Development of general purpose μSR spectrometer ARTEMIS at S1 experimental area, MLF J-PARC

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We have developed a general purpose μSR spectrometer ARTEMIS and installed at S1 experimental area of MLF, J-PARC. The new spectrometer has the identical design with the D1-spectrometer developed in 2013; the common design of the two general purposes spectrometers helps sharing the sample environment apparatus and direct comparison of the beam characteristics between the two experimental areas. We have upgraded the front-end circuit of positron/electron detectors, and achieved high enough hit rate tolerance for muon beam available in the future 1 MW operation of MLF. Other revisions and modifications, which became necessary after the commissioning and the actual usage of the S1/D1 spectrometers have been applied to both of the twin spectrometers.

KEYWORDS: muon spin relaxation, spectrometer, detector, electronics

1. Introduction

With the development of S1 experimental area [1] of MLF (Material and Life science experimental Facility), J-PARC (Japan Proton Accelerator Research Complex), a spectrometer for muon spin relaxation (μSR) measurement became necessary to use the pulsed muon beam for material science. A μSR spectrometer consists of positron/electron detectors, data acquisition (DAQ) hardware/software, sample environment (SE) apparatus, automatic sequence control of the DAQ and SE, and experimental status and data monitors to ensure the remote operation of measurements. As the first spectrometer to be installed to S1 experimental area, we decided to build a general-purpose μSR spectrometer to incorporate with various kinds of measurement needs. We employed the identical design with the one installed in D1 experimental area in 2013. It is equipped with the positron/electron detector covering 21.2% of the 4π solid angle, 0.4 Tesla longitudinal and 12 mT transverse Helmholtz coils [2]. It also has four flux gate magnetic probes and estimate the stray field at the sample position, and actively feeds back to zero field with a three pairs of field compensation Helmholtz coils. The identical design of the two spectrometers helps sharing sample environment apparatus as well as direct comparison of the muon beam characteristics between D1 and S1 experimental areas. Also the modifications to improve the spectrometer performance, as developed through commissioning at S1 experimental area,