

The synchronization and timing system updating at CTFEL facility

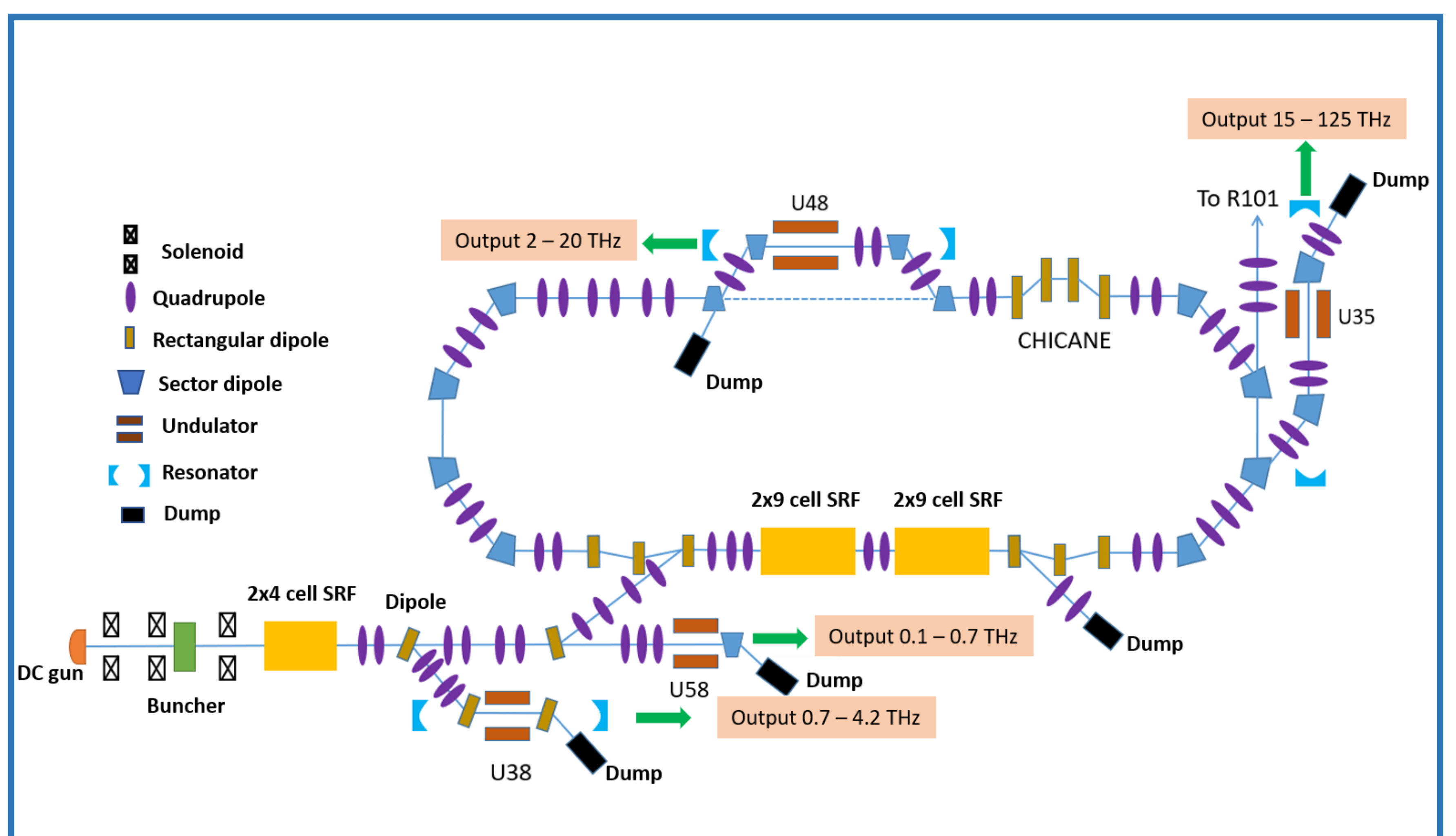
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Abstract

Chinese Academy of Engineering Physics terahertz free electron laser facility (CTFEL) is a superconducting linac-based user facility. It provides laser pulses with frequencies from 0.1 THz to 4.2 THz. CTFEL works in pulsed mode with a repetition of 10 Hz where up to about 54000 bunches at a bunch spacing of 18.5 ns are accelerated in one macro-pulse. To satisfy the high-precision synchronization requirement from user experiments, the synchronization system based on coaxial line is updated to a continuous laser carrier and Michelson interferometer-based system. The timing system is updated to event system.

New facility based on CTFEL

The layout is the CTFEL facility after updating in 2025. At present, the acceleration part consists of a DC injector with 320 kV and one L-band 2*4 cell superconducting cavity cryomodule. A L-band buncher is located between the DC injector and the 2*4 cell superconducting cavity cryomodule. One undulator with a period of 58 mm is in the downstream after several quadrupoles. The other undulator with a period of 38 mm and a resonator locates after a dog-leg transfer section. The new section includes two 2*9 cell superconducting cavities, two undulators with period of 35 mm and 48 mm respectively and a X-ray FLASH lab. This circular beamline is also the main part of energy recovery linac (ERL) in the future. During this construction of new facility section, the synchronization and timing system is updating from the coaxial cable based without feedback to the fiber optic cable based with continuous laser and Michelson intervened system.



CTFEL synchronization and timing system

The synchronization and timing system has been completed in the early of this year. We analyze the short time jitter of phase reference signal from the synchronization system. The 1.3 GHz reference signal from a master oscillator has 69 fs time jitter with integrated scale from 10 kHz to 50 MHz. After modulated in the infrared laser and transferred by 30 meter fiber, the reference signal from the synchronization receiver has 72 fs time jitter. Then the RMS jitter of the synchronization system is about 16.7 fs.

