Available online at www.sciencedirect.com

ScienceDirect

Physics Procedia 90 (2017) 62 – 68

Physics Procedia

Conference on the Application of Accelerators in Research and Industry, CAARI 2016, 30 October – 4 November 2016, Ft. Worth, TX, USA

Neutron Imager with Micro Channel Plates (MCP) in Electrostatic Mirror Configuration: First Experimental Test

V. Variale[a]*, B. Skarbo[b]

[a]*Istituto Nazionale Fisica Nucleare,INFN Sezione di Bari, Italy*
[b]*Budcker Institute of Nuclear Physics, Novosibirsk, Russia*

Abstract

The idea of a new high transparency device based on Micro Channel Plate (MCP) has been recently presented for monitoring flux and spatial profile of neutron beams. It consists of the assembly of a very thin aluminum (Al) foil with ^{6}Li deposit placed in the beam and a MCP equipped with a phosphor screen readout viewed by a CCD camera. A peculiar feature of this device is that it uses a 90° electrostatic mirror to minimizing the perturbation of the neutron beam, i.e., absorption and scattering. It can be used at existing time-of-flight facilities, in particular at the n_TOF facility at CERN, for monitoring the flux and spatial profile of neutron beams in the thermal and epithermal region. In this contribution the first experimental test carried out by using radioactive sources will be presented and the related results discussed.

© 2017 The Authors. Published by Elsevier B.V. This is an open access article under the CC BY-NC-ND license (http://creativecommons.org/licenses/by-nc-nd/4.0/).
Peer-review under responsibility of the Scientific Committee of the Conference on the Application of Accelerators in Research and Industry

Keywords: neutron detection, beam monitor;

1. Introduction

The Micro Channel Plate (MCP) devices have many advantageous detection features as: fast time response, low dead time, high counting rate, low dark current. In particular they have a very high spatial resolution (J. L. Wiza,

* Vincenzo Variale, Tel.: +39 080 5442344; fax: +39 080 5442344.
E-mail address: vincenzo.variale@ba.infn.it

1875-3892 © 2017 The Authors. Published by Elsevier B.V. This is an open access article under the CC BY-NC-ND license (http://creativecommons.org/licenses/by-nc-nd/4.0/).
Peer-review under responsibility of the Scientific Committee of the Conference on the Application of Accelerators in Research and Industry
doi:10.1016/j.phpro.2017.09.020

1979). These features make the MCP very suitable to be used in beam profile monitor devices construction. The MCP radiation detection efficiency depends on the radiation type and energy. For the neutrons, however, they have a very low direct detection efficiency (up to 0.6% for fast neutrons). For that reason, it is necessary of using other than the MCP also a converter material to increase the neutron detection efficiency. In the last years, MCP devices have been largely employed both for detection of ionizing radiation and as image intensifier. It has also been demonstrated that MCPs can be applied in neutron detection and imaging with many advantages (G. W. Fraser and J. F. Pearson, 1990; O. H. W. Siegmund et al., 2001; A. S. Tremsin et al., 2005).

Recently the idea of a new high transparency device based on MCP for monitoring the flux and the spatial profile of a neutron beam has been proposed (V. Variale, 2015). In that reference the device design details are shown and discussed, here, for sake of clarity, the device behavior scheme is shown in fig.1 again. The device consisted of an Aluminum (Al) foil with a ^{6}Li deposit, placed in the beam, and a MCP assembled with a phosphor screen readout viewed by a CCD camera, placed outside the beam. The reaction ^{6}Li(n,α) t used as converter gives to the slow neutrons which hit the ^{6}Li atoms a great chance to produce α and t ions with 2 and 2.7 MeV of energy, respectively. At those energies the α and the t particles have, in Aluminum, a range of 5 μm and 30 μm, respectively. Then, by taking an Al foil with a thickness of 14 μm, all the α would be stopped and all the t transmitted. Furthermore, the tritons would exit from the Al foil and emit Secondary Electrons (SE) which would be accelerated by the nearby grid, and then, reflected at 90°, towards the MCP, by the other grids tilted at 45° (the electrostatic mirror). The SE impinging on the MCP inner channels generate an electron avalanche. Behind the MCP (in chevron configuration) there is the signal read-out system, a phosphor screen followed by a CCD camera where the beam image is collected by a proper lens and recorded.

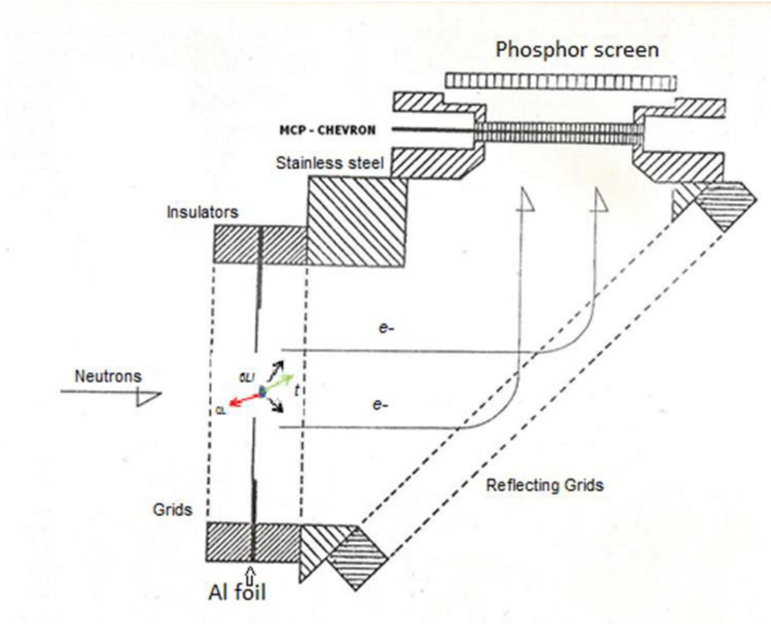

Figure 1. Neutron beam monitor with electrostatic mirror configuration. On the Aluminum foil, the converter material ^{6}Li is deposited. In the figure is shown as a ^{6}Li atom hit by a neutron produces the reaction ^{6}Li(n,α) t.

In this paper the MCP based monitor test measurements carried out with radioactive sources are presented and discussed.

Download English Version:

https://daneshyari.com/en/article/8207493

Download Persian Version:

https://daneshyari.com/article/8207493

Daneshyari.com