COZ Operation Guide

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1 Operation start after the shutdown

1.1 Test Pulse Run (TPR)

TPR enables fast check of the chamber readout. These runs should be taken especially after the recabling on the CDA (Cable Distribution Area) and closing the shells. For detailed description of data taking procedure in the TPR mode see "Shift Instructions". It is recommended to take TPR each month also during the breaks in the normal data taking period. The results in the form of L4 histograms could be checked immediately.

The general COZ performance is monitored by online histograms like wire hit map, signal pulse amplitudes spectrum and drift times distribution. These allow for fast performance check of the chamber.

1.2 Switching On the High Voltage (HV)

Before switching on HV the following checks are neccessary:

1. 3 CAEN HV crates in the trailer on the 1^{st} floor
    - correct cabling of all HV channels (rear side)
    - trip logic on the rear side of the CAEN modules
    - interlock cable has to be plugged in (front side)
    - enable HV (switch on the front side)
2. gas mixture composition (measurement from gas experts - room 601)

It is recommended to switch the HV in 3 to 4 steps with gradually higher HV settings. The slow rise of the HV from low start values to the nominal ones (training) is important at least for two reasons:

1. this training enables continuous removing of the dust and other impurities which could get into chamber, especially if the chamber was opened during the shutdown. This also helps to remove surface charges.

2. one usually starts the chamber operation when the gas composition is not stabilized at the nominal value yet (too high fraction of Argon moves the chamber operation point to the lower HV values).

For an example of the slow HV training with 4 different HV settings, each of them switched on for 12 to 24 hours, see Table 1.

U_{SW}	U_{CS}	U_{FS}	U_{CA}
1500	250	200	-3000
2000	250	200	-3900
2200	280	230	-3900
2300	300	250	-3900

2 Choosing the HV values

The electrostatics and the COZ operation conditions are controlled through 4 different values of HV. The gas gain, i.e. the chamber efficiency, is determined by signal (sense) wire voltage U_{SW}. The U_{CS} - HV of the central fieldforming strip affects the relative efficiency from inner to outer wires. The HV difference between the first strip U_{FS} and the cathode U_{CA} determines the field gradient in the drift region and therefore the drift velocity.

Typical HV values used:

1. U_{SW} - the selection of this voltage should compromise between the efficiency and HV stability. It depends on the gas mixture composition and the HERA machine operation conditions. In the past it was immpossible to keep the HV above 2360-2370 V and even at these voltages the stable operation was rather exceptional (there were problems with the stability of the gas mixture and due to this the COZ was very sensitive to the high background rates).

2. U_{CS} has to be set to the value at which the efficiency of the outer wires is smaller just by around 5 %. The higher value of U_{CS} has negative effect on the efficiency of the outer wires. On the other hand, if U_{CS} is set too low then the HV stability of COZ gets worse. From the previous test runs the value of 300 V was found suitable.

3. recommendation for the U_{FS} value is $U_{FS} = U_{CS} - 50V$. High tension on this strip has positive effect on the HV stability of the whole chamber.

4. $U_{CA} = -3900\,V$, upper limit 4000 V is set by the used CAEN HV modules. *Warning ! - if for some reason U_{CA} for any ring has to be reduced, keep in mind that the difference with respect to its neighbours must be $<$ 1000V.*

- HV setting mostly used was $2350 \pm 20/300/250/3900\,V$ for $U_{SW}/U_{CS}/U_{FS}/U_{CA}$ respectively.
- not all sense wires are equally stable. There are differences between them up to 30-40 V !
- for taking cosmics data it is possible to increase the U_{SW} up to 2380-90 V.

3 Gas Mixture

Last year we ended the data taking period with the mixture 45.5/54.5 % of Argon/Ethan and a 1.3 % admixture of Isopropanol. To read about problems related to the COZ operation and unstability of gas mixture see the electronic logbook from COZ web page. On this web page is also a report dedicated to the alcohol problems (of COZ of course) to the Data Quality Meeting (COZ web page).

4 Trips, HV Stability

The trip status for the corresponding channel is set if its current is above the preset limit I_0 for a time $n \times 0.1$ s. I_0 and n can be set individually for each channel in the HV-steering file. Current values are: for SW - $n = 1$, $I_0 = 20\mu A$; for CS and FS - $n = 9999, I_0 = 160\mu A$; and for CA $n = 0, I_0 = 160\mu A$. The maximal current limit of $200\,\mu A$ is coming from the CAEN module. Cathodes and CS, FS should not trip normally. Possible sources of problems could be due to the short cut between the fieldforming strips or due to the damaged HV cable. In this case one measures higher current in the fieldforming circuit. If this current reaches the hardware limit of $200\,\mu A$ one has to reduce the corresponding HV.

4.1 Handling of Trips

The basic question is what number of trips is tolerable and at what number and/or frequency of trips one should react. Rule of thumb is: in the case of frequent trips reduce the U_{SW} of the problematic channel by 20-30 V. If this does not help reduce it more! After few days of stable running you can try slowly, in steps by 10 V to increase the HV. Let us define that 3 trips of the same channel within an hour is too much. In the HV steering program is built in a protection which does not allow the shift crew to switch on the channel if it had tripped $3\times$ during 1 hour - channel is locked. In this case shift crew should call the COZ expert and after the check of the actual situation experts decides what to do. There can be different sources of problems.

- if COZ is not the only one chamber tripping then most probably bad background conditions are the source of problems
- HERA operation is not very stable - i.e. background rates are generally not very high but occasionally big spikes lead to the trips.
- if COZ is the only chamber tripping frequently - look for reason
  - more channels are tripping simultaneously, chamber is generally unstable $\rightarrow$ problem could be due to the wrong gas mixture (Ar/Ethan ratio and Isopropanol content)
  - the same channel(s) is (are) tripping frequently

5 Monitoring of Currents in the COZ

The currents flowing through each HV circuit are monitored and written to the data base. With simple SQL program the data can be read out, written to the PAW-Ntuples and analyzed. It is very useful to follow the currents as a function of time. Each increase is a signal that the concerned channel is getting worse. SQL programs cozcafs.sample and cozsw.sample can be found in the directory ~/kurca/h1/coz/currents.

6 Editing and Loading of the New HV-File

COZ HV steering is done via the Mac computer in the room 307 (in the near future will be replaced by PC under Windows operation system).

6.1 Changing a file with high voltage setting

One should not edit directly the hv_COZ file, but edit the corresponding file in the folder hv_COZ_settings. Make a duplicate of this file, rename it to hv_COZ and move it onto the old hv_COZ (it will be overwritten).

Now in more details these 2 sentences.

1. hide HV-Programm (it cleans your terminal from windows not needed at that moment)
2. start EditHV-alias (double click on the icone right top)
3. open the file to be edited (File - open) → folder HV → folder COZ_HV_settings → select the wanted file
4. change a HV parameter : click on the value to be changed → type in the new value and click on it validating the change
5. "Save" (under the same name) or "Save as" (if under different name) and "Quit"

6.2 Loading of a file with new high voltage setting

1. switch OFF the COZ HV
2. hide HV-programm
3. open disk HD-HVMac (doubleclick) → double click folder HV → double click folder COZ_HV_settings
4. the currently loaded HV file has usually a hot label. Unlable the old file (Label: none) and Label the new file (Label: hot)
5. duplicate the new file (File → Duplicate) → rename the file xyz_hv_file_copy → hv_COZ
6. move the new hv_COZ file from the folder hv_COZ_settings into the folder HV
7. activate the HV_Programm (icon right top)
8. load the new hv_COZ file: File menu (left top) → Open → hv_COZ
9. the new file will appear in HV logging file.

10. check the "readout" , i.e. if the values loaded are those you wanted
11. wait until all HV channels are loaded !
12. you can switch on the chamber (first into standby then on)

7 Update of the Data Base Banks C3Z6, C3Z7

Electrostatic field parameters corresponding to the HV setting file are stored in the banks C3Z6 and C3Z7. The isochrones of the inner and outer wires respectively are parametrized by ellipses. The computation and production of these banks is done with the modified Garfield programm (installed on hydra computer at DESY Zeuthen - directory /h1data/COZ_ISO). C3Z6 and C3Z7 banks are written to the H1 database by standard tools. These banks have to be recalculated and written to the data base for each change of U_{CA} and/or U_{CS} and/or U_{FS} HV parameters. Small changes of U_{SW} by 10-30 V do not necessary require new banks.