

Abstract

A cryogenic permanent-magnet undulator (length 2 m, period length 15 mm) is under development for Taiwan Photon Source (TPS). To obtain a magnetic-field distribution of the cryogenic undulator after it is cooled to an operating target temperature below 80 K, a device of hybrid type combining a Hall probe and stretched-wire method has been designed and developed, to perform the field measurement at low temperature and in an ultra-high vacuum environment. This poster describes mainly the entire system, including kernel components, control systems and preliminary test results.

SYSTEM REQUIREMENTS

The field-measurement devices must be placed in a narrow clearance space of the ultra-high vacuum environment around a vacuum chamber, magnet array and a nearby cooling system. Adjacent components in the vicinity of the magnets and the field-measurement device must neither interfere with each other nor perturb the signal source. As stated above, a compact design is a crucial and essential element of the system development. The movement requirements of the measurement system are listed in Table 1.

System Composition - Hardware

Figure 1 displays the overall construction of the system to measure a magnetic field. The free space between vacuum chambers is used to accommodate the measured undulator. According to the functions of the system, the field-measurement equipment of hybrid type can be divided into two portions, a Hall probe and a stretched wire.

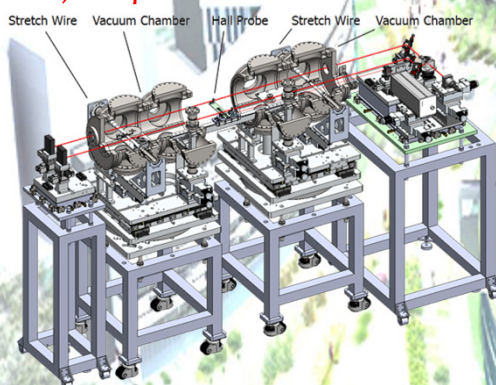


Figure 1: Overview of the measurement system.

VERIFICATION OF RESULTS

To verify the function and performance of the system under the vacuum-sealed condition at 10^{-4} Pa, a couple of magnet arrays (length 0.2 m) of period length 22 mm and a gap fixed at 7 mm would be dedicated to testing, as shown in Fig. 3. Figure 4 shows that the reproducibility of Hall probe system is better than 0.2° in RMS phase error, which indicates that this system is reliable to examine an undulator in a vacuum environment.

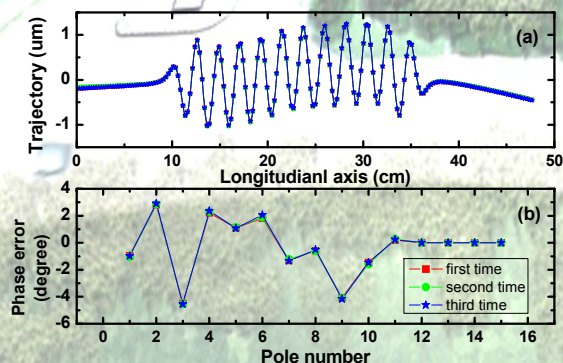


Figure 4: Result of measurement of the magnetic field.

References

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DESIGN AND DEVELOPMENT OF A SYSTEM OF HYBRID TYPE TO MEASURE THE MAGNETIC FIELD OF A CRYOGENIC UNDULATOR

Table 1: Movement Requirements of Each Method

Method	Stretch Wire	Hall Probe
Stroke range		
Vertical	± 1 mm	± 5 mm
Transverse	± 22 mm	± 1 mm
Longitudinal	-	2.4 m
Scanning Speed	10 mm/s	3 mm/s

Control and Data Acquisition System

Figure 2 shows an architectural diagram of the entire control and data acquisition system. As the core of the control system, a computer monitors the x-y positions of the Hall probe through two quad-cell PSD and corrects them with two rail-supported x-y stages. It also controls the movements of the x-y stages of the stretched-wire movement and the Hall probe rotary stepping motor. After measurement, this computer reads data of a voltmeter and a digital integrator and plots the measurement results.

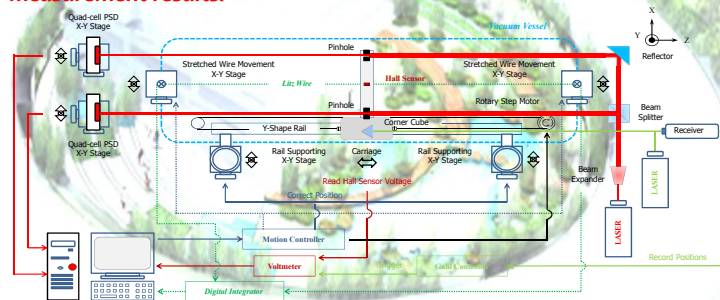


Figure 2: Diagram of the control and data acquisition system.

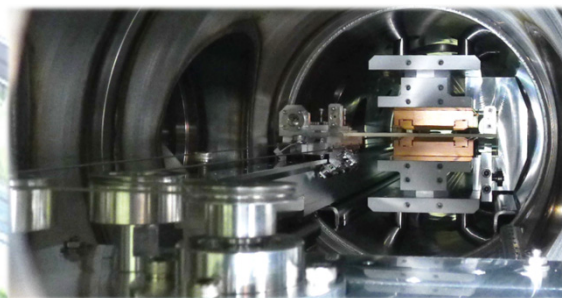


Figure 3: Magnetic-field measurement of IU22 with 0.2 m long.

CONCLUSION

The design of a system of hybrid type to measure the magnetic field of a cryogenic permanent-magnet undulator is proposed. The fabrication of Hall-probe components has been accomplished; some significant experiments of the system have been performed at room temperature and in a vacuum environment. The test results confirm that the engineering architecture enables collection of information about the magnetic field. Calibration of the Hall probe at varied temperature and testing of the reliability at cryogenic temperature are required. The stretched-wire parts are under fabrication and will also be tested.

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