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The Advanced Photon Source (APS) Linear Accelerator as a Source of Slow Positrons *

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Abstract. The Advanced Photon Source [1] linear accelerator (linac) system consists of a 200-MeV, 2856-MHz S-band electron linac, a 2-radiation-length-thick tungsten target for positron production, and a 450-MeV positron linac [2]. The linac is briefly described, and some possibilities for its use as a slow positron source are discussed.

I. INTRODUCTION

The APS electron linac is designed to accelerate 30-ns-long pulses containing 50 nC of charge to an energy of 200 MeV at 48 pulses per second. The 500-W beam impinges on a 7-mm-thick water-cooled tungsten target that serves as a positron converter. Pair-produced positrons and electrons are refocused by a 1.5-T pulsed coil and directed into the positron linac where, during normal operation, they are captured and accelerated to 450 MeV. Electrons can be accelerated to 650 MeV when the target is withdrawn. The linac is shown in Figure 1. In the figure, the electron and positron linac sections are displayed parallel to each other for clarity. The linac is utilized to fill the APS storage ring and can then be used for other purposes, including slow positron production, between fills or top-off operations. The nominal electron beam power of 500 W can be increased to as much as 90 kW for slow positron production, however safe handling of this beam power presents challenges. The actual maximum beam power may have to be limited to less than 90 kW to ensure safe operation of the facility.

II. LINAC DESCRIPTION

The APS linac produces electrons with energy up to 650 MeV or positrons with energy up to 450 MeV as noted in Table 1. Electrons are emitted from a thermionic cathode in an electron gun. The nominal pulse length is 30 ns, but the system is capable of producing longer pulses. Electrons exit the gun at 100 keV and are bunched before entering the first of 14 3-m-long, SLAC-type accelerating structures that make up the remainder of the linac. The upstream accelerating structure in each linac section is directly powered by a 35-MW klystron, while the remaining 12 structures are powered in groups of four by a klystron and SLED (SLAC Energy Doubler) cavity assembly. Power to the klystrons is

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