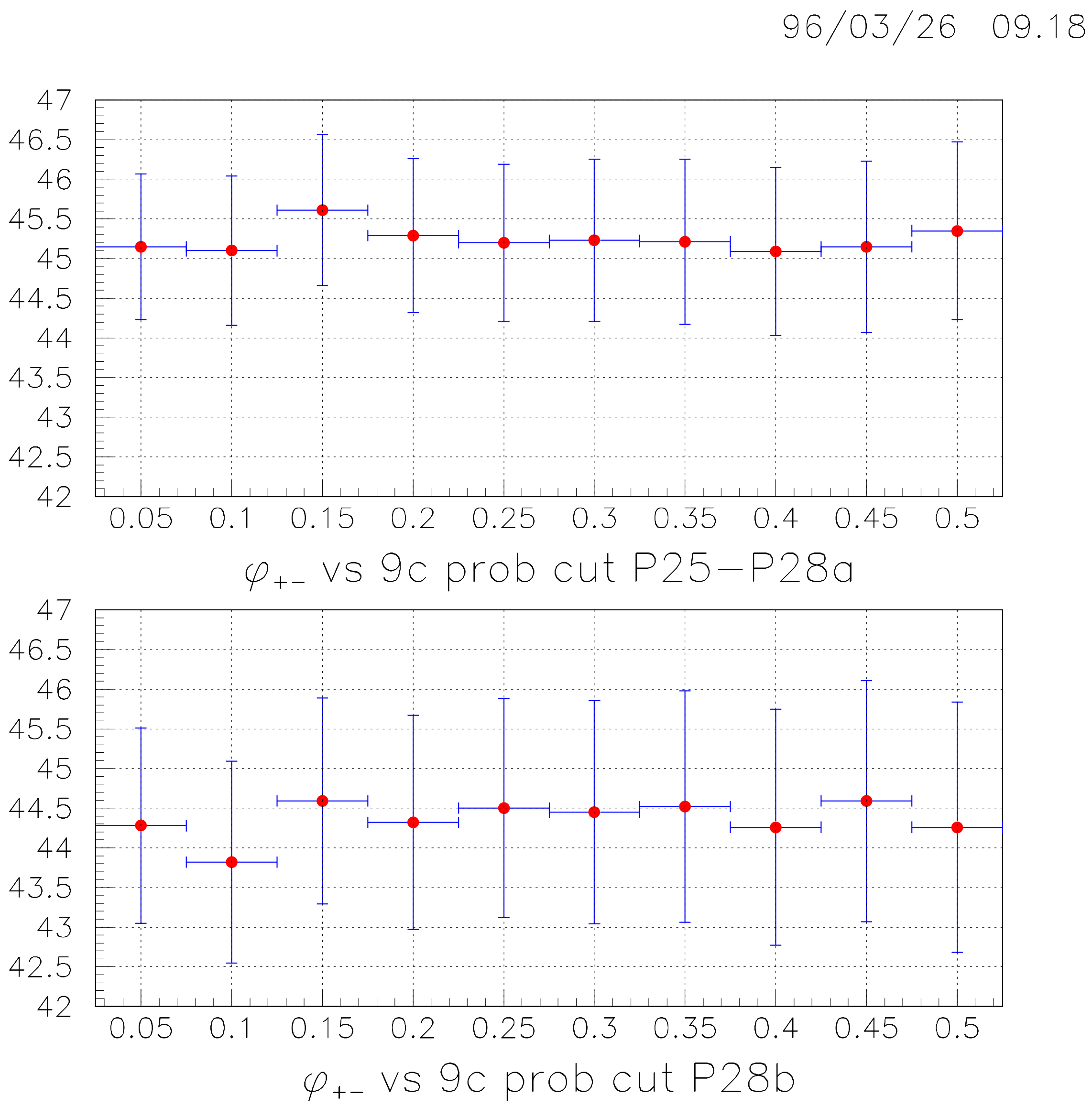

Figure 3: Variation of φ_{+-} by changing the cut on the 9C-fit probability

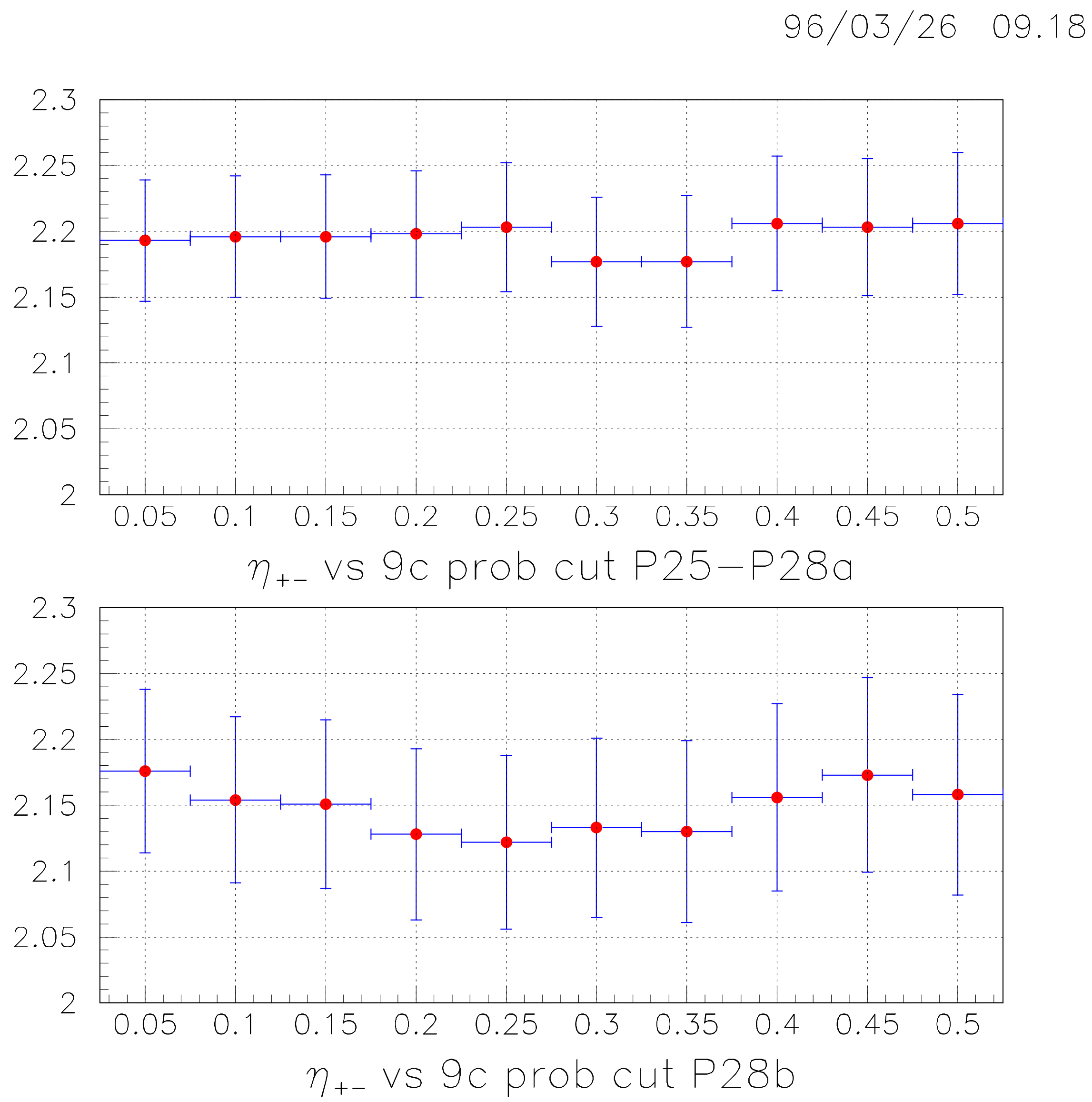

Figure 4: Variation of η_{+-} by changing the cut on the 9C-fit probability

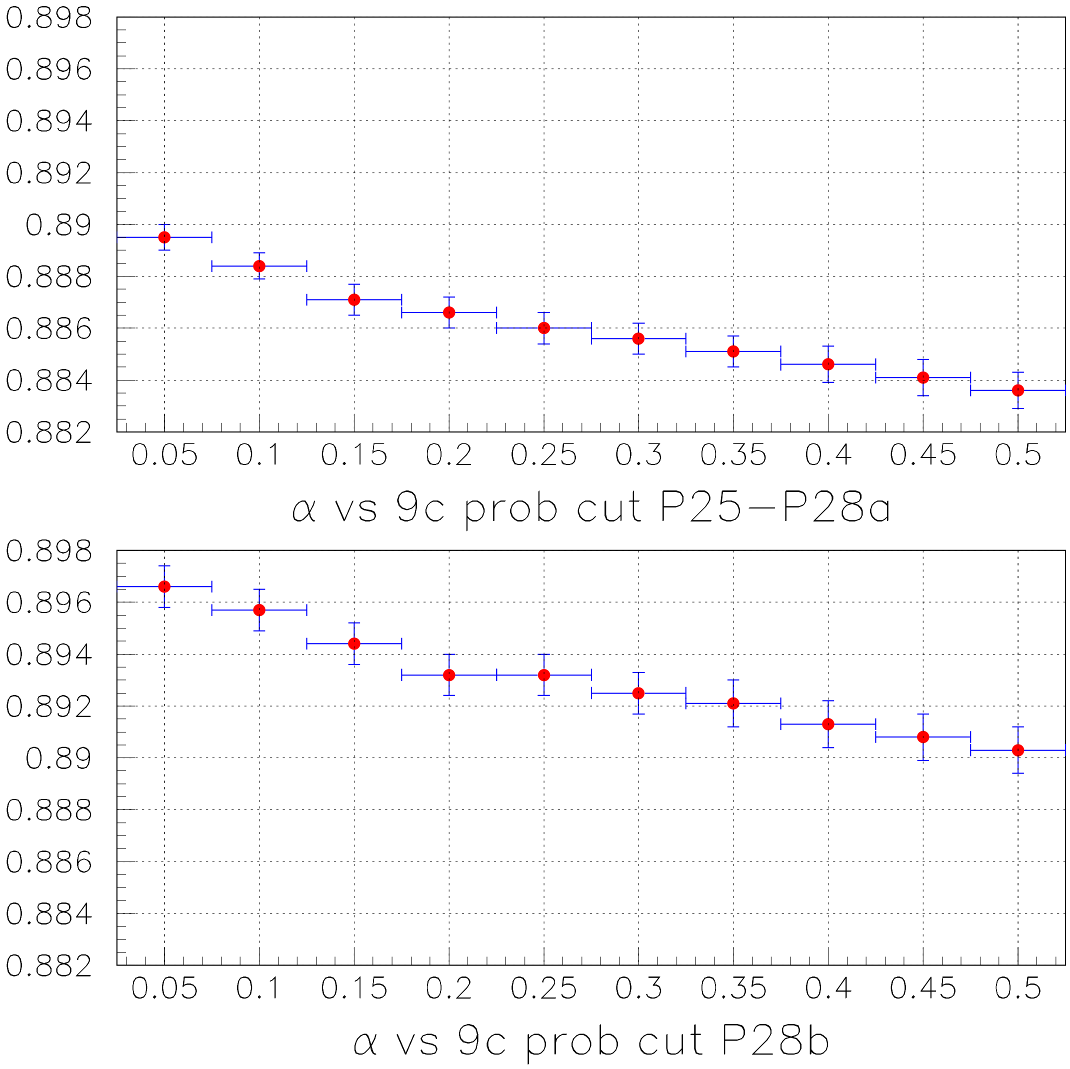

Figure 5: Variation of the background by changing the cut on the 9C-fit probability

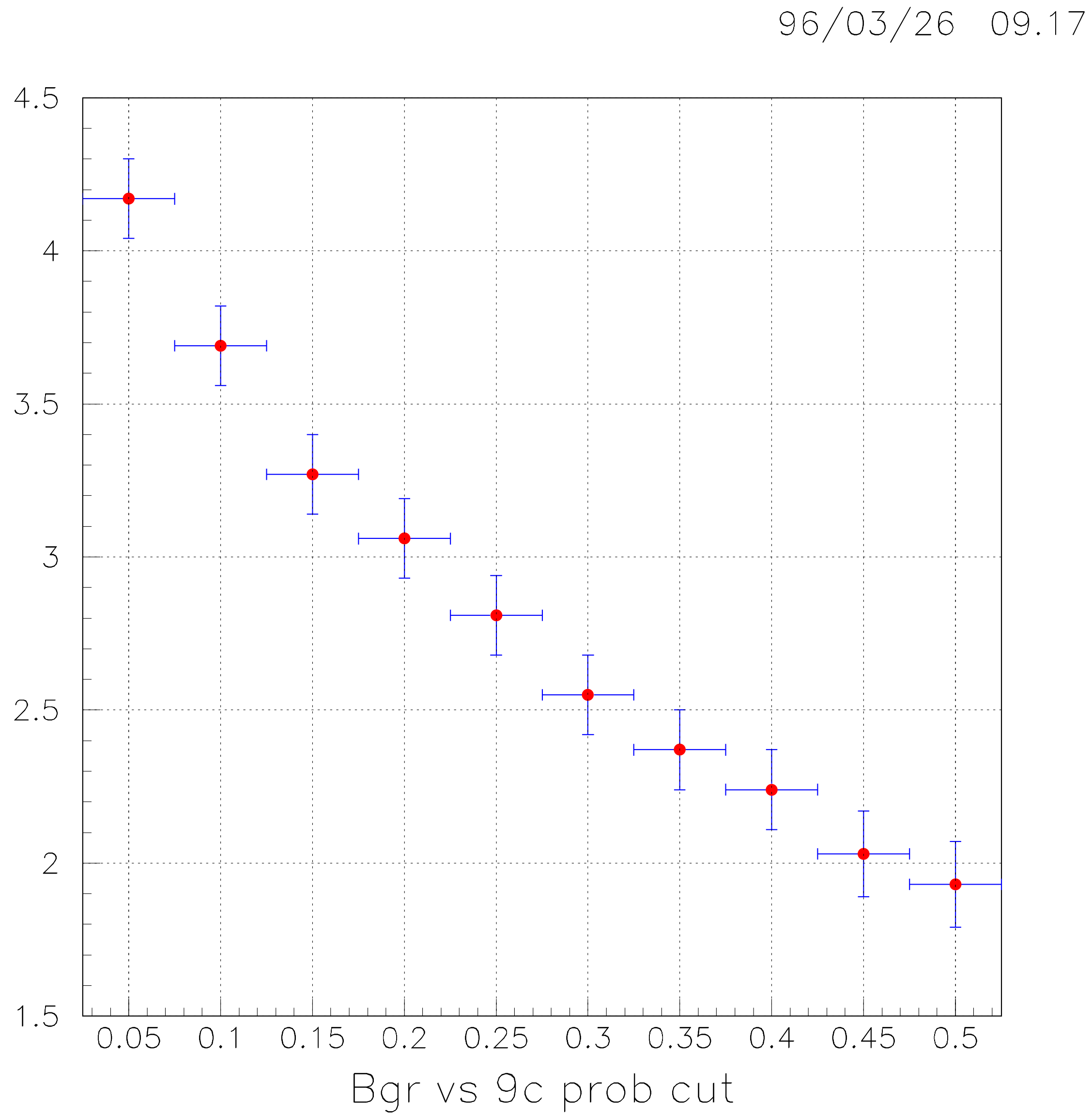

Figure 6: Variation of the average normalization by changing the cut on the 9C-fit probability

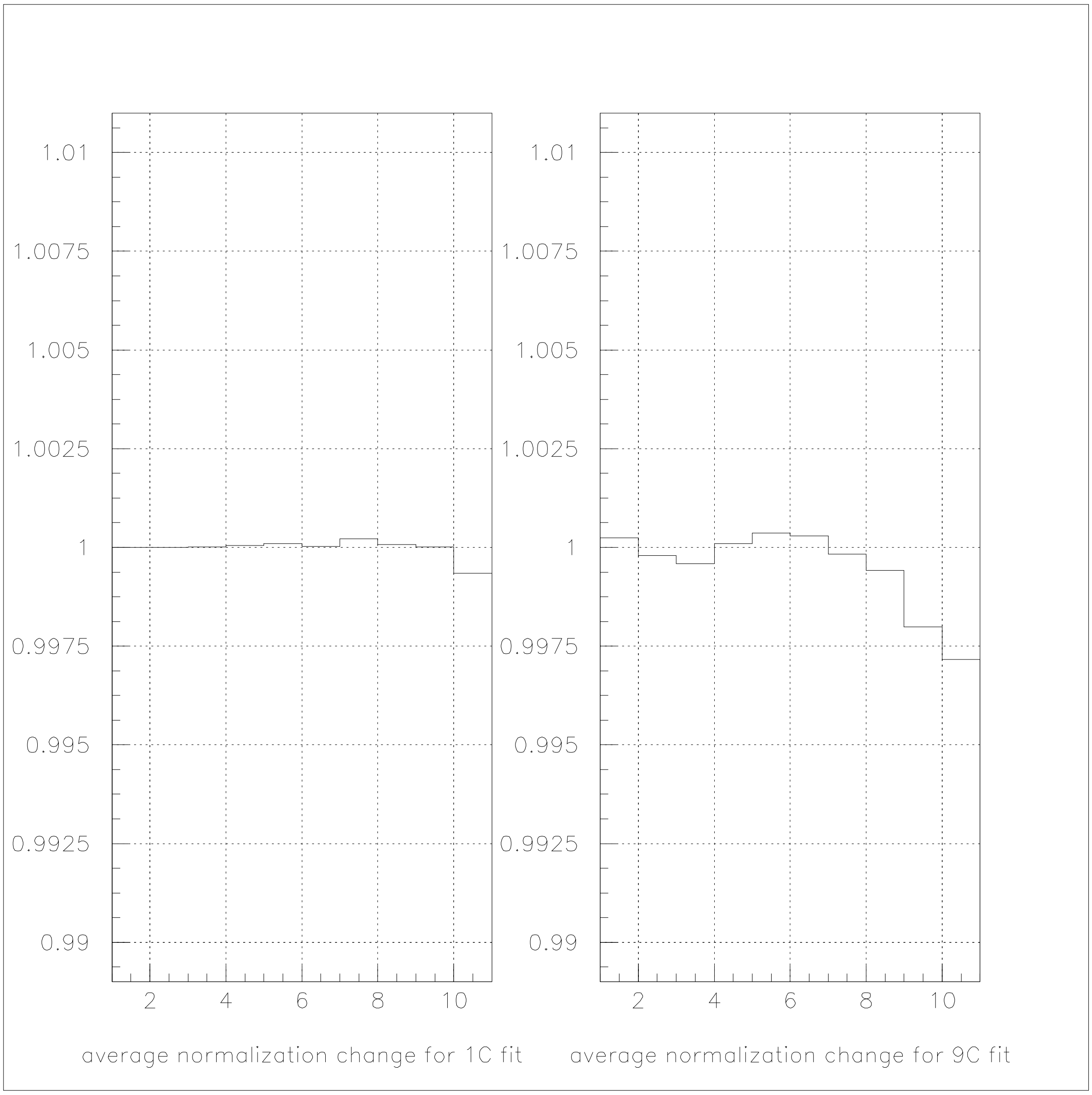

Figure 7: Variation of the average normalization as function of lifetime

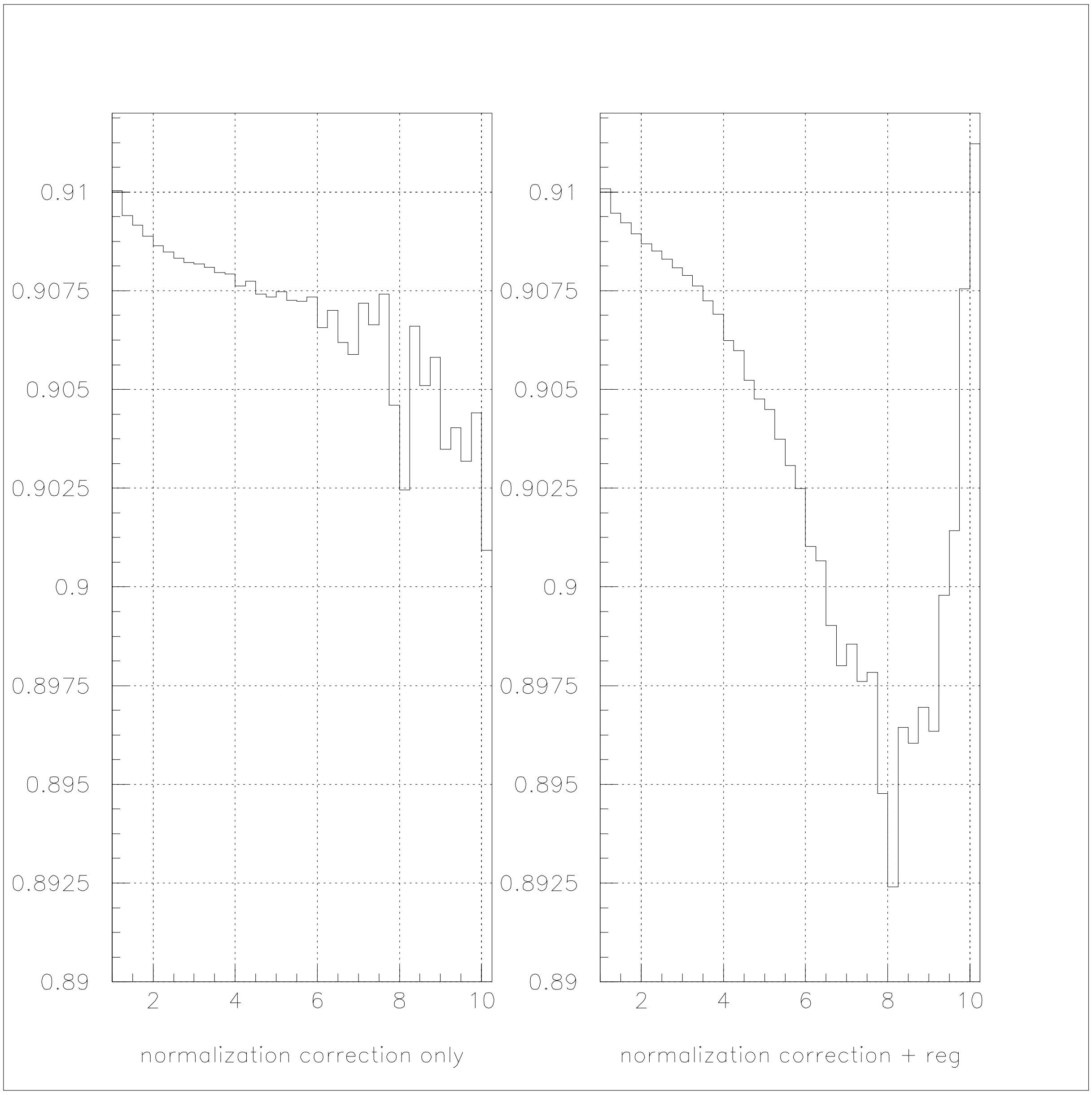

Figure 8: Average normalization corrections as function of lifetime