Longitudinal bunch compression in final stage of energy driver for inertial confinement fusion driven by cluster-ion beam

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Longitudinal bunch compression manipulation in final stage of a particle accelerator complex is a critical research topic in a heavy-ion inertial fusion (HIF) system [1,2].

Induction synchrotron has been developed [3,4], and induction microtron has been proposed to accelerate heavy ions such as Pb or C-60 with a large mass to charge ratio [5]. Recently, a novel driver system was proposed for inertial confinement fusion driven by cluster-ion beams, which consists of a multi-beam and two-way induction synchrotron, a permanent magnet storage ring, and induction microtrons as an injector [6]. Also the longitudinal bunch compression system is required in the final stage after the acceleration of the cluster-ion beams.

For the longitudinal bunch compression, the barrier bucket scheme in the recirculator and the fast rotation scheme in the linac are considered. The beam bunch is compressed longitudinally to squeeze the duration between the barrier buckets in the recirculator. After the bunch compression in the recirculator, the bunch is compressed additionally with the head-to-tail velocity tilt in the linac. The velocity modulation for the longitudinal bunch compression is applied by the bipolar voltage pulses, which is produced by the induction modulator.

In this study, the effective scenario of the longitudinal bunch compression is studied in comparison with the barrier bucket and the fast rotation schemes including with the viewpoint of the cost. The pulse duration, required voltage, and the linac length required for the drift compression are estimated using the envelope equations [7-9].

References

[1] K. Horioka, *et al.*, Nucl. Instrum. Methods Phys. Res. **A 606**, 1 (2009)

[2] T. Kikuchi, *et al.*, Nucl. Instrum. Methods Phys. Res. **A 577**, 103 (2007)

[3] K. Takayama, *et al.*, Phys. Rev. Lett. **98**, 054801 (2007)

[4] K. Takayama, *et al.*, Phys. Rev. ST-AB **17**, 010101 (2014)

[5] K. Takayama, *et al.*, Phys. Rev. ST-AB **18**, 050101 (2015)

[6] K. Takayama and K. Horioka, "A Quantum Beam Driver for the Future Inertial Fusion", The 21st International Symposium on Heavy Ion Inertial Fusion (HIF2016), Astana, Kazakhstan (July, 2016)

[7] T. Kikuchi, *et al.*, Phys. Plasmas **9**, 3476 (2002)

[8] T. Kikuchi, *et al.*, Laser Part. Beams **20**, 589 (2002)

[9] T. Kikuchi, *et al.*, IEEJ Trans. FM **125**, 515 (2005)