Observation of THz CSR burst at UVSOR-II

M. Shimada[1], M. Katoh[1,2], M. Hosaka[2], A. Mochihashi[1*], Y. Takashima[2], S. Kimura[1], T. Takahashi[3]

[1]*UVSOR Facility, Institute for Molecular Science, Japan*
[2]*Graduate School of Engineering, Nagoya University, Japan*
[3]*Research Reactor Institute, Kyoto University, Japan*
**Present affiliation : JASRI Spring-8, Japan*

In 2004, we reported the first result from the observation of bursts of Terahertz Coherent Synchrotron Radiation (THz CSR) at UVSOR-II [1]. In this experiment, UVSOR-II electron storage ring was operated in a single-bunch mode with the electron beam energy of 600 MeV. The bursts were observed at the infrared/THz beamline BL6B which has a large solid angle, 215 × 80 mrad^2 [2]. A hot-electron bolometer, which is sensitive from a few cm^{-1} to 50 cm^{-1}, was used as a detector.

Figure 1 shows the average intensity of the terahertz radiation measured by using a mechanical chopper and a lock-in-amplifier, in the single bunch mode (black circles) and in the multi-bunch mode (gray circles) against the average beam current. Large fluctuations can be seen in two beam current regions around 80 mA and above 130 mA. In these regions, very intense bursts were observed. They appeared quasi-periodically at the lower current while chaotically at the extremely higher current. The time structure of each burst sometimes showed periodicity which was approximately same as twice of synchrotron frequency..

After the upgrade of RF cavity at 2005 [3], a correlation between the bursts and a vertical beam instability was discovered. The threshold beam current came to be lower down to around 40 mA. The quisi-periodic structure in each burst cannot be seen.

At 2006, a schottky THz diode detector was introduced for measurement with high time resolution of around 100 ps. We have successful in observing the THz CSR at each revolution of the electron bunch (5.6 MHz). The bursts seems to contain rapid temporal structure which could not resolved with the bolometer.

We have constructed a laser bunch slicing system by introducing a Titanium Sapphire (Ti:Sa) femto-second laser [4]. The minimum duration of Ti:Sa laser is 130 fs and the maximum power per pulse is 2 mJ. We could observe both bursting THz CSR and CSR produced by the bunch slicing simultaneously in some beam current region. So far, we have not observed that the slicing induced the bursts.

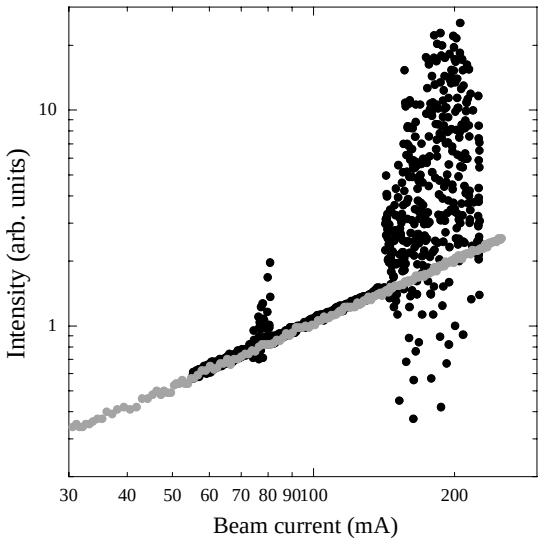

Fig. 1. Average intensity of the terahertz radiation in the single bunch mode (black circles) and in the multi-bunch mode (gray circles) as a function of the average beam current, measured by using a mechanical chopper and a lock-in-amplifier.

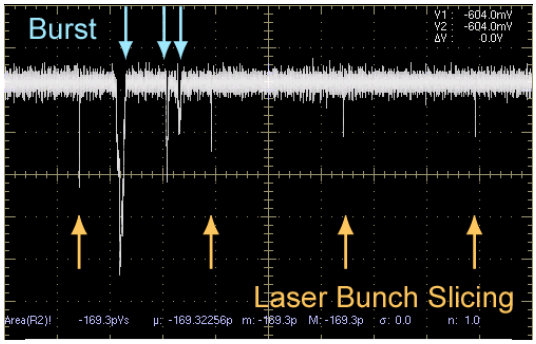

Fig. 2. THz CSR produced by the laser bunch slicing with the CSR bursts.

Reference

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