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The Advanced Photon Source (APS) Linear Accelerator - Design and Performance*

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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 and a 2-radiation-length-thick tungsten target followed by a 450-MeV positron linac. The linac system has operated 24 hours per day for the past two years to support accelerator commissioning and beam studies, and to provide beam for the experimental program. It achieves the design goal for positron current of 8 mA, and produces electron energies up to 650 MeV without the target in place. The linac is described, and its operation and performance are discussed.

INTRODUCTION

The linac is the source of particles, either electrons or positrons, at the APS. It is designed to accelerate 30-nsec-long pulses containing 50 nC of electrons to an energy of 200 MeV at 48 pulses per second. The 480-W beam is focused to a 3-mm diameter spot on a 7-mm-thick water-cooled tungsten target that serves as a positron converter. Bremsstrahlung-pair-produced (BPP) positrons and electrons are refocused by a 1.5-T pulsed coil and are directed into the positron linac. Both electrons and positrons are captured and can be accelerated to about 450 MeV. The final optimization is achieved as a result of rf phasing and steering.

DESCRIPTION

Electrons are emitted from a thermionic cathode in the electron gun and exit the gun at a nominal energy of 100 keV. They are transported to a prebuncher cavity that bunches the beam longitudinally at 2856 MHz before it enters the buncher. The buncher is a short piece of disk-loaded waveguide that further compresses the beam bunches to allow for efficient capture and acceleration in the rest of the linac. Beam exits the buncher with an energy of about 4 MeV and enters the first of fourteen 3-m-long, traveling-wave, constant-gradient SLAC-type accelerating structures that accelerate particles through the rest of the linac. Rf power at 2856 MHz, provided by klystron amplifiers, enters the disk-loaded accelerating structures via input-coupler cells and couples to adjacent cells through holes in the center of the disks. Dimensional changes in the individual cavities keep the axial electric fields constant over the entire length of the structure and compensate for

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