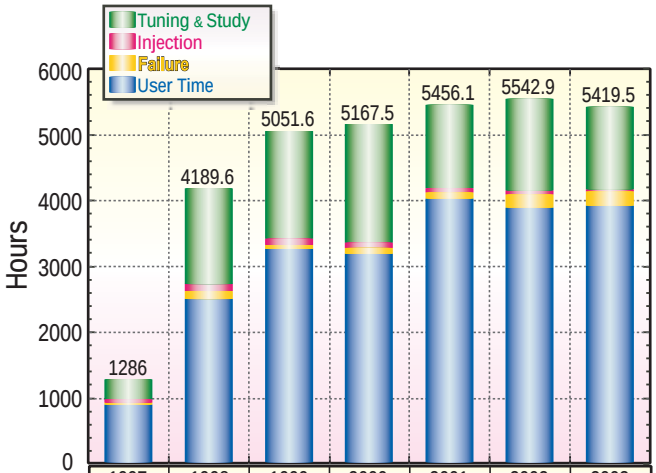
The operation statistics since the facility was opened to users are shown in Fig. 1. In 2003, the SPring-8 storage ring was operated on four- or five-week period for one operation cycle. The total operation time of the accelerator complex was 5419.5 hours. Of those hours, 72.4% (3926.0 hours) were available to the users. The injection time and the down time due to failure accounted for 0.7% (39.2 hours) and 3.9% (208.5 hours) of the operation time, respectively; a great loss of user time was due to one major failure in October 2003. A crack and hole were made on the side-wall of the vacuum chamber for a beam injection point, because the aborted electron beams of about 100 mA hit the inner side-wall of the vacuum chamber. Consequently, the broken injection vacuum chamber was removed and replaced by a reserved one. As a result, the user time of 119.5 hours was cancelled for the failure and recovery works. The remaining 23.0% (1245.8 hours) was dedicated to: (i) the machine and beamline study, (ii) the machine and beamline tuning, (iii) the commissioning of new photon beamlines.

The operation modes of three different filling patterns were delivered to the user time; 37.2% in the multi-bunch mode operation, 50.8% in the several bunch mode such as 203-bunch mode (203 equally spaced bunches), 29 equally spaced 11-bunch trains, and the remaining 12.0% in the hybrid filling mode such as a 2/21-partially filled multi-bunch with 18-isolated bunches. For the hybrid filling mode, 1 or 1.5 mA is stored in each isolated bunch. An isolated bunch purity of better than $10^{-10}$ is routinely being delivered.

Table I presents a summary of the useful beam parameters of the storage ring. In November 2002, the low emittance optics was introduced to the user time by breaking the achromatic condition. After the above mentioned failure, however, the ring optics went back to the former HHLV optics, because in case of the low emittance optics the aborted beam hits the injection vacuum chamber just like concentrated fire.




| | 1997 | 1998 | 1999 | 2000 | 2001 | 2002 | 2003 |
|---|---|---|---|---|---|---|---|
| Tuning & Study (Accel. & BL) | 304 | 1457.6 | 1624.2 | 1815 | 1276.5 | 1394.9 | 1245.8 |
| Injection | 50 | 110 | 95.2 | 70.4 | 59.3 | 60.8 | 39.2 |
| Failure | 26 | 110 | 57.2 | 88.7 | 87.1 | 190.5 | 208.5 |
| User Time | 906 | 2512 | 3275 | 3193.4 | 4033.2 | 3896.7 | 3926 |

Fig. 1. Operation statistics since the facility was opened to users.

Table I. Beam parameters of SPring-8 storage ring

| | HHLV Optics | Low Emittance Optics |
|---|---|---|
| Tunes ($\nu_x$ / $\nu_y$) | 40.15 / 18.35 | 40.15 / 18.35 |
| Current[mA]: single bunch | 13 | 10 |
| multi bunch | 100 (120[*1]) | 100 |
| Bunch length (FWHM) [psec] | 32 | 34 |
| Horizontal emittance[nm·rad] | 6.3[*2] / 6.6[*3] | 3.1[*2] |
| Vertical emittance[pm·rad] | 16.9[*3] | 8.7[*3] / 3.9[*4] |
| Coupling [%] | 0.26[*3] | 0.28[*3] / 0.13[*4] |
| Beam size[mm]: ($\sigma_x$ / $\sigma_y$)[*5] | | |
| Long ID section | 381 / 13.4 | 283 / 11.4 |
| ID section | 397 / 8.5 | 289 / 7.2 |
| BM section | 149 / 21.0 | 103 / 15.2 |
| Beam Divergence[mrad]: ($\sigma_{x'}$ / $\sigma_{y'}$)[*5] | | |
| Long ID section | 16.1 / 1.2 | 11.9 / 0.81 |
| ID section | 15.9 / 1.9 | 11.7 / 1.3 |
| BM section | 57.4 / 0.78 | 53.8 / 0.68 |
| Operational Chromaticities: ($\xi_x$ / $\xi_y$) | +7 / +6 (+2 / +2)[*6] | +8 / +8 |
| Lifetime[hr]: 100 mA (multi bunch) | ~ 150 | ~ 97 |
| 1 mA (single bunch) | ~ 24 | ~ 9 |
| Dispersion distortion[mm]:horizontal (rms) | 24 | 9.3 |
| vertical (rms) | 1.1[*7] | 1.1[*7] |
| Orbit stability (tune harmonics)[mm]: | | |
| horizontal (rms) | – | 1.3 |
| vertical (rms) | – | 0.35 |

[*1] Maximum stored beam current at machine study.
[*2] Measured by a pulse bump and scraper, [*3] two dimensional interferometer, and [*4] two photon correlation.
[*5] Assuming that 0.26% coupling for "HHLV" and 0.2% coupling for "Low Emittance Optics"
[*6] With bunch-by-bunch feedback. [*7] With correction by 24 skew Q's.