

Machine Operation

Figure 1 presents the operational statistics since the operation start in October, 1997. In 2002, 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 5542.9 hours. Of those hours, 70.3% (3896.7 hours) were available to the users. The injection time and the down time due to failure accounted for 1.1% (60.8 hours) and 3.4% (190.5 hours) of the operation time, respectively; a great loss of user time was due to one major failure in June 2002. A cooling water leak to a vacuum vessel of the in-vacuum undulator occurred, after which the in-vacuum undulator was removed from the storage ring and replaced by a dummy vacuum chamber. As a result, 134.5 hours of user time was cancelled for the failure and replacement. The remaining 25.2% (1394.9) was dedicated to: (i) the machine and beamline study, (ii) the machine and beamline tuning, and (iii) the commissioning of new photon beamlines.

The operation modes of three different filling patterns were delivered to the user time; 35.0% in the multi-bunch mode, 47.2% in the several bunch mode such as 203-bunch mode (203 equally spaced bunches) and 84 equally spaced 4-bunch trains, and the remaining 17.8% 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.

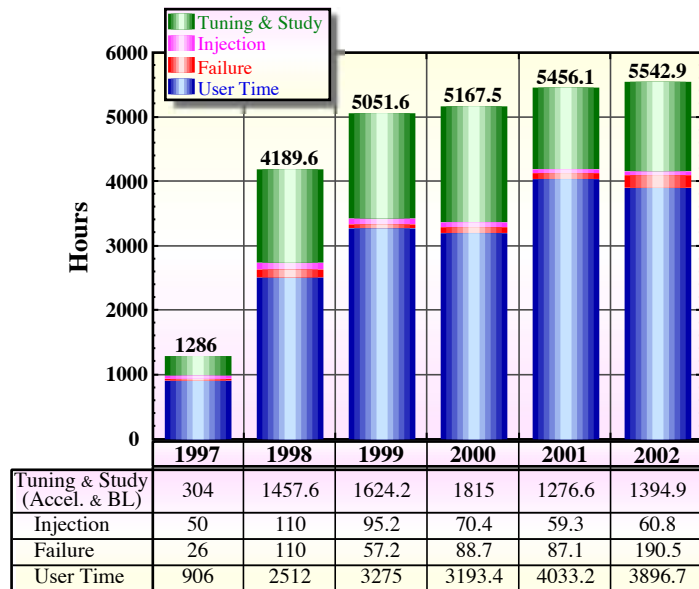


Fig. 1. Operational statistics since the facility was opened to users.

	1997	1998	1999	2000	2001	2002
Tuning & Study (Accel. & BL)	304	1457.6	1624.2	1815	1276.6	1394.9
Injection	50	110	95.2	70.4	59.3	60.8
Failure	26	110	57.2	88.7	87.1	190.5
User Time	906	2512	3275	3193.4	4033.2	3896.7

Table I. Beam parameters of SPring-8 storage ring.

Tunes (ν_x / ν_y)	40.15 / 18.35
Current[mA]: single bunch	10
multi bunch	100 (120 * ¹)
Bunch length (FWHM) [psec]	34
Horizontal emittance [nm·rad]	3.1 * ²
Vertical emittance [pm·rad]	8.7 * ³ / 3.9 * ⁴
Coupling [%]	0.28 * ³ / 0.13 * ⁴
Beam size[μm]: (σ_x / σ_y) * ⁵	
Long ID section	283 / 11.4
ID section	289 / 7.2
BM section	103 / 15.2
Beam Divergence[μrad]: (σ_x' / σ_y') * ⁵	
Long ID section	11.9 / 0.81
ID section	11.7 / 1.3
BM section	53.8 / 0.68
Lifetime[hr]: 100 mA (multi bunch)	~ 97
1 mA (single bunch)	~ 9
Dispersion distortion[mm]:horizontal (rms)	9.3
vertical (rms)	1.1 * ⁶
Orbit stability (tune harmonics)[μm]:	
horizontal (rms)	1.3
vertical (rms)	0.35

*¹ Maximum stored beam current at machine study. Measured by a pulse bump and scraper*², two dimensional interferometer*³, and two photon correlation*⁴.

*⁵ Assuming that 0.2% coupling.

*⁶ With correction by 24 skew Q's.