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Electronic developments for HADES RPC wall: overview and progress

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This contribution presents the actual status and progress of the electronics developed for the Resistive Plate Chamber detector of HADES. This new detector for the Time of Flight detection system will contain 1000 RPC modules, covering a total active area of around 7 m2. The Front-End electronics consist of custom-made boards that exploit the benefit of the use of commercial components to achieve time resolutions below 100ps. The readout electronics, also custom-made, is a multipurpose board providing a 128-channel Time to Digital Converter (TDC) based on the HPTDC chip.

Summary

New advances on RPCs (Resistive Plate Chambers) show that only since a few years ago it is possible to use RPCs for precise time of flight measurements at normal conditions of pressure and temperature with inexpensive materials. These detectors are becoming widely used because their excellent TOF capabilities and reduced cost, facing in some applications the well assessed technology of plastic scintillators. The RPC detectors that will be installed in the low angle region of HADES (High Acceptance DiElecton Spectrometer) are used for both, particle identification and triggering. 1024 double-sided readout detectors will be distributed in an active area of about 7 squared-meters, distributed in 6 sectors, covering a polar angle between 18 and 85 deg. with 2pi azimuthal acceptance.

The electronic systems involved in the RPC system are: the Front-End that digitizes the signals from the RPC cells, the Readout that label and pack the digital signals from the Front-End and the power supply and slow-control system. All of them are based on custom-made boards.

The Front-End electronics of the HADES RPC consists of two different boards. The Daughterboard provides the specific signal processing for timing and charge measurement. This digital conversion converts the fast analog RPC signals into time-window signals where the rising edge provides information about the timing and the width codifies the charge. The digitized signals are converted to LVDS and transmitted through the Motherboard which also provides stable supply voltages and programmable threshold DACs for the discriminators.

A general-purpose trigger and readout board with on-board DAQ functionality is currently being developed. Its primary application was to be a 128-channel Time to Digital Converter (TDC) electronics based on the HPTDC (achieving 40 ps resolution) to read out the HADES RPC detector, but the new version has been designed in a way to be detector independent and thus may serve for any high speed data acquisition by using a flexible add-on board concept.

Custom power supply boards provide the required voltages to the Front-End electronics: +5V, -5V and +3.3V. This power supply boards are based on commercial switching DC/DC modules that have been conveniently filtered (common and differential modes) to obtain clean power supply voltages. This supply boards will also contain sensing capabilities to implement the low voltage monitoring system, based on Linux computers-on-chip that runs Epics in a distributed system over the Ethernet.

HADES is currently installed at GSI Darmstadt (Germany), and has as main goal the detection of electron pairs produced in relativistic pion-nucleus and nucleus-

nucleus collisions, with high invariant-mass resolution and high acceptance, to obtain information about the modification of the properties of vector mesons in nuclear matter, both normal and hot and compressed. HADES consists of several sub-detectors providing triggering, and particle identification and discrimination capabilities. Among these sub-detectors the RPC detectors covers the TOF system at low angles, where the particle rate where particle rates reach their maxima, whereas plastic scintillator rods read by photo-multiplier tubes are set up for large angles. The new RPC detector will increase the granularity and time resolution to levels that will allow extending the range of possible collisions in HADES from C-C to Au-Au.

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