Beam profile measurement using helium gas light emission for superheavy element search experiment†

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The newly constructed superconducting linear accelerator (SRILAC)[1] continues to operate with the aim of discovering new superheavy elements following the discovery of 113 Nihonium,[2] and production medical radiation isotopes At.[3] In this experimental search for superheavy elements, owing to the demand to extend the durability of the expensive Cm target to the best extent possible the accelerated V beam must be adequately widened. Therefore, a He gas light emission monitor (HeLM) has been introduced to measure the beam width non-destructively and constantly.

Figure 1 shows the schematic of the differential pumping system, target chamber for the GARIS-Ⅲ, and HeLM. The beam originates from the left side and hits the Cm targets. As helium gas is flowing in the target chamber, the electrons of helium gas is excited by the collision with the beam. By monitoring the emitted light with a CCD camera when the excited electrons are de-excited, the beam profile can be obtained continuously. The image data obtained is sent to an image analysis PC with a video server for digital processing. These measurements and data analysis are controlled and programed with LabVIEW and the analyzed data are shared with a large-scale EPICS control system.

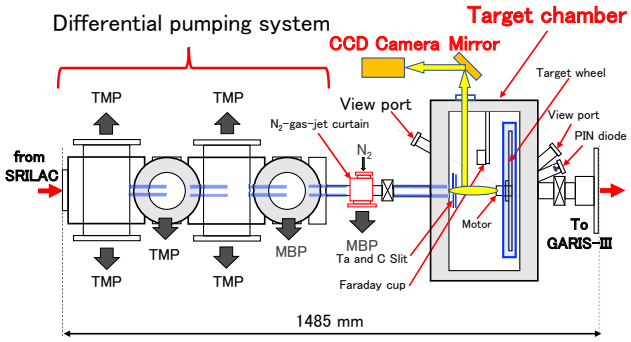

Fig. 1. Schematic of the differential pumping system, target chamber for GARIS Ⅲ and HeLM.

Figure 2 shows the front panels programmed with LabVIEW and measurement results. Recently, the beam width measurement with the HeLM and the beam optics calculation[4] facilitated the precise beam size control at the Cm target. Furthermore, the correlation between the beam size measured with the HeLM and elastic scattering counts measured with a semiconductor detector are confirmed to be quite consistent.

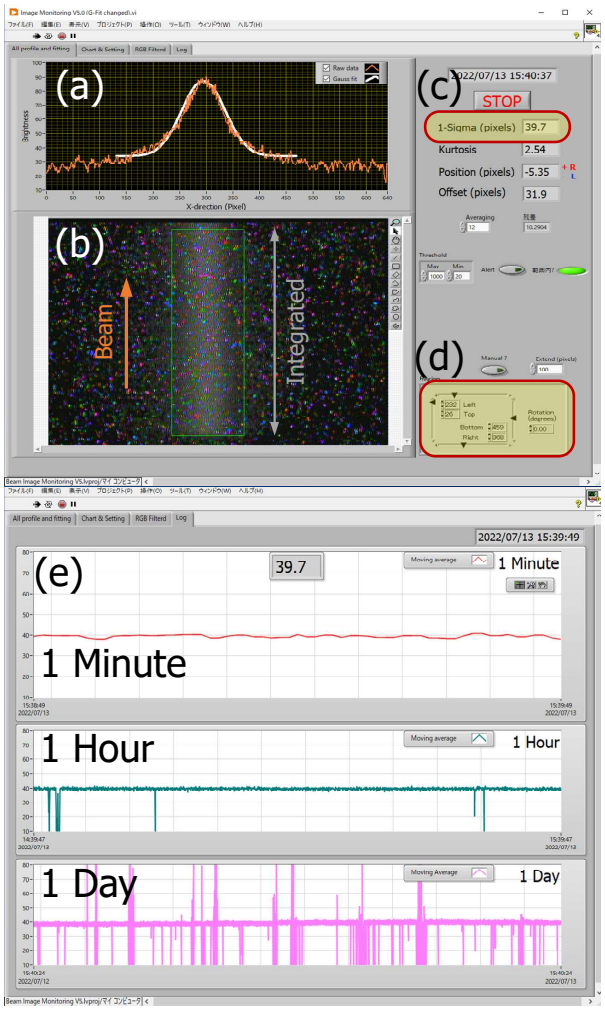

Fig. 2. The front panels programmed with LabVIEW and measurement results. (a) The integrating the brightness in the direction of travel of the beam and the result of Gauss fit, (b) image of He gas emission, (c) value of Gauss fit 1σ and the deviation from the center, (d) selection of the fitting region (manual, direct numerical input) and (e) Record of the Gauss fit 1σ.

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