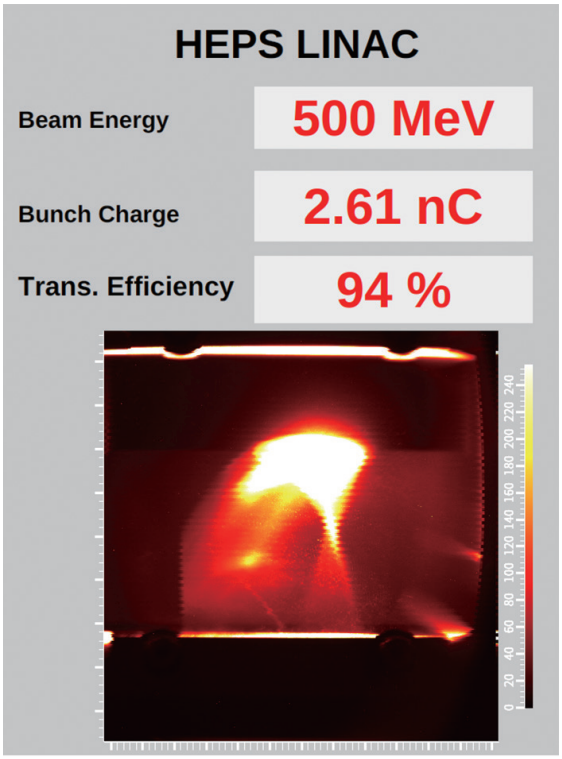
Basic Research

HEPS Achieves the First Electron Beam Accelerated to 500 MeV

The first electron beam of the High Energy Photon Source (HEPS) was accelerated to 500 MeV with better than 2.5 nC of bunch charge by the Linear accelerator (Linac) on March 14, which was a key milestone of the HEPS project – HEPS beam commissioning has since begun.

The HEPS Linac, with a total length of about 49 m, is an S-band normal conducting electron linear accelerator with a very high bunch charge and a large bunch charge range. As the source and first-stage accelerator of electrons, the Linac mainly comprises an electron gun, a bunching system, and a main accelerator.

A number of Linac technological innovations have been developed. Physics-based beam commissioning applications were developed based on the python accelerator physics application set (Pyapas) – a new architecture framework. The accelerating gradient of the S-band accelerating structures with a symmetrical coupler and internal water-cooling system was measured at 33 MV/m. The pulse-to-pulse stability of the solid-state modulator based on insulated gate bipolar transistors was measured at better than 0.02%, improved by about an order of magnitude than the pulse-forming



The first electron beam was accelerated to 500 MeV with better than 2.5 nC of bunch charge by the HEPS Linac (Image by IHEP)

Linac online RF conditioning completed on Sept. 23, 2022 (Image by IHEP)

A design sketch of the HEPS at night (Image: IHEP)

network (PFN) type modulator. The electron gun, with its cathode grid assembly developed in-house, can provide a 14.7-nC beam current for 1 ns at 50 Hz and is the first piece of accelerator equipment installed in the accelerator tunnels.

As one of China's key scientific and technological infrastructure projects during the 13th Five-year Plan, HEPS will not only be the first high energy light source in China but also one of the brightest fourth-generation synchrotron radiation facilities in the world. HEPS began construction in Huairou Science City on June 29, 2019. Over the past nearly four years, installation and RF conditioning of the Linac, along with installation of the booster and the first two beamline hutches, were completed. With building acceptance completed on Decmber 12, and girder installation at the storage ring begun on February 1, HEPS had entered the large-scale equipment installation phase.

Milestones of the HEPS Linac

29/06/2019: Design completed

28/06/2021: Electron gun—the first piece of accelerator equipment—was installed in the Linac tunnel.

08/03/2022: Installation in the Linac tunnel begun

12/05/2022: Linac vacuum-sealing in the tunnel completed

23/09/2022: Linac online RF conditioning completed

09/03/2023: Linac commissioning began

14/03/2023: The electron beam was accelerated to 500 MeV with better than 2.5 nC of bunch charge by the Linac.

(Source: IHEP)