Identification of every target mounted on a rotating wheel and its application

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Several pieces of sector-shaped targets mounted on a rotating wheel have been employed for superheavy element (SHE) production experiments with high-intensity beams. Thus far, it had not been possible to determine the thickness difference between each target without which, we adopted the average thickness of all the peaces. To distinguish it, we have developed a new wheel frame with an extra ID-tag placed between the spoke-position-indicator tags on the circumference of the wheel (Fig. 1).

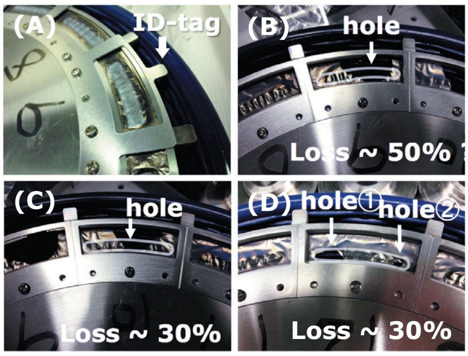

Fig. 1. (A) New wheel frame with an ID-tag. (B,C,D) Observed pin-holes on irradiated targets #11, 12, and 14, respectively.

A circuit block diagram for identifying each target frame is shown in Fig. 2. To avoid unnecessary beam irradiation of the spokes, timing signals of each tag detected by a photo-diode sensor are used. In the case of a rotational speed of 2000 rpm, the timing signals from the spoke tags are periodically generated for every 1.875 ms, whereas an additional signal from the ID-tag is generated for every 30 ms in one rotation. A signal timing chart [A], shown in Fig. 2, indicates that an original signal is generated from the photo sensor. The chart [B] is modified from the signal [A] by changing its delay and width. The chart [C] is obtained by a logical 'AND' operation of the signal [A] with [B], resulting in a useful timing for one rotation of the wheel. This pulse is delivered to a reset scalar and the scaler measure the timing in every rotation. This angle-timing information is recorded together with the reaction-event data measured at the focal-plane detector for each separate event. The chart [E] indicates the timing of the spokes with elimination of the timing of the ID-tag. The [E] is obtained by a logical 'AND' operation of the signal [A] with [D], which is an inverted signal of [B]. This pulse is delivered to the accelerator in order to chop the beam.

As a typical example, a two-dimensional plot (Fig. 3) of the event rate is monitored over a long irradiation period (abscissa) for a rapid rotation timing (ordinate). Event rates for targets #11, 12, and 14 become relatively higher than those for other targets caused by pin-holes on the target foils as shown in Fig 1(B,C,D). Thus, this plot is useful in identifying the condition of every target foil. Moreover, it enables additional beam chopping for masking the broken target, as shown in Fig. 3. The masking signal can be easily obtained with a logical 'OR' operation of the inverted signal [E] with a certain delayed signal of [C].

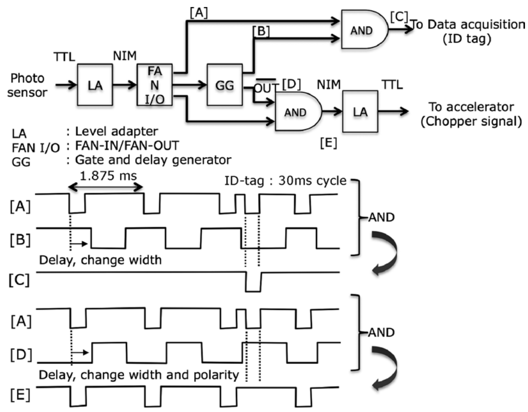

Fig. 2. Block diagram for ID of every target-frames.

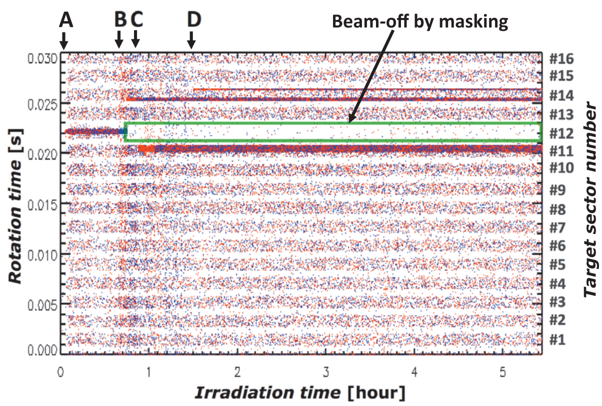

Fig. 3. A target-condition monitoring chart using event timing. Sudden changes in event density at A, B, C, and D indicate the broken parts of the target sector #12, 14,11, and 14, respectively.

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