

# Interlock system and remote-controlled system for a cryogenic target

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Originally, the target cooling system at RCNP was developed for solid targets by T. Kawabata [1], in addition, the cooling system for gas target was developed by H. Matsubara [2]. These systems have been used for many experiments at the cyclotron facility in RCNP. A schematic view of the system for solid targets is shown in Fig. 1. It is installed on the top of the scattering chamber. In these systems, the vertical position of the target can be changed by using a stepping motor, which is controlled remotely via the RS-232C connection. We have no problem when only cryogenic target is used. However, when we use the targets in the scattering chamber besides a cryogenic target, a collision between two target ladders can happen.

In order to prevent such accidents, we developed the interlock system, where two target systems communicate with each other about their position. The stepping motor for the target ladder in the scattering chamber is driven by a programmable logic controller (PLC) and controlled from the "wsdev" system, which was developed by A. Tamii. We introduced PLC modules: a positioning module and input/output modules, and arranged so that the motor of the cryogenic target could be driven from "wsdev" as shown in Fig. 2. Furthermore, the temperature of the target are measured with the thermocouples and automatically recorded in the accelerator database. Users can monitor the target temperature by using a database referral program "accdb".

With this interlock system, one of the targets can move freely only while the other target stops at the safe position. The target system in the scattering chamber is not restricted to move when the cryogenic target is not installed. This system was successfully used in the experiments E388, E391 and E406.

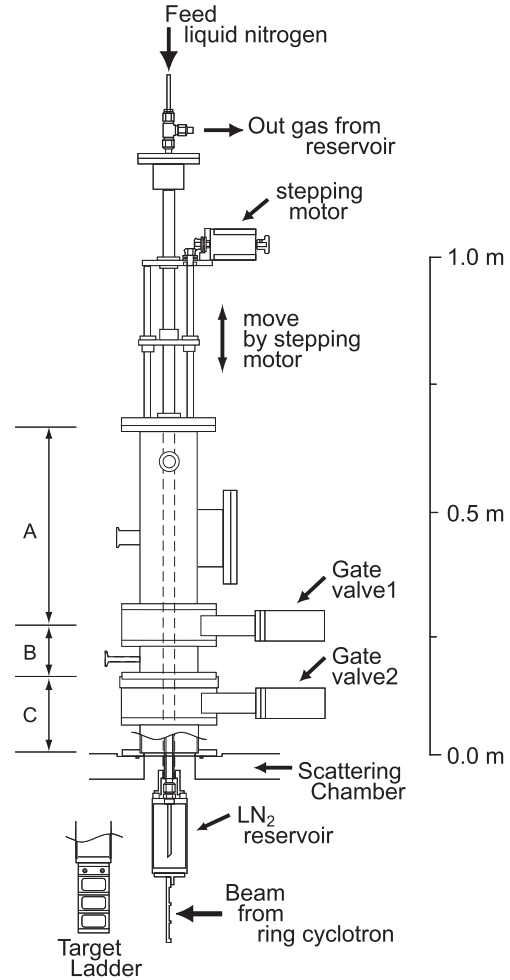


Figure 1: Schematic view of the target cooling system for solid targets [1].

Scattering Chamber		GR	LAS	WS Beam Line				
		PRESET	ACTUAL					
Target Position	▼		0.430	V	DOWN	◀ ■ ▶	UP	↻
Target Rotation	▼		3.359	V	CW	◀ ■ ▶	CCW	↻
FC Position	▼		32.399	V	DOWN	◀ ■ ▶	UP	↻
FC Rotation	▼		2.161	V	CCW	◀ ■ ▶	CW	↻
FC Tilt	▼		32.400	V	CCW	◀ ■ ▶	CW	↻
Table Rotation	▼		1.238	V	CCW	◀ ■ ▶	CW	↻
Cool Target	▼		0.000	pls	UP	◀ ■ ▶	DOWN	↻

Figure 2: Screenshot of the remote controlling GUI "wsdev".

## References

- [1] T. Kawabata *et al.*, Nucl. Instr. Meth. A **459**, 171–176 (2001).
- [2] H. Matsubara *et al.*, Nucl. Instr. Meth. A **678**, 122–129 (2012).