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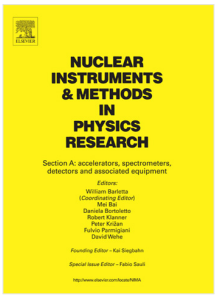

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Gaseous and dual-phase time projection chambers for imaging rare processes

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Abstract

Modern approaches to the detection and imaging of rare particle interactions through gaseous and dual-phase time projection chambers are discussed. We introduce and examine their basic working principles and enabling technological assets.

Key words: Time Projection Chambers, TPCs, drift chambers, imaging chambers
PACS: 29.40, Cs

Contents

1. Introduction

The introduction of the time projection chamber (TPC) by David Nygren in 1974 [1] has exerted a perdurable influence in particle and nuclear physics, casting its shadow over much of today's instrumentation. TPCs revolutionized experimentation at colliders with the introduction of a novel scheme for reconstructing particle trajectories, in which electric and magnetic fields would be set parallel to each other [2]: with the passage of charged particles, ionization electrons are locally released in the detector medium and then collected after meter-long drift distances, their spread reduced through the convenient orientation of the $\boldsymbol{E}$ and $\boldsymbol{B}$ fields. Once collected at an x,y-sensitive image plane, their arrival times are back-converted to longitudinal positions (z) through their average drift velocity, a technique borrowed from drift chambers (e.g., [3,4]).

By identifying a preferred alignment relative to the spectrometer's magnetic field, Nygren posited a detector con-

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