Summary

In this thesis an uncertainty in $\Delta G/G$, $\delta(\Delta G/G)$, measured in PGF followed by D^0 meson decay into $D^0 \rightarrow K^-\pi^-\pi^+\pi^+$ has been estimated. This uncertainty for 100 days data acquisition in the COMPASS 2002 run is equal to 0.7. The corresponding value for the "golden channel", $D^0 \rightarrow K\pi$, is equal to 0.22 (cf. J.-M. Le Goff, Evaluation of D^0 and D^* channels for the measurement of $\delta\Delta g/g$, COMPASS note 2002-02).

PYTHIA 6.203 and AROMA 2.2.4 were used in simulations. AROMA was used for the signal simulation and PYTHIA for the background. Neither COMGEANT nor CORAL were used. The following cuts were made: solenoid acceptance, re-interactions in the target, resolution in the D^0 mass, muon detection probability, spectrometer efficiency, reconstruction efficiency as well as demands that both kaons and pions should decay behind the RICH and that their momenta should be greater than 0.5 GeV. The effect all these cuts is given in tables 1 and 2.

After all the above cuts $\delta(\Delta G/G)$ was found to be equal to 1.2. A new variable, $\sqrt[4]{\prod p_i} \times P_{tD}$, was found as the most effective in separating the signal from the background. Here $\sqrt[4]{\prod p_i}$ is a geometrical average of momenta of particles from $D^0 \rightarrow K3\pi$ (in the LAB frame) and P_{tD} is the transverse momentum of the D^0 (in the LAB frame). The separation was done in intervals of $\sqrt[4]{\prod p_i} \times P_{tD}$ and in each interval $\Delta G/G$ and $\delta(\Delta G/G)$ were calculated. The final value of the $\delta(\Delta G/G)$ has been calculated as a weighted average error. In figure 27 of the text a distribution of $\sqrt[4]{\prod p_i} \times P_{tD}$ is presented (grey field - signal, black field - background). Values of $\delta(\Delta G/G)$ in different intervals of the $\sqrt[4]{\prod p_i} \times P_{tD}$ variable are given in table 3.

Kinematical cuts on the z_D and $\cos\theta_K^*$ were not effective in reducing $\delta(\Delta G/G)$, contrary to preliminary results reported in the proposal. The $D^0 \rightarrow K3\pi$ decays via intermediate resonant states were also studied and turned out to be ineffective in reducing $\delta(\Delta G/G)$. This fact is also contradictory to preliminary results reported in the proposal.

In obtaining $\delta(\Delta G/G)$=0.7 it was assumed that efficiencies of the reconstruction programs and of the spectrometer will be as high as in the final phase of the data acquisition in the SMC experiment ($\approx$ 90 % per track). For efficiencies much lower (e.g. as in the COMPASS 2001) estimated values of the $\delta(\Delta G/G)$ could be larger even by an order of magnitude. The $\delta(\Delta G/G)$ from $D^0 \rightarrow K3\pi$ is much more sensitive to these efficiencies than that from the $D^0 \rightarrow K\pi$ reaction due to fact that in $D^0 \rightarrow K3\pi$ four particles' tracks have to be measured compared to two from $D^0 \rightarrow K\pi$.

To have a more precise estimate of the $\delta(\Delta G/G)$, CORAL and COMGEANT have to be used. Only in that case final conclusion concerning the $D^0 \rightarrow K3\pi$ usefulness can be made.

Cut	% signal	$D^0 \to K3\pi$ events
$0.35 < y < 0.85$ for $D^0 \to K3\pi$ events	100%	1.5 M
K, π momenta greater than 0.5 GeV	95 %	1.4 M
solenoid acceptance, particle decay position	42%	625 k
resolution in the D^0 mass (40 MeV)	30 %	450 k
re-interactions in the target	15%	215 k
SPS efficiency, muon detection probability, etc. (from the proposal)	5.6%	84 k
spectrometer efficiency (0.9/track)	3.6 %	55 k
reconstruction programs efficiency (0.9/track)	2.3 %	35 k

Table 1: number of $D^0 \to K3\pi$ events left after a consecutive cut.

Cut	% background	$K3\pi$ combinations
$0.35 < y < 0.85$ events with $K3\pi$ combination	100%	$\approx$ 35 G
neutral electric charge of the $K3\pi$ combinations	45%	$\approx$ 15 G
K, π momenta greater than 0.5 GeV	27%	$\approx$ 8 G
resolution in the D^0 mass (40 MeV)	0.81%	260 M
solenoid acceptance, particle decay position	0.14%	45 M
re-interactions in the target	0.074%	24 M
SPS efficiency, muon detection probability etc. (from the proposal)	0.028%	9.2 M
spectrometer efficiency (0.9/track)	0.018%	6.0 M
reconstruction programs efficiency (0.9/track)	0.012 %	4.0 M

Table 2: number of $K3\pi$ background combinations left after a consecutive cut.

$\sqrt[4]{\prod p_i} \times P_{tD}$ GeV^2	% signal	% background	signal:background	$\delta(\Delta G/G)$
0-5	32.2 %	68.4%	1:240	3.05
5-10	34.0 %	25.3%	1:85	1.76
10-15	17.7 %	4.8%	1:30	1.5
15-20	8.5 %	1.05%	1:14	1.5
>20	7.6 %	0.45%	1:7	1.15
total	100.0%	100%	1:115	0.7

Table 3: $\delta(\Delta G/G)$ in different intervals of the $\sqrt[4]{\prod p_i} \times P_{tD}$ variable.