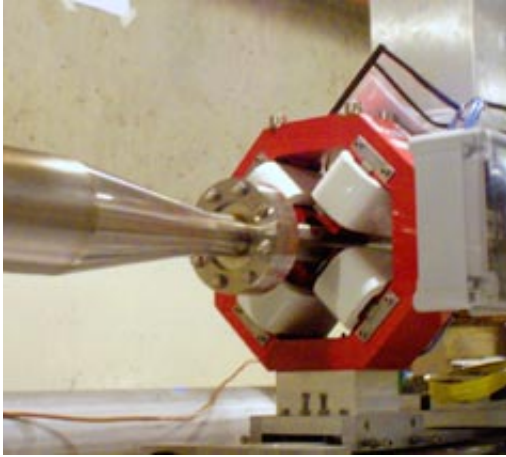


A Bunch of Electron Chicanery

November 21 2006



The first bunch compressor for the LCLS, being installed during the current shutdown. This quadrupole magnet is situated on the downstream end of the bunch compressor nearest the electron gun.

As the Linac Coherent Light Source (LCLS) takes shape over the next few years, one of the key issues occupying the minds of physicists is controlling the size and shape of the electron pulses used to generate the x-ray laser light.

Optimal operation of the LCLS will require achieving pulses of electrons that are tightly bunched. This will both ensure that the machine operates the way it was designed and give researchers a means of taking data on an extremely short timescale.

During the current shutdown, technicians have been busy installing the

first of two hardware systems onto SLAC's linac that will shorten the length of the electron bunches. Called "bunch compressors" or "magnet chicanes," these devices consist of a series of magnets and drift tubes that divert the electrons flowing through the linac along a bent path that travels out away from the accelerator a short distance and then back.

This out-and-back scheme works because each linac beam pulse contains electrons that have slightly different energies, with electrons in the tail of each bunch being given a higher energy than the electrons in the head of the bunch. Electrons with lower energy are bent more by the bending magnets than electrons with higher energy. When the pulse is made to bend out and back, the low-energy electrons in the head of the bunch travel slightly farther than high-energy electrons in the tail, taking slightly longer, allowing the high-energy electrons in the tail to catch up to the head. The result is a more tightly bunched clump of electrons.

The second bunch compressor, scheduled to be installed during the shutdown of 2007, will be quite a bit longer than the one currently being installed. The first compressor, which is about 18 feet long, is situated near the electron gun where the pulses originate. At this point the pulses have only been accelerated slightly. The second compressor, which will be over 65 feet long, will occupy a spot much further down the linac, by which point the beam has been accelerated to a much higher energy. And because electrons with higher energy bend to a lesser degree than low-energy electrons, a longer compressor is needed to shorten the bunches.

Source: by Brad Plummer, SLAC Today

Citation: A Bunch of Electron Chicane (2006, November 21) retrieved 26 April 2024 from <https://phys.org/news/2006-11-bunch-electron-chicanery.html>

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