Analysis of the stability of the system.

The stability of the system was checked by looking at the background files during the whole 2003 data taking period. For each background file, the following steps were taken:

- Each background file was fitted to the following function:

$$p3 + p0 \times \left\{ \frac{1}{p1^2} + \left(1 - \left(\frac{p2}{x} \right)^2 \right)^2 \right\} \tag{1}$$

  where $p0$ is a scaling factor, $p1$ is the quality factor (Q), $p2$ is the peak frequency (resonant frequency) of the background, and $p3$ is the offset of the background fit.

  The standard deviation for each fit was calculated.

- The width of each background file at one sixth of the total background height was calculated. The FWHM (full width half maximum) could not be calculated due to the shape of most of the background files, which were not left-to-right symmetric. The shape and fitting of one background file can be seen in figure 1 (top).

- The reference background file 030531_132329.bgr was chosen in order to calculate the gain for each background. Each background was plotted against the reference background, and a straight line was fitted to the resulting set of points, so that the gain could be obtained from the slope of that linear fit. This linear fit can be seen in figure 1 (bottom).

- The noise for each background file was calculated as follows:

$$noise = \frac{2 \times stdev \times 1.14343 \times 10^{-7}}{gain} \tag{2}$$

  where *stdev* is the standard deviation.

Therefore, the peak frequency, the width of the background signal, the gain and the quality factor, could be plotted against time for each coil, to check the stability of the system. These plots have been attached to the end of this report. First the whole data period (from 2003-May-13 to 2003-July-15) is plotted and then only the data from 2003-June-20 to 2003-July-15. Note that the peak frequency for coils 6 to 10 is around 16370000 Hz, and that for coils 1 to 4 is around 16390000 Hz. Note also that the gain for coil 6 has a lower value than for the rest of the coils. Coil number 6 is placed inside the target cell, while the rest of the coils are placed around the target cell.
(Programs backgrounds.C and plotbac.C were used for this purpose. First, the program backgrounds.C produces an output file containing the name of each background file, its time in unix seconds, its width, its peak frequency, $p0$, $p0$'s error, $p1$, $p1$'s error, $p2$, $p2$'s

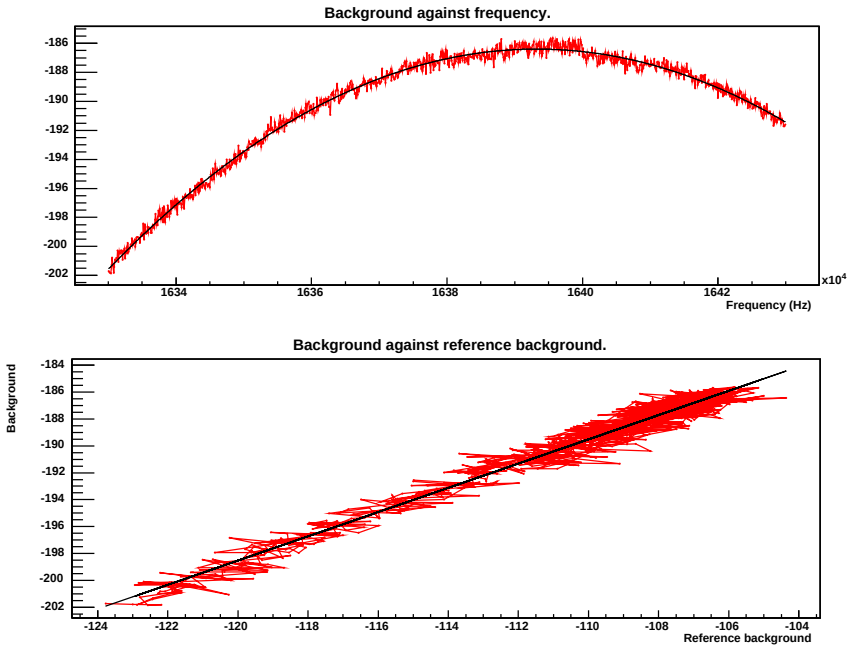

Figure 1: Top: example for the fit on the plot of one background against frequency. Bottom: example for the linear fit performed on the plot of one background against the reference background.

error, $p3$, $p3$'s error, standard deviation, gain, offset of linear plot, and noise. Then the program plotbac.C plots some of these background characteristics against time.)

In the plot of the peak frequency of each background against time, coil by coil, for the period between the 20th of June and the 15th of July, it was seen that the highest fluctuation of the value of the peak frequency corresponded to coil number 1. For the background files that gave rise to these two points that had the lowest and the highest peak frequencies in this period of time, a signal file (.sig) was chosen and the polarization value was calculated first using one of the mentioned backgrounds to perform the background subtraction from the signal, and then using the other one. It was seen that the values obtained for the polarization in each case were very similar, whith the percentage difference between them beeing very small. These results can be seen in table 1.

Finally the value of the gain was studied due to its relevance for the stability of the system. Gain factors from Jaakko's 'GainMay03' report where used to scale the gain of each coil from a value around 1 to a value around 200. These scaling factors can be seen in table 2.
Once the gain was scaled to the right value for each coil, it was fitted to a straight line (function $p0 + p1 \cdot x$). This was done only for the period starting on 2003-June-20 and finishing on 2003-July-15. These linear fits for each of the nine coils can be seen in the

coil	Pol.(low peak freq.)	Pol.(high peak freq.)	% difference
1	57.2337	57.1920	0.073%
2	58.5285	58.5736	0.077%
3	51.2713	51.2158	0.108%
4	58.9369	58.8965	0.069%
6	-45.3813	-45.0339	0.771%
7	-47.8700	-47.9848	0.239%
8	-49.9230	-49.8851	0.076%
9	-49.0332	-49.1328	0.203%
10	-49.7102	-49.6422	0.137%

Table 1: Polarization values calculated first from the background having the lowest peak frequency in the time period from the 20th of June to the 15th of July, and then from the background having the highest peak frequency in that period.

coil	Scaling factor (gain factor)
1	214.159
2	207.039
3	213.339
4	214.016
6	207.521
7	205.432
8	200.294
9	215.561
10	208.021

Table 2: Gain factors used to scale the gain of each coil to a value around 200. (From Jaakko's 'GayMay03' report).

graphs attached to the end of this report. The resulting fitting parameters are given in table 3.

(Graphs are saved in the computer as: all1.ps to all10.ps; all1.eps to all10.eps; cdrom4coil1.ps to cdrom4coil10.ps; cdrom4coil1.eps to cdrom4coil10.eps; gainfit1.ps to gainfit10.ps; gainfit1.eps to gainfit10.eps). (Programs are: backgrounds.C, plotbac.C and plotbac2.C).

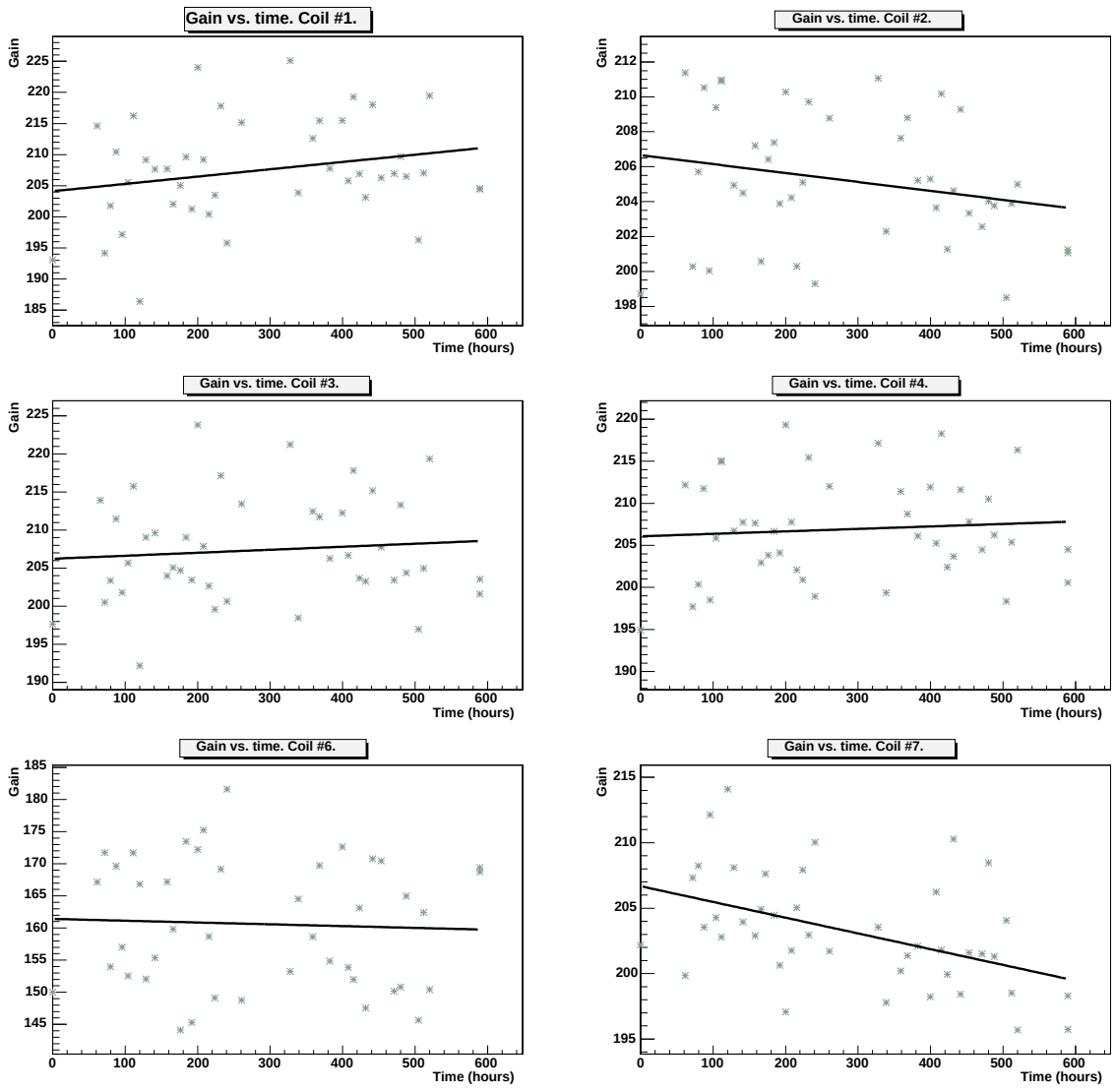

Figure 2: Gain linear fits for coils 1 to 7. (From 2003-June-20 to 2003-July-15).

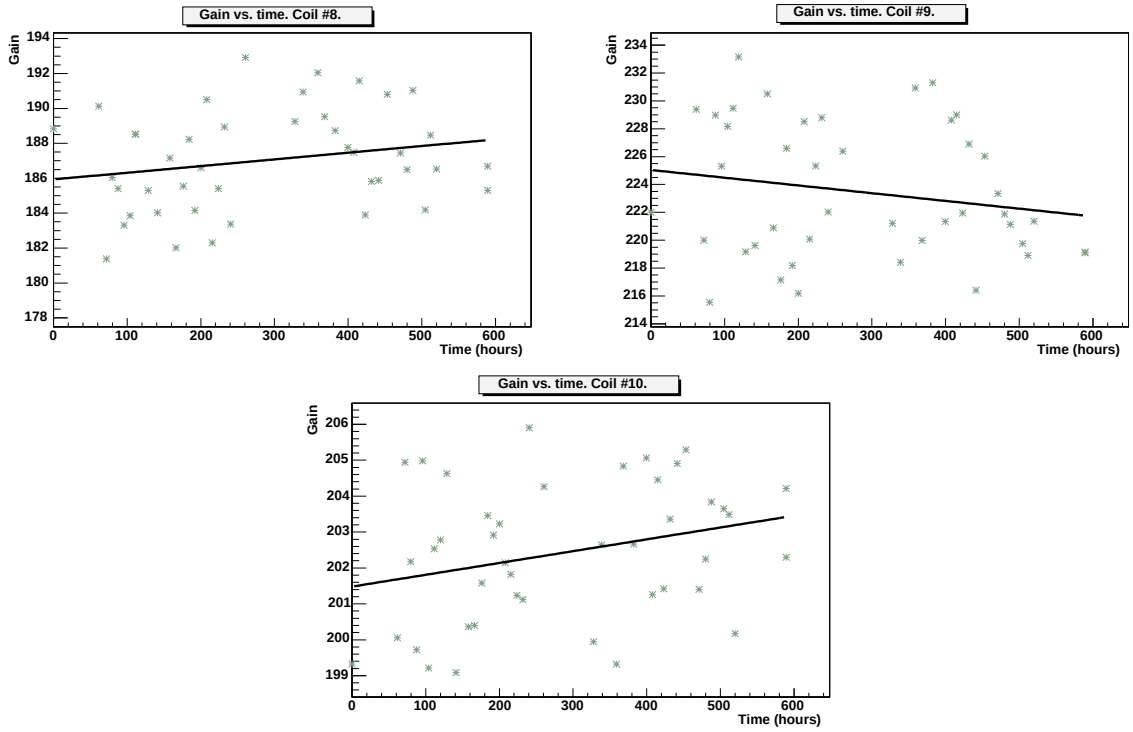

Figure 3: Gain linear fits for coils 8 to 10. For background files from 2003-June-20 to 2003-July-15.

coil	p0	p1
1	204.112 ± 0.309963	$1.17469 \times 10^{-2} \pm 0.93875 \times 10^{-3}$
2	206.659 ± 0.297996	$-5.11467 \times 10^{-3} \pm 0.72337 \times 10^{-3}$
3	206.226 ± 0.310245	$3.95298 \times 10^{-3} \pm 0.93955 \times 10^{-3}$
4	206.073 ± 0.309428	$2.93569 \times 10^{-3} \pm 0.93735 \times 10^{-3}$
6	161.416 ± 0.309937	$-2.79383 \times 10^{-3} \pm 0.93868 \times 10^{-3}$
7	206.678 ± 0.309804	$-1.20317 \times 10^{-3} \pm 0.93840 \times 10^{-3}$
8	185.933 ± 0.247169	$3.82348 \times 10^{-3} \pm 0.69339 \times 10^{-3}$
9	225.042 ± 0.309971	$-5.55651 \times 10^{-3} \pm 0.93877 \times 10^{-3}$
10	201.480 ± 0.309972	$3.29236 \times 10^{-3} \pm 0.93877 \times 10^{-3}$

Table 3: Fitting parameters for the gain for background files from 2003-June-20 to 2003-July-15. The gain was fitted to a straight line with the function $p0 + p1 \cdot x$.