MEASUREMENT OF INTENSITY FOR BETATRON OSCILLATION ON THE BEAM PROFILE

Y. Yamamoto, S. Okada and T. Yoshino

AURORA is the weak focusing type with the simplest lattice composed of a single bending magnet, which produces an exactly axial symmetric magnetic field with little error magnetic field. The vertical beam size was measured to use the SR-interferometer by Mitsuhashi et al in 1997 [1-2]. The result of the size to be 10.5 μm showed ability of the SR-interferometer. At the user operation, we controlled the vertical beam size to keep 130 μm by RFKO to extend beam lifetime [3]. We tried to measure the frequency spectrum on the beam profile to monitor any instability by RFKO.

Measurement system which was composed by the radiation detector (APDM: avalanche photodiode module, C5658 HAMAMATSU), spectrum analyzer (U3200 ADVANTEST) and PC was constructed behind the beam extraction port BL-9 at the atmosphere [4]. A thick beryllium flat mirror was set to reflect the primary ray by 90° to extract the visible component in the vacuum chamber. This visible ray through the optical glass window to divide the vacuum and atmosphere was reflected again by an aluminum flat mirror, and introduced into the measurement system. The stored beam profile was magnified strongly by the conventional profile monitor using objective lens and magnifying lens. The radiation detector was scanned with using the micrometer on the beam profile in vertical direction. For the operating condition of RFKO, the center of frequency was 57.6 MHz in agreement with vertical betatron frequency ($f_{\beta y}$), deviation of frequency modulation 200 kHz, sweep frequency 1, 3 or 10 kHz. Stored beam current was about 200 mA at every measurement.

We had obtained three peaks for the frequency spectrum. Most strong peak frequency was 190.9 MHz, next 57.6 MHz and the third 75.7 MHz. Figure 1 (A), (B) and (C) show measured peak intensities as a function of the vertical scanning position on the magnified beam profile for the sweep frequency of 1, 3 and 10 kHz, respectively. Distributions of plotted points for 190.9 MHz are consistent with the beam profile, and these intensities are in proportion to the stored beam current. On the distributions for 57.6 MHz, there are double peaks on both sides of the center of beam profile, and intensities decrease dependent on the sweep frequency. This result suggests that the bunching beam size repeat increase because of the resonant oscillation using RFKO and decrease owing to the radiation dumping. This suggestion is consistent with that the dumping time constant of vertical betatron oscillation is 0.63 ms, and the tune spread is about 30 kHz and smaller than the deviation frequency of the modulation of RF kicker.

SR Center, Ritsumeikan University, Kusatsu, Shiga 525-8577, Japan

Distributions for 75.7 MHz have single peaks at the center of beam profile. This tendency is obviously different by comparison with one for 57.6 MHz. The origin of 75.7 MHz isn't the vertical betatron oscillation, RF frequency or those sum peak effect. We guess that electrons kicked by RFKO oscillate in horizontal with the frequency of 75.7 MHz in third order resonance given by $\nu_x+2\nu_y=2$.

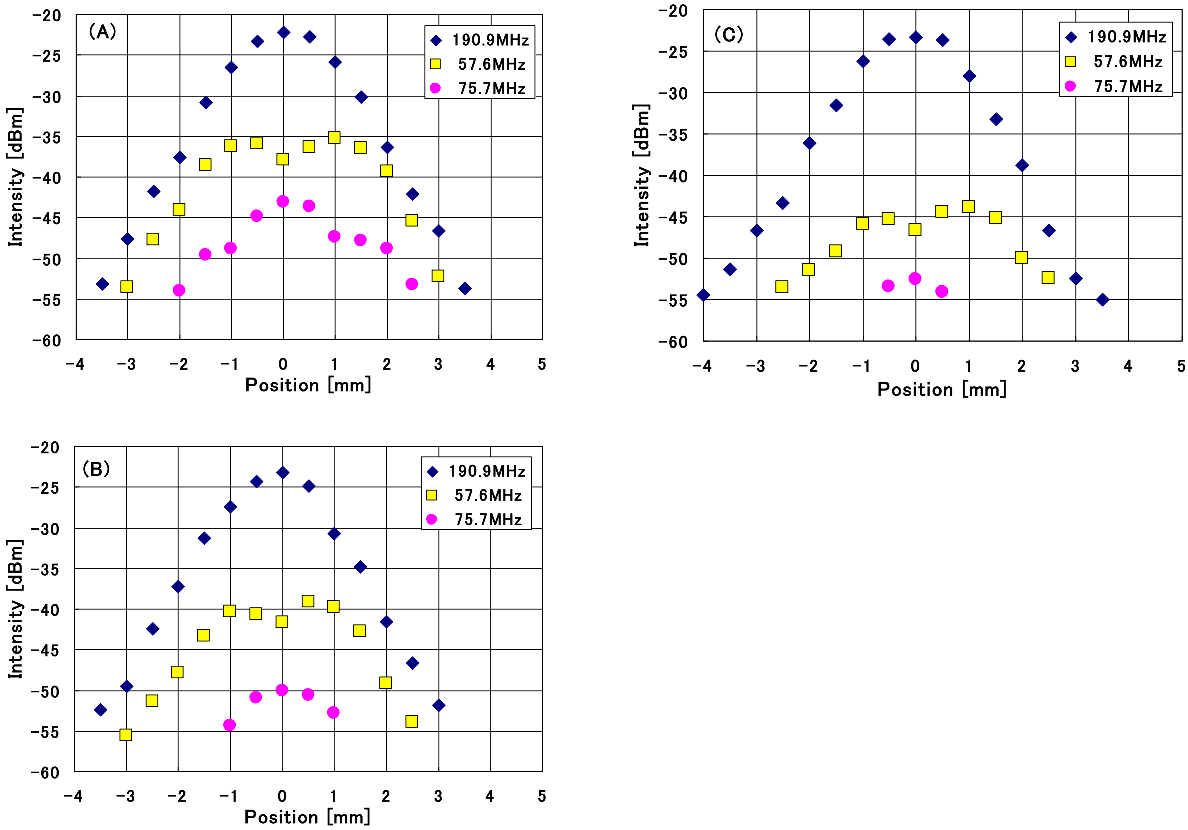

Figure 1. Observed peak intensity as a function of scanning position. (A) , (B) and (C) show results for 1 kHz , 3 kHz and 10 kHz of the sweep frequency of the modulation, respectively. Diamonds show the results for 190.9 MHz of peak frequency, squares for 57.6 MHz and circles for 75.7 MHz, respectively.

References

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