Positron Working Group
News Letter, December 2016

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The recently created Jefferson Lab Positron Working Group is now developing scientific activities towards JPos'17 International Workshop, to be held at JLab in 2017. Topical sub-groups have been created and are seeking for the contributions of interested persons to pursue new ideas and develop experimental projections within the CEBAF 12 GeV and JLEIC contexts.

Please contact the PWG coordinators of the topic of your interest.

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1 JPos17 International Workshop

We have successfully received a FY17 Jefferson Science Associates Initiative Award to support a proposed International Workshop on Positrons at Jefferson Lab (JPos'17). This award effectively kicks-off the organization of the workshop which is anticipated to occur at Jefferson Lab in August or September of 2017. The exact dates will be fixed in January and announced thereafter.

JPos'17 will be organized as a 3-4 day workshop with successive sessions corresponding to the physics reach of 12 GeV CEBAF, the proposed JLEIC, and sub-MeV positron applications. A specific accelerator session dedicated to positron production for each scenario completes the scientific program. If you wish to contribute or make a presentation at the workshop please contact the corresponding PWG sub-group coordinators.

2 Scientific information

Interference physics

The recent release of the results of the OLYMPUS experiment [1] did not bring a fully conclusive answer with respect to the role of the two-photon exchange mechanism in elastic electron scattering. This expresses the need for new experimental data, especially in a kinematic range where these higher order contributions are expected to be significant. The combination of a polarized positron beam with a large acceptance detector at reasonably accessible luminosities should provide a definitive answer to this problem.

In the CEBAF 12 GeV energy domain, polarized positron beam intensities ranging from tens up to hundreds of nA are anticipated. This intensity range is particularly adapted with the operation of polarized targets and opens exciting physics possibilities at CEBAF 12 GeV.

Charged current physics

Test of the Standard Model

Positron applications

Considering accelerator based slow positron production, beam qualities for applications are essential in terms of useful intensity, spot size, angular dispersion, and technique to reach sub-MeV energies. A scheme of interest involves an efficient positron collection system followed by a decelerating section. For an initial electron beam in the tens of MeV range, produced positron energies are very similar to the ones of the International Linear Collider scheme. An optimized capture system could potentially benefit not only the positron project at JLab.

Based on radioactive sources, slow positron research with polarized beams is starting to develop activities in connection with spintronics [2, 3]. Acccelerator based slow positron source can definitely bring not only high beam intensity and polarization, but also new investigation methods based on the easy spin reversal of the initial electron beam.

Positron source and beam physics

The positron source and beam physics sub-group is exploring stand-alone positron injector solutions that satisfy three key experiment parameters: positron intensity, positron polarization and suitable bunch structure. The initial parameters for CEBAF 12 GeV are intensity of 5 μA cw and polarization greater than 60% and for JLEIC a collision luminosity greater than 10^{33} cm^2/s and polarization greater than 40% with a suitable injection scheme.

With these conditions in mind the working group is developing a strategy to leverage the Jefferson Lab highly spin polarized electron source and the PEPPo approach for efficiently transferring polarization from electrons to positrons via polarized bremsstrahlung and pair production. For both CEBAF and JLEIC the envisaged positron injector requires extending the polarized electron source intensity reach into the ∼milliAmpere range. A novel approach being considered for the JLEIC scheme is to charge an accumulation ring with MeV electrons before dispensing them to the positron conversion target with the required bunch structure. A polarized positron injector R&D plan based on this scheme for CEBAF/JLEIC has been submitted to the DOE Early Career Research Program by Fanglei Lin of CASA. In addition Niowave Inc. has recently submitted a DOE SBIR/STTR Phase IIB proposal to further develop their high power (>10kW) bremsstrahlung radiator and partnered with Jefferson Lab to test as a suitable positron production target.

Finally, source and beam physics topics for JPos'17 have been outlined by the working group coordinators who will soon begin reaching out to the PWG and Accelerator community for active participation.

References

[1] B.S. Henderson *et al.* arXiv:1611.04685 (2016).

[2] A. Kawasuso, Y. Fukaya, M. Maekawa, H. Zhang, T. Seki, T. Yoshino, E. Saitoh, K. Takanashi, J. Magnetism and Magnetic Mat. **342** (2013) 139.

[3] M. Maekawa, H. Zhang, H. Li, Y. Fukaya, A. Kawasuso, JJAP Conf. Proc. **2** (2014) 011305.

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