Large Area Microchannel Plate Imaging Event Counting Detectors with Sub- Nanosecond

O.H.W. Siegmund, *Member, IEEE*, J.B. McPhate, S.R. Jelinsky, J.V. Vallerga, A.S. Tremsin, *Member, IEEE,* R. Hemphill, H.J. Frisch, R.G. Wagner, J. Elam, A. Mane and the LAPPD Collaboration

***Abstract*–Progress towards the development of a 20 cm sealed tube optical detector with imaging and photon event time stamping is presented. Novel microchannel plates employing borosilicate micro-capillary arrays have been tested. These provide many performance characteristics typical of conventional MCPs, but have been made in sizes up to 20 cm, have low intrinsic background (0.08 events cm^{-2} s^{-1}) and very stable gain behavior for at least 7 C cm^{-2} of charge extraction. Bialkali (Na_2KSb) photocathodes with > 20% quantum efficiency have also been made on borofloat-33 windows compatible with a 20 cm sealed tube device.**

I. Introduction

The development of large area imaging and timing detectors with high performance has advantages for many potential applications, but also presents some significant challenges. For example, in the application of detection of Cherenkov light in neutrino detection, timing resolution of a few picoseconds and spatial resolution of <1 mm over areas of 20 cm would be advantageous. Currently available devices are limited to sizes of about 5 cm and use either conventional microchannel plates (MCPs), or dynode multipliers for amplification, coupled to pad array readouts. Extension of these schemes to devices as large as 20 cm presents significant problems and potentially considerable cost. A collaboration (Large Area Picosecond Photon Detector, LAPPD) [1] of the University of Chicago, Argonne National Laboratory, University of California, Berkeley, and a number of other national laboratories, universities and commercial companies have undertaken the task of employing novel technologies to develop a 20 cm format sealed tube visible sensitive detector.

The operational scheme of the photodetector is illustrated in Fig. 1. Incoming light passes through an entrance window (Borofloat 33) and interacts with a semitransparent photocathode on the inside of the window. The photoelectrons produced cross a proximity gap and are detected by an MCP pair. This pair of novel borosilicate substrate MCPs, that are functionalized by atomic layer deposition, amplify the signal and the resulting electron cloud is detected by a strip line anode for determination of event positions and time of arrival.

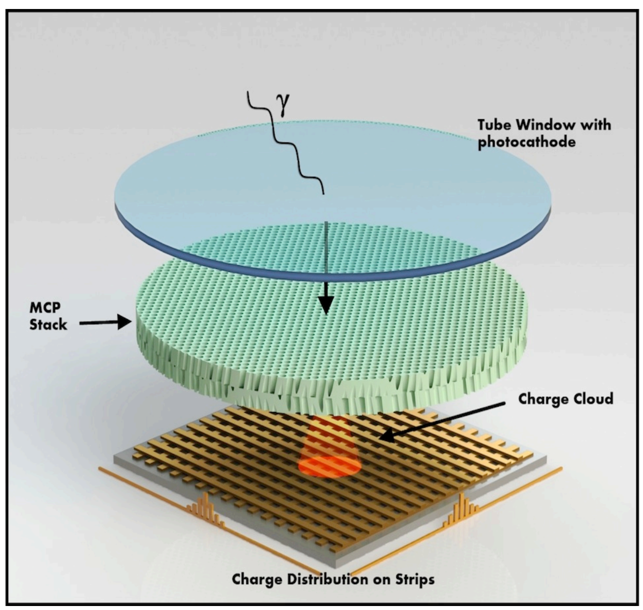

Fig. 1. Depiction of a sealed tube microchannel plate detector. Incoming photons pass through an entrance window and are converted to photoelectrons by a semitransparent photocathode. A microchannel plate stack multiplies the photoelectron and the resulting charge is collected by a strip-line anode.

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O. H. W. Siegmund is with the University of California, Berkeley, CA 94720 USA (telephone: 510-642-0895, e-mail: ossy@ssl.berkeley.edu).

J. B. McPhate is with the University of California, Berkeley, CA 94720 USA (telephone: 510-643-8242, e-mail: mcphate@ssl.berkeley.edu).

S. R. Jelinsky is with the University of California, Berkeley, CA 94720 USA (telephone: 510-643-7893, e-mail: sharonj@ssl.berkeley.edu).

J. V. Vallerga is with the University of California, Berkeley, CA 94720 USA (telephone: 510-6432-5666, e-mail: jvv@ssl.berkeley.edu).

A. S. Tremsin is with the University of California, Berkeley, CA 94720 USA (telephone: 510-642-4554, e-mail: ast@ssl.berkeley.edu).

R. Hemphill is with the University of California, Berkeley, CA 94720 USA (telephone: 510-642-6208, e-mail: rhemp@ssl.berkeley.edu).

H. J. Frisch is with the University of Chicago, Chicago, IL 94720 USA (telephone: 773-702-7479, e-mail: frisch@hep.uchicago.edu).

R. G. Wagner is with the Argonne National Lab. Lemont, IL 94720 USA (telephone: 630-252-6321, e-mail: rgwcdf@hep.anl.gov).

J. Elam is with the Argonne National Lab. Lemont, IL 94720 USA (telephone: 630-252-3520, e-mail: jelam@anl.gov).

A. Mane is with the Argonne National Lab. Lemont, IL 94720 USA (telephone: 630-252-1342, e-mail: amane@anl.gov).

The LAPPD collaboration is based at the Argonne National Lab. Lemont, IL 94720 USA (telephone: 630-252-6321, web: http://psec.uchicago.edu/).