A concept for 3.4 GeV positron beam B.Wojtsekhowski, JLab

Can we add a new CPBAF to the existing CEBAF? The first two arcs are not very expensive.

Arc1-neg - 1 GeV electron Arc1-pos - 2 GeV positron Arc2-neg - 2 GeV electron Arc2-pos - 1 GeV positron

Resulting positron beam of 3.4 GeV

Extra magnet can use the return flux. Need new/add. magnets for arc1 and arc 2

Injector can be from FEL with energy ~ 100 MeV The positrons acceleration is parallel to the electron beam!

1.2 GeV beam could be obtained even before the new Arc magnets are installed.

The arc dipole magnet in CEBAF



The arc dipole magnet in CEBAF



2/24/21



Proposed Arc, two magnets shifted along the orbit



Modified Arc (when the orbit is busy), a combined magnet



16 dipoles in Arc 2







Positron-2021, B.Wojtsekhowski

2/24/21

Search for U boson in electron-positron annihilation in flight

B. Wojtsekhowski, P. Degtiarenko, A. Freyberger, L. Merminga Thomas Jefferson National Accelerator Facility, Newport News, VA 23606

2006

Abstract

An experiment is proposed to search for a new gauge boson U in reaction $e^+e^- \rightarrow U\gamma$ in the mass range from 2 to 15 MeV. The data could determine the particle mass and the coupling constant f_e^2 (or its upper limit). The experiment could utilize a 160-330 MeV positron beam in JLab FEL. It needs a low-power liquid hydrogen target and a high-resolution gamma detector. With 240 hours of beam-time and full detector, this

Two-photon annihilation is a dominant process of high-energy photon production in e^+e^- collisions at a cms energy of a few tens of MeV. Two reactions, depicted in the left panel of Fig. 2, are two-photon annihilation and production of an exotic U-boson. The



FIGURE 2. The diagrams: a) two-photon annihilation, b) the U-boson $-\gamma$ production. The $e^+e^- \rightarrow U + \gamma$ reaction.

2/24/21

I have been interested in a positron beam since May 2006 for a model independent search for a dark photon, with the first plan based on FEL:

Search in the missing mass spectra is a truly model independent approach

B. Wojtsekhowski, Searching for the dark matter U boson with a positron beam, at Mini-symposium on Identifying Dark Matter II: Axionic and Sterile Neutrino Dark Matter, DNP/APS meeting, Nashville, October 25–28, 2006.

B. Wojtsekhowski, *Searching for a U-boson with a positron beam*, *AIP Conf. Proc.* **1160** (2009) 149 [arXiv:0906.5265].

Two-photon annihilation is a dominant process of high-energy photon production in e^+e^- collisions at a cms energy of a few tens of MeV. Two reactions, depicted in the left panel of Fig. 2, are two-photon annihilation and production of an exotic U-boson. The



FIGURE 2. The diagrams: a) two-photon annihilation, b) the U-boson- γ production. The $e^+e^- \rightarrow U + \gamma$ reaction.

Positron-2021, B.Wojtsekhowski

2/24/21

Significant R&D is needed for the full scale 11 GeV positron project

Staging could be a much needed solution for the positron project progress

The proposed 3.4 GeV stage will open a window for a number of experiments – esp. A', TPE

The cost of the CEBAF part is 16 x 2 dipoles plus a pipe + correctors. Cost of the injector ??

From Robin Wines:

For a new 2 meter long dipole, I would scale the 4 meter dipole down to \$41,800 for 2021.

Total cost of additional dipoles is \$1.44M

Full scale for this stage (P3) is likely below \$10M

Main advantage: work could be done in parallel to an electron beam delivery

Why start the positron program with P3?

- It is a cost effective plan: 10M vs. 100M
- It will be first time a cw positron beam
- It will have a tiny energy spread
- It will have 3.4 GeV energy (great for the TPE and the A'/X-17 boson)
- It will be in parallel to the electron beam 11 GeV program
- It could be delivered to the halls via the existing beam lines
- It has a clear prospect of reaching higher beam energy when ready (10 GeV)
- It needs a modest funding for the P3 stage
- It ought to be done when the opportunity exists