Fast closing system for Grand Raiden

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Many experiments have been performed by using the magnetic spectrometer Grand Raiden (GR) [1]. In the experiments, we have evacuate the beam line, the scattering chamber (SC), and the GR, and have used a thin foil as an exit window of the GR in order to reduce reactions of charged particles. Unfortunately, the window have sometimes broken, and inflow of air have broken reaction targets in the SC, which located upstream of the GR. Therefore, we introduced a fast closing system [2] to protect the target.

The system consists of a vacuum sensor (VAT, HV sensor: 770SH-99NN-0001), a fast closing shutter (VAT, 77344-XE44-ABJ1), modules to control the system (VAT, controller VF-2: 770VF-16NN-AAB4; control module: 336941; HV sensor module: 339176; valve module: 341598; 2Gate module: 355805). Figure 1 shows a schematic layout of the system. The sensor is attached on the exit chamber (EC) of the GR. The shutter is inserted between the GR and the SC. The shutter was specially made to fit the space. An opening, 126 × 35 mm^2, is also specially designed to match various experimental conditions (Fig. 2). The modules are placed in a rack near the D2 magnet. Using a 10-m cable (VAT, 770CS-99LX) and a 40-m cable (VAT, 770CV-99LX), the sensor and the shutter are connected to the HV sensor module and the valve module, respectively. Total response time of the present system is some dozen msec. In addition, two existing slow valves placed in front of and behind the SC can be connected to the 2gate module so as to maintain the vacuum in the SC and the beam line.

We examined whether the system is able to protect the target in the SC. The schematic layout is shown in Fig. 1. We placed an 1.68-mg/cm^2-thick gold target in the SC. We attached a blank flange to the exit window. Instead, we attached a flange which has a 70-mm-diameter Kapton window to the EC as an air inlet. By breaking the Kapton window, we performed the examination. The shutter closed as soon as we broke the Kapton window. The slow valve between the SX and the Q2 magnets subsequently closed. In the SC, the target was unchanged, and the vacuum was not seriously deteriorated. In the examination, we also monitored electric current of three cold cathode gauge heads, C.C.1, C.C.2, C.C.3 (BALZERS, IKR020), to which we supplied -3.3 kV, by a oscilloscope. The currents were converted to the voltage signals by op-amp current-to-voltage converters [3]. Because the voltage level becomes higher as the vacuum becomes worse, we were able to measured the time differences among the gauges by recording time over a threshold voltage. The difference between C.C.1 and C.C.2 and between C.C.1 and C.C.3 were 21.6 msec and 34.6 msec, respectively. The result is consistent with an rough estimation from the speed of sound and the geometries. Considering the results mentioned above and the flight path of the central ray in the GR (20 m), we can conclude that the response time of the present system is fast enough to shut the inflow of air into the SC.

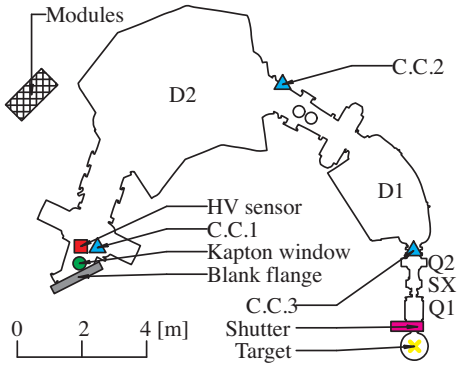

Figure 1: Schematic view of the GR and the layout of the fast closing system. The layout of the examination is also shown.

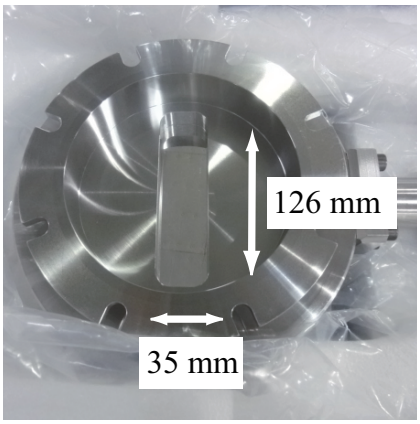

Figure 2: Fast closing shutter.

References

[1] M. Fujiwara, et al., Nucl. Instr. and Me th. A **422**, 484 (1999).
[2] Fast closing shutter <http://www.vatvalve.com/en/products/catalog/F/773_1_V>.
[3] AD8506 <http://www.analog.com/static/imported-files/data_sheets/AD8505_8506_8508.PD>.