

Construction and commissioning of a setup to study ageing phenomena in high rate gaseous detectors

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A setup, dedicated to the investigation of ageing properties of gaseous detectors due to materials used for their construction has been constructed and commissioned at the GSI detector laboratory. An outstanding feature of the setup is that tedious and repetitive measurements can be conducted fully automated.

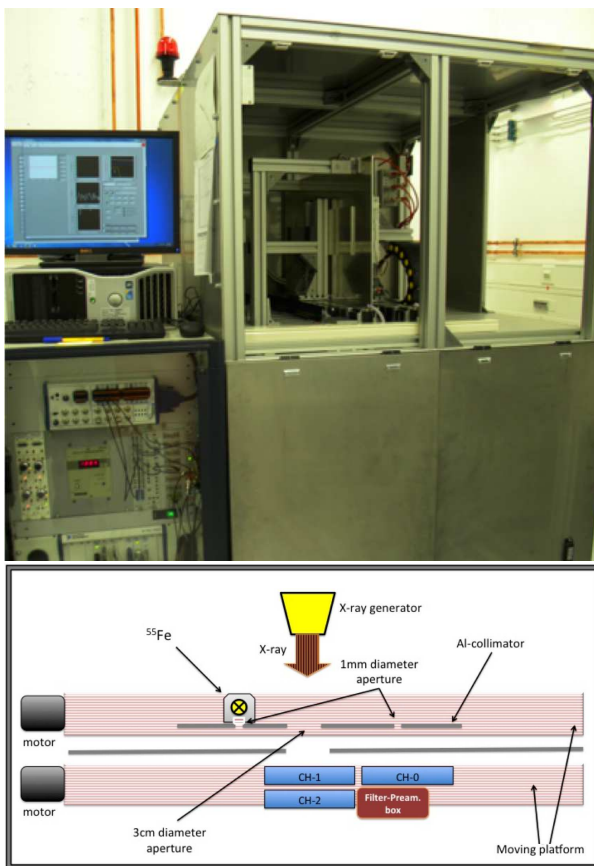


Figure 1: Photograph of the setup mounted in a metallic enclosure and the associated data acquisition system (top). Sketch of the components of the ageing setup (bottom).

The setup consists of three identical Multi Wire Proportional Chambers (MWPCs) mounted onto a moving platform, an X-ray generator to produce ionizing radiation and an ⁵⁵Fe source for gain diagnostics. A second moving platform holds an aluminium collimator plate which has three different apertures. Two of the chambers are flushed with gas which has passed through outgassing boxes containing the materials under investigation. One of the chambers is operated with clean gas for reference purposes. All gas lines are equipped with individual Mass Flow Controllers.

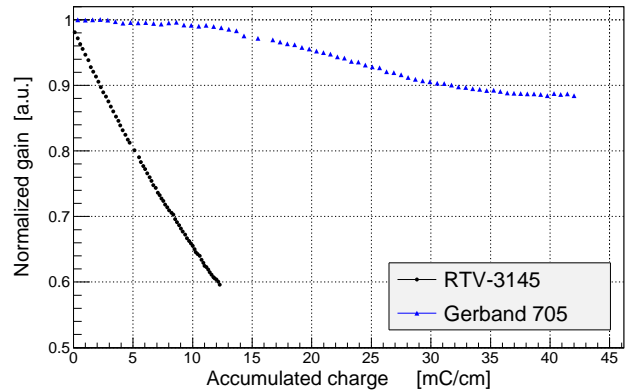


Figure 2: Normalised gain of chamber tested with Gerband 705 (blue) and chamber tested with RTV-3145 (black) as a function of accumulated charge per unit length of the anode wires.

The measurements are carried out with a premixed gas mixture of ArCO₂ (80/20). The data acquisition and control system based on LabView is configured to allow fully automated measurements during long term tests. Figure 1 shows a photograph of the setup and a sketch of the components.

Before fabrication of the MWPCs, simulations of their electric field and gain had been done using a combination of a gas simulation program (Magboltz) and a electric field simulation program (Garfield). The accuracy of the gas temperature measurement has been greatly improved which allows a very accurate correction of the gain measurement. Over a period of eight months, cleaning procedures have been developed and all sources of contamination of the equipment have been eliminated. Thereafter, the setup has been operated with very stable behaviour, evidenced by the fact that around 0.5% peak-to-peak residual variation of the normalised gain has been achieved. Thus the setup shows the required high stability to be used for precise ageing studies.

First ageing tests have been carried out with two materials over two weeks: Aluminium tape named Gerband 705 and a adhesive/sealant named RTV-3145. At the end of these two weeks, the ageing rate (R) caused by Gerband 705 was about 0.3%/mC/cm while it was 3%/mC/cm for RTV-3145. The blue and black curves of Fig. 2 illustrate the normalised gain of the MWPC contaminated with Gerband 705 and RTV-3145, respectively, as a function of the accumulated charge per wire length.