Performance of Hyperball-J from the commissioning beam time at the J-PARC K1.8 beam line

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A new Germanium (Ge) detector array, Hyperball-J, for measurements of gamma rays from Λ hypernuclei and of X rays from Ξ^- atoms was constructed at the J-PARC K1.8 beam line. Hyperball-J will be used for the first time for a gamma-ray spectroscopy of 4ΛHe and 19ΛF hypernuclei using a strangeness exchange (K-,π-) reaction (the E13 1st phase experiment). The reaction is identified by Superconducting Kaon Spectrometer (SKS) system, as known as SkSMinus. Beam kaons as well as pions produced in the reaction are identified and momentum analyzed event by event. By a missing mass analysis and selecting a bounded region of Λ binding energy, gamma rays from Λ hypernuclei can be measured with fine energy resolution of a few keV. This experiment will be the first of a series of future hypernuclear gamma-ray spectroscopy experiment using an intense Kaon beams provided by the J-PARC facility.

Hyperball-J consists of 32 high purity Ge detectors with an expected total photopeak detection efficiency of 6% for 1-MeV gamma ray. In order to utilize the high intensity kaon beams, some new features have been implemented. Firstly, Ge crystals are cooled mechanically by a compact pulse tube refrigerator in order to reduce resolution degradation from radiation damages. Secondly, PWO scintillators which have a short decay time constant of about 6 ns are used to detect background energy-depositing events such as Compton escaped gamma rays and beam halo particles passing through the Ge detectors.

In May, 2003, a commissioning beam time for the E13 experiment was allocated to the K1.8 beam line, during which data was taken under conditions nearly identical to E13 using a CF2 target with the (K-, π-) trigger. Gamma rays originated from beam reacting with the target were successfully measured in coincidence between Hyperball-J and SksMinus. In this contribution, a performance of various components of Hyperball-J will be presented. In particular, Ge energy spectra and the quality of background suppression using the PWO counters will be presented.