Abstract

Design of a new read-out branch for the Crystal Barrel detector.
The Crystal Barrel spectrometer (CB) previously used at LEAR (CERN) is part of the CB/TAPS-experiment at the ELSA accelerator facility in Bonn. The detector consists of 1230 CsI(Tl)-crystals arranged in concentric circles in the shape of a barrel. Together with the forward-plug and TAPS it provides nearly a coverage of 4π solid angle. The current read-out assembly of the main barrel part equipped with Si-photodiodes mounted on wavelength-shifters does not allow fast trigger decisions. As shown by the forward-plug the read-out with photomultiplier tubes leads to a much faster time information and thus the capability to trigger. In order to be able to place the detector into a magnetic field of about $2.5T$ for the measurement of particle momenta and to achieve a first-level-trigger capability the read-out with Large-Area-Photodiodes (LAAPDs) was investigated. Several tests with low-energetic γ-sources were done, which showed that the read-out with LAAPDs results in a signal rise time, which is only depending on the time constants of the scintillator. Additionally a modified CB-subunit with 9 crystals was investigated at the A2-tagging-facility at the MAMI accelerator in Mainz. The central crystal of the subunit was irradiated with energy-marked photons between $90MeV$ and $1.2GeV$. The subsequent analysis involved shower reconstruction, multiplicity calculations, determination of the energy resolution and the time resolution of coincidences between the tagger and the crystal-matrix. The CB-subunit was modified compared to the original assembly: The read-out was done with two LAAPDs - each of them covering an area of $10x10mm^2$. The LAAPD-signals were preamplified by a low-noise charge-sensitive preamplifier (Uni Basel) and afterwards digitized with a peak-sensing-ADC. Further steps include the development of a new preamplifier board together with the University of Basel that is able to sum up two APD-signals if desired and to split the signal into two shaping branches, one for proper timing information and the other to provide good energy information. The signal will finally be read out with the aid of a sampling FlashADC in order to allow immediate integration of the signals and the possibility for particle identification.