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Editorial

Topical issue on an experimental program with positron beams at Jefferson Lab

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The interest in high energy and high duty cycle polarized and unpolarized positron beams, in complement to the existing CEBAF (Continuous Electron Beam Accelerator Facility) electron beams, has been nurtured since the very first energy upgrade of the accelerator up to 6 GeV. Along the years, experimental results about the electromagnetic form factors and the generalized parton distributions of the nucleon pointed towards the importance of positron beams for the experimental determination of these fundamental quantities of the nucleon structure. Further ideas emerged about testing the predictions of the standard model and exploring the dark matter sector. A long term and comprehensive research effort was then started both in the physics and the technics areas to assess the potential of an experimental program and to address the eventual technological issues of high duty cycle positron beams. This path was marked out by successive reference events as the JPos09 international workshop, the first of its kind, dedicated to the positron case at the Jefferson Lab (JLab) [1]. This led to the development and realization of the PEPPo (Polarized Electrons for Polarized Positrons) experiment [2] which, measuring polarizations as high as 82%, demonstrated a new scheme for the production of polarized positron beams [3], particularly suited - but not only - to high duty cycle beams. This success was rapidly followed by the JPos17 international workshop which reviewed extensively the physics with positron beams from the smallest energies of atomic physics and material science research up to CEBAF and EIC (Electron Ion Collider) energies [4]. This was readily opening the perspective of a long term nuclear physics experimental program with positron beams at JLab.

The JLab Positron Working Group (PWG) was subsequently created with the aim of supporting the development of the JLab positron physics and technics cases. It gathers today more than 250 nuclear physics and accelerator physics scientists from 75 research institutions worldwide. The physics potential of a positron beam experimental program at JLab was first presented to the Program Advisory Committee (PAC46) in the form of a letter of intent [5]. Two years later, the JLab PWG released the Positron White Paper [6] at the same time that two proposals were presented at the PAC48 [7,8], followed by a third one the year after at the PAC49 [9]. Concomitantly, the *Polarized Electrons, Positrons and Polarimetry (P3E)* R&D activity of the STRONG-2020 [10] European Union's Horizon 2020 research and innovation program was awarded, supporting research in essential pillars of high-intensity polarized positron sources. The success of positron proposals at PAC48 was further conforted by a JLab Laboratory Directed Research & Development award about the design of a positron source for CEBAF, which recently evolved into a dedicated R&D program. As today, positron beams and physics have been recognized as part of the future opportunities for nuclear physics science at JLab [11].

The present Topical Issue is an extented and elaborated version of the Positron White Paper. It presents with extensive details the experimental program accessible to polarized and unpolarized positron beams at JLab. Using currently existing and/or future detector equipment, specific experiments and physics channels are thoroughly discussed and evaluated in terms of their physics impact. It encompasses the

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determination of several of the physics quantities that characterize nucleons and nuclei structure: the electromagnetic form factors, the generalized polarizabilities, the parton distributions, and the generalized parton distributions. It also addresses some of the hotest questions of the field as the charge radius of the proton and the occurence of beyond the standard model physics. The latter is particularly expressed in the search of low mass dark matter particles, the measurement of weak neutral-current couplings, and the investigation of charged lepton flavor violation. Altogether, this accounts for 20 single contributions organized according to the *Table of contents* presented hereafter. While this program represents already several years of actual beam running, it should not be understood as an exhaustive list but more surely as the minimal impact of future CEBAF positron beams on the nuclear physics science.

Table of contents

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