NewSUBARU Storage Ring

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Operation status
There are nine operating beam lines for the user experiments as shown in Fig.1 (BL-2, 3a, 3b, 6, 7a, 7b, 9, 10 and 11). The other two beam lines are used for R & D and γ-ray source by laser Compton back scattering (BL-1) and for accelerator beam diagnostics with visible light (BL-12). BL-1 will be opened for users in the next year.

Fig.1. Plan View of NewSUBARU Facility

The total operation time in 2004 was ~ 3400 hours (user time: ~ 1440 hrs, R&D, machine study: ~ 1600 hrs, tuning: 330 and trouble: 36) (See Fig.2). The storage ring is usually operated in weekdays. Monday and, sometimes, Tuesday are for 1.5 GeV operation. The top-up operation is performed for 1.0 GeV to keep the beam current constant, typically ~250 mA. The day time is ordinarily assigned to users and the remains to machine study and R&D. At 1.5 GeV operation, the stored current reduces from ~320 mA to ~160 mA in 8.5 hours. This gives the lifetime of ~20 hrs at 100 mA & 1.5 GeV.

Stability of Orbit and Photon Flux
After the improvement of the primary control system of water cooling to keep the temperature change less than ±0.1 °C, the orbit shift of the electron beam is mainly caused by the temperature change of the ring vault. Figure 3 shows the beam position signal at the dispersive point, the room temperature and the photon flux at BL-7b. When the air condition control system is turned off, there appear only small drifts. This system will be improved in the next year.

Fig.2. Percentage of Operation Time

Percentage of Operation Time

<table>
<thead>
<tr>
<th>Category</th>
<th>Percentage</th>
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<tbody>
<tr>
<td>User Time</td>
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<tr>
<td>Study / R&amp;D</td>
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<tr>
<td>Tuning</td>
<td>9.4</td>
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<tr>
<td>Trouble</td>
<td>1.0</td>
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Fig.1. Plan View of NewSUBARU Facility
Coherent Synchrotron Radiation

The rms bunch length is ~ 10 mm in the normal operation and is reduced to ~ 0.5 mm by setting the momentum compaction factor as ~ 1.0 E-5 with the RF voltage of ~ 300 kV. Then the strong coherent synchrotron radiation (CSR) in mm-wave or THz region is observed as shown in Fig. 4. Figure 4 (a) shows the dependence of the radiation power to the electron bunch current. The power is linear to the square of the bunch current in the ultra short bunch operation even for very weak current. The similar dependence is observed when the bunch current exceeds ~ 3 mA in the normal operation. The former is a steady radiation and the latter is a burst mode. The spectral power distribution is obtained as shown in Fig. 4 (b). The cutoff point due to the vacuum chamber is estimated as ~ 3 cm⁻¹. The enhancement factor at the wavelength of 2 mm is ~ 2.0E6 and is well explained from the number of electron in a bunch (7.0 E6)

![Fig. 3. Orbit and Flux change due to room temperature change.](image)

![Fig. 4. CSR observation](image)

(a) Bunch current dependence of SR

(b) Spectral power distribution of CSR
NewSUBARU Storage Ring

**Main Parameters**
- Circumference: 118.731 m
- Lattice: modified DBA
- Straight Sections: 4 m + 4 + 15 m + 2
- Injection Energy: 1.0 GeV
- Maximum Energy: 1.5 GeV
- Bending Radius: 3.22 m
- RF Frequency: 499.955 MHz
- Harmonic Number: 198
- RF Voltage: < 140 kV
- Betatron Tunes: 6.30 / 2.23

**Typical Operation Parameters at 1 GeV**
- Mom. Comp. Factor: 1.35 E -3
- Natural Energy Spread: 4.7 E -4
- Natural Emittance: 38 nm
- Natural Bunch Length: 20 psec (rms)
- Maximum Current: 500 mA (multi-bunch)
- 50 mA (single bunch)
- rms COD in (x / y): 6 / 8 µm

**Critical Photon Energy from Bending Magnet**
- 2.3 keV @ 1.5 GeV, 0.67 keV @ 1.0 GeV

Beam Optics in 1/4 - Ring.

\[
\beta (m) \quad \beta_x \quad \beta_y \quad D_x (m)
\]

\[
s (m): 1/4 \text{ Ring}
\]

\[
s : \text{ from the Center of Long Straight Section} \quad (D_x: \text{ Horizontal dispersion})
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