ALERT Gas System Requirements

Author: Gabriel CHARLES
Date: 2023/09/23
Topic: this note describes the requirements for ALERT Gas System

ALERT detector is composed of a chamber filled with He/CO_2 gas mixture. After a short description of the detector and the gas mixture selected, we show the effect of temperature and pressure change on some of the parameters of the detector. From these results we conclude on the constraints on the gaseous system.

The chamber is filled with gas. The gas is introduced through a small volume before the active area of the detector. The total volume is about 52 L. We probably want to renew the gas volume every five hours. The required flow rate is hence 10L/h or 170 sccm. We probably want to be able to double this value in case of problem, so if the system can reach a flow of **340 sccm**, it would be nice. A high flow also ensures a good homogeneity of the gas in the detector. Studied were carried out to see the effect of pressure and temperature changes on the drift time (fig. 1) and gain (fig. 2) in the gas in presence of a 5T magnetic field in He/CO2 (80/20), the parameters are important for precise reconstruction. The variations chosen for the pressure and temperature are the one obtained from sensors installed in Hall B.

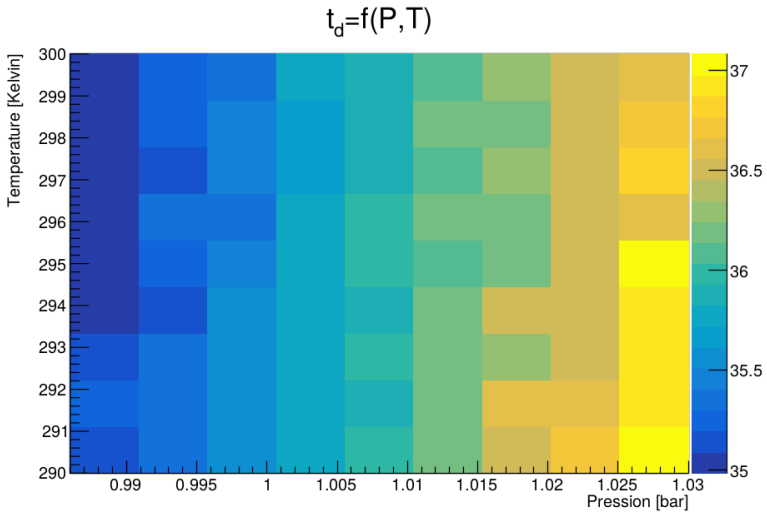

Fig. 1 Drift time in ns as a function of pressure (X) and temperature (Y)

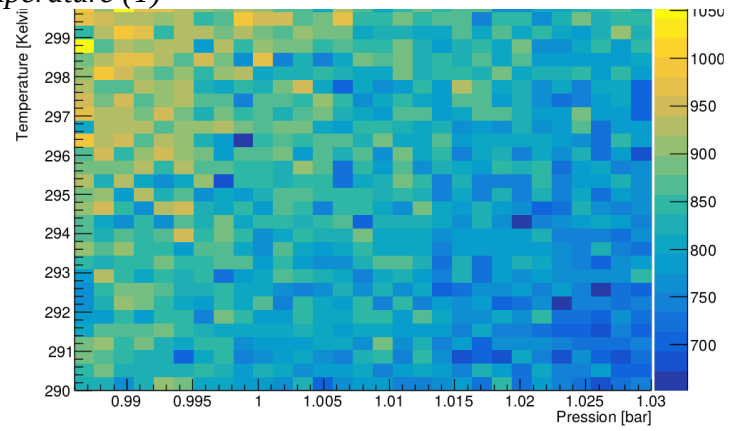

Fig. 2 Gain as a function of pressure (X) and temperature (Y)

As one can see, the variations of the drift time are of the order of 8 % while on the gain variation are above 30 %.

1) Conclusions from these studies: we would like to have a system where the temperature and pressure at the entry of the detector are controlled and monitored as we may be able to take into account these effects in the reconstruction. Measuring the values at the output of the dectector is also necessary. We would like the four values to be stored every 10 minutes.
If it is possible to imagine a system where the temperature and pressure are more stable than in the Hall we will be happy to discuss it with you. In any case, the temperature and pressure should never be lower than in the hall (example of gas that became liquid and froze at the exit of the bottle due to low temperatures outside temperatures).

2) Not related to the working conditions of ALERT, it is important to take into account that leaks may affect the behavior of PMTs of CLAS12. To minimize the risk we will mount a first enclosure close to our detector and a second one a bit further with fans to extract the He (CO2 is less likely to leak) outside the area covered by the PMTs.
Though, efforts must also be made at the pipe level, it is now clear that to avoid leak, especially with helium, plastic pipes are prohibited, hence it will be necessary to have solid gas pipes. We should propably exchange on how to fix them.

3) The chamber is composed of aluminium wires. These kind of wires is known to be subject to Malter effect but it can be recovered by inserting water vapor inside the gas. The proportion of water with respect to the other gas mixture elements is usually very low, around 0.3 % of the total gas. It would be nice if such system could be implemeted from the begining. A gas system where anything from 0.1 % to 3 % of water vapor can be added would be perfect.

4) Using different bottles for CO_2 and He would allow us to adjust the mixture if needed.