Experimental Study on Single Electron Storage

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We have started single electron storage experiments at UVSOR since 2021 with the aim of conducting fundamental research on electromagnetic radiation. At BL1U, we extracted undulator light in the UV region at a wavelength of 355 nm into the atmosphere and observed its intensity by a photomultiplier tube, as reducing background light using appropriate band-pass filters, and decreased the electron beam intensity using a beam scraper. We succeeded in observing a step-function-like intensity change under a small number of electron storage conditions with a good SN ratio and in confirming the single electron storage. In 2022, we improved the method of observing the accumulation state of single electron and attempted to observe undulator radiation from single electron.

This study utilizes an insertion device called a tandem undulator, which consists of two undulators arranged in series. It is known that the synchrotron radiation from the tandem undulator shows a finely modulated spectrum with the envelope of that from one undulator, as shown in Fig. 1 [1]. This modulation is the result of the spectral interference between the radiation from two undulators.

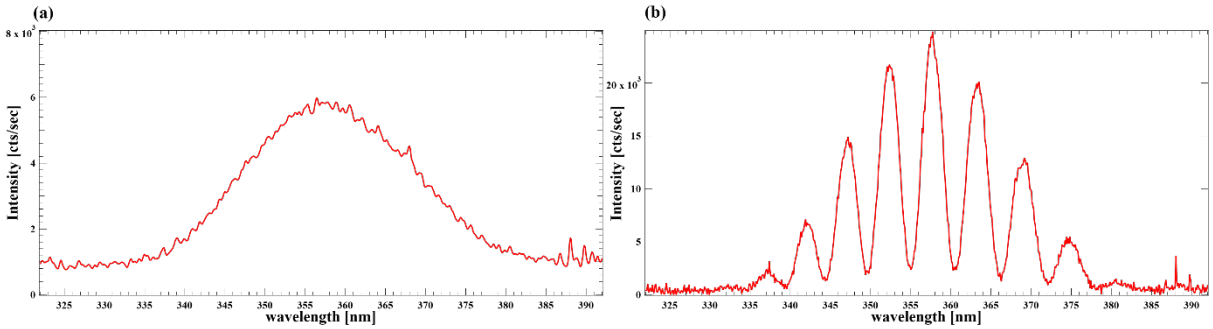

FIGURE 1. Spectra at a low beam current I_b = 0.1 mA; (a) from single undulator and (b) from tandem undulator.

The number of photons emitted during single passage of an electron in the undulator is much less than unity, which is in the same order of fine structure constant. Then, we have a question that when the single electron radiate single photon in the tandem undulator, does the spectrum shows the modulation? This is similar to Young's interference experiment but in the time domain. We have conducted such an experiment at UVSOR BL1U. The latest result from the experiment will be presented at the symposium.

REFERENCES

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