

APPLICATION OF MOBILE TECHNOLOGY TO PHOTOMULTIPLIER TUBE READOUT FOR PARTICLE PHYSICS EXPERIMENTS

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Water Cherenkov neutrino physics experiments typically utilize thousands of large area PhotoMultiplier-Tubes (PMTs) distributed around water volumes of size 105 m³. The precision of the physics results depends on the overall enclosed volume, and so larger detectors of order 106 m³ are desirable but presently hindered by the typical large costs involved. As part of the novel CHIPS neutrino detector, which drastically reduces several potentially dominant construction costs, we are developing intelligent, low-cost data acquisition modules that will be installed directly with each PMT. The new system takes advantage of recent rapid development of ARM chips used in Raspberry Pi[12], BeagleBone[13] (BB) and other single-board computers, because they are very small, inexpensive and consume very little power. More generally, ARM chips are found in almost every mobile phone, are practically bug-free, hugely adaptable and versatile, and can be applied (rather than developed from scratch) to work at the very front end of a particle physics experiment. With a 1GHz clock, cable Ethernet and a micro USB power supply, the single board computers provide a complete suite of functionality. The White Rabbit[15] (WR) system developed at CERN and GSI for a timing distribution network with sub-nanosecond accuracy over Ethernet delivers encoded PPS timing signals. These three technology developments together provide an innovative and very inexpensive electronics platform for neutrino physics. Looking at the detector construction, the PMTs, and the electronics, we expect the final costs to be dominated by the PMTs themselves.

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