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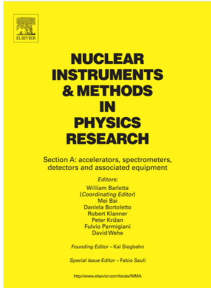

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Proton beam spatial distribution and Bragg peak imaging by photoluminescence of color centers in lithium fluoride crystals at the TOP-IMPLART linear accelerator

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Abstract

Solid-state radiation detectors based on the photoluminescence of stable point defects in lithium fluoride crystals have been used for advanced diagnostics during the commissioning of the segment up to 27 MeV of the TOP-IMPLART proton linear accelerator for protontherapy applications, under development at ENEA C.R. Frascati, Italy. The LiF detectors high intrinsic spatial resolution and wide dynamic range allow obtaining two-dimensional images of the beam transverse intensity distribution and also identifying the Bragg peak position with micrometric precision by using a conventional optical fluorescence microscope. Results of the proton beam characterization, among which, the estimation of beam energy components and dynamics, are reported and discussed for different operating conditions of the accelerator.

Keywords: Lithium fluoride; Photoluminescence; Bragg peak; Proton beam imaging; Linac.

1. Introduction

Lithium fluoride (LiF) is an alkali halide crystal with peculiar physical and optical properties. In particular, it is almost not hygroscopic and it is sensitive to ionizing radiation (X-rays, gamma-rays, electrons, neutrons, protons, alpha-particles and heavier charged ions) that induces the formation of laser-active electronic defects, known as color centers (CCs), characterized by a high stability at room temperature (RT). Such properties make LiF suitable for several applications, not only in optoelectronics [1] and integrated optics [2], but also in dosimetry [3,4].