PALIS laser interlock system for human and machine protection

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A laser interlock system has been developed to facilitate safe operation and machine protection in the new laser system for PArasitic slow RI-beam production by Laser Ion Source (PALIS)[1].

Fig. 1 shows the overview of the interlock system for the current PALIS laser setups. There are many items pertaining to laser operation, for example dye circulator, chiller, air compressor, laser beam shutter, power meter, wave meter, and so on. These often depend on each other. If some interruption in dye flow occurs during the irradiation of strong pump laser beam, the dye cell and dye itself are damaged almost immediately. Further, if cooling water stops or leaks, those devices that require refrigeration stop functioning. These accidents are dangerous and can potentially start a fire or cause fatal damage to laser devices. The irradiation of laser beams direct on to the human body, especially on to the eyes must be avoided. Therefore, some safety devices like a beam shutter or door interlock, are necessary. Additionally, a monitoring system is essential to establish a robust system and to reduce the frequency of operator interventions for reading laser beam power, laser beam position, and wavemeter.

In this circumstance, one needs to build an automated system using a programmable logic controller for operating all devices remotely. We adopted a National Instruments (NI) Compact RIO system that are referred from ISOLDE RILIS[2]. NI CompactRIO incorporates a real-time processor and reconfigurable FPGA. The hot-swappable industrial I/O modules can directly connect to sensors and actuators. CompactRIO embedded systems are developed using high-productivity LabVIEW graphical programming tools for rapid development.

The sensor devices for dye circulation are necessary to monitor the dye flow at all times. However, the dye solution is often composed of volatile liquid, and the interconnection of sensor surface on the liquid flow is not adequate. Here, we use two types of sensors on an experimental basis. One is a vibration sensor that can detect a small oscillation of the flow tube synchronized with a circulator's pumping action. The other is an ultrasonic sensor that evaluates the echo of high frequency sound waves received back by the sensor. If any sensor detects an interruption in dye flow, the beam shutter immediately acts to stop the pump laser beam. In addition to these sensors, alcohol sensors monitor a dye leak. Several sensors are used for cooling water to detect a leak and to monitor the dye temperature stability. The laser power meters and beam shutters are coupled with air cylinders. Therefore, the air pressure is also monitored by a pressure sensor. The door interlock system for laser beams was prepared in the BigRIPS room. The laser beams cannot be sent to the BigRIPS room unless any door in the BigRIPS room is closed.

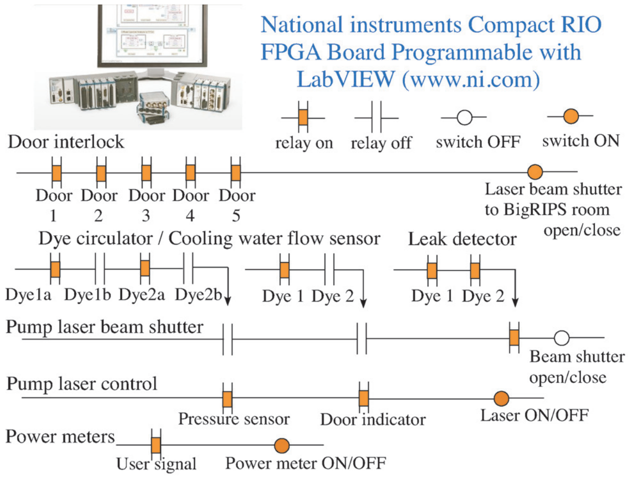

Fig. 1. The overview of the interlock system with interactive equipments for current PALIS laser experiment.

The laser interlock system for PALIS experiment is being developed. This system is motivated not only for human and machine protection but also for facilitating an efficient and robust experimental environment. By effective utilization of these system, the off-line and on-line commissioning test for PALIS will be started from April 2014.

References
1) T. Sonoda *et al.*: AIP Conf. Proc. **1104** 132 (2009).
2) Bruce Marsh, presentation slides in EMIS2012.

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