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KEK Digital Accelerator and Latest Switching Device R&D

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The digital accelerator (DA), which is a small-scale induction synchrotron [1] requiring no high-energy injector accelerator and capable of providing a wide variety of ions, has been constructed at KEK [2]. Since the last year beam commissioning has been carried out. The KEK-DA consists of a 200 kV high voltage terminal, in which a permanent magnet x-band ECRIS is embedded, 15 m long LEBT, electro-static injection kicker, and a 10 Hz rapid cycle synchrotron equipped with the induction acceleration system. An ion pulse chopped in 5 micro-sec by the newly developed Marx generator driven Einzel lens chopper was guided through the LEBT and injected by the electrostatic kicker in one turn. The 3 micro-sec ion pulse was successfully captured with a pair of barrier voltage-pulses of 2 kV and accelerated up to 12 MeV with another flat induction-acceleration voltage-pulse through a full acceleration period of 50 msec. Beam commissioning has been started with a He1+ ion beam of 100 microA. Details of fully digital-controlled barrier bucket trapping and induction acceleration are described.

For continuously upgrading the induction synchrotron, we have been developing the next generation of switching power supply [3] employing noble solid-state switching elements, such as SI-Thyristor and SiC-JFET. Unfortunately packages of these elements, which can be utilized in modern accelerator performance, are not commercially available and not expected even in future. Our accelerator society must develop devices to meet their own specification, such as 1 MHz CW operation and output current/voltage of 100 A/2 kV. Recent activities on this subject at KEK will be introduced.

[1] K.Takayama and R.J.Briggs (Eds), "Induction Accelerators", (Springer, 2010).
[2] T. Iwashita et al., "KEK Digital Accelerator", Phys. Rev. ST-AB 14, 071301 (2011).
[3] K.Okamura et al., "Characterization of SiC JFET in novel packaging for 1 MHz Operation", Materials Science Forum 717-720, 1029-1032 (2-12).

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