

# The New Readout Electronics for TAPS\*

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The new readout electronics for the electromagnetic calorimeter TAPS is being built by the Gießen physics department in collaboration with KVI, Groningen (The Netherlands) and the University of Basel. It is planned to employ the new electronics in joint experiments with TAPS and the dilepton spectrometer HADES at GSI, Darmstadt. The concept is based on the VME-standard and accommodates modern expectations regarding data rate, resolution, flexibility and trigger selectivity. An additional requirement is compatibility with the HADES readout system [1].

An 8-channel prototype miniseries from the new VME-readout electronics for the electromagnetic calorimeter TAPS [2] has been employed during a first test beam time at the MAMI tagged photon beam facility. The analog functions for the TAPS telescopes (BaF<sub>2</sub> scintillators and TAPS Veto System) are implemented on a piggyback residing on HADES/TAPS ADC Motherboards [3]. The determination of time-of-flight information (time chain) as well as the separate charge integration of the two scintillator components with two dynamic ranges (energy chain) has been implemented for each BaF<sub>2</sub> detector. The piggyback board logic is derived from constant fraction discriminators. Additional leading edge discriminators allow fast, selective triggers. Programmable logic devices (PLD) are used bi-directionally for setting discriminator thresholds and, during data taking, for registering the discriminator signals. A prototype for a 64-channel multiplicity coincidence unit for the TAPS first level trigger has been completed and tested. Test results of the time chain using a time calibrator have been reported earlier [2].

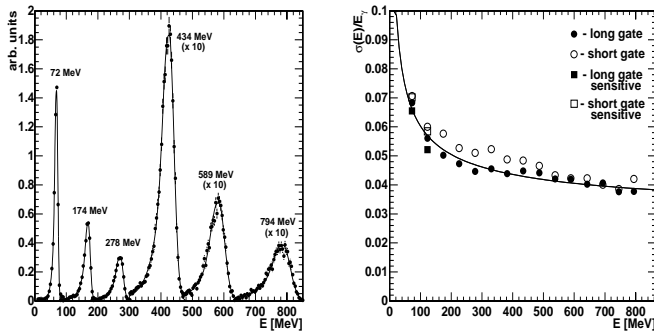


Figure 1: Left: Shower line shapes for various incident photon energies from the first in-beam test measurement with 7 BaF<sub>2</sub> crystals. Right: Energy resolutions for the 4 integration gates as a function of incident photon energy.

An in-beam test was performed to study the energy resolution and linearity. A detector array consisting of 7 BaF<sub>2</sub>-crystals was placed in the tagged photon beam. Figure 1 presents the energy response to incident photon energies between 70 and 800 MeV. The analog signals have been integrated over 2 μs with a full scale range of 1 GeV. The line shapes are fitted with the typical response of BaF<sub>2</sub> crystal arrays (solid lines). The corresponding resolutions (σ) as function of incident photon energy are also shown in Figure 1.

A second test measurement employing a mini-series of the new TAPS electronics is realized by participation in a current TAPS experiment at MAMI. The experimental setup includes the TAPS detector in a wall formation placed on one side of the beam covering ca. 30% of 4π. The small detector array (7 BaF<sub>2</sub> crystals) is placed on the other beam side at 100° and read out by a HADES-compatible acquisition. Figure 2 presents the π<sup>0</sup> → γγ invariant mass peak from the reaction γ + <sup>4</sup>He where one of the final state photons was detected in the small detector array read out by the new electronics. The figure demon-

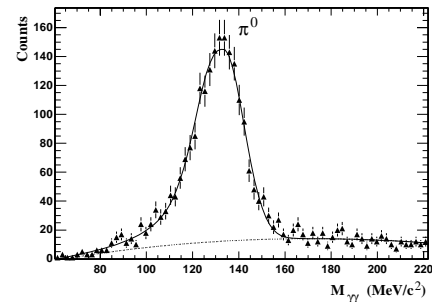


Figure 2: The π<sup>0</sup> → γγ invariant mass peak from the reaction γ + <sup>4</sup>He. One of the final state photons was detected in the small detector array read out by the new TAPS electronics prototypes. The solid line represents a fit with the known π<sup>0</sup> → γγ line shape plus background (dotted line).

strates the clean observation of γγ invariant masses, being one of the key ingredients of a standard TAPS analysis.

Milestones for the year 2001 include the final revision and mass production of the TAPS piggybacks. The readout of four channels per VME module is foreseen to be managed per motherboard. Accordingly, the BaF<sub>2</sub> calorimeter with a planned total of 9x64 detectors necessitates 144 VME-modules.

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## References

- [1] <http://www.physik.uni-giessen.de/hades/>
- [2] GSI Scientific Report 1999
- [3] R.Bassini et al., A 32 Channel TDC on a VME-Board, IEEE Trans. on Nucl. Science, Vol. 45, 3, June 1998