decade. In order to design a detailed plan, the working group for the SPring-8 upgrade plan was formed on October 10, 2008, comprised of scientists and engineers of RIKEN and JASRI who will lead the next generation. The working group has started closely examining the upgrade processes needed for the accelerator complex, X-ray sources, and effective utilization of the SPring-8.

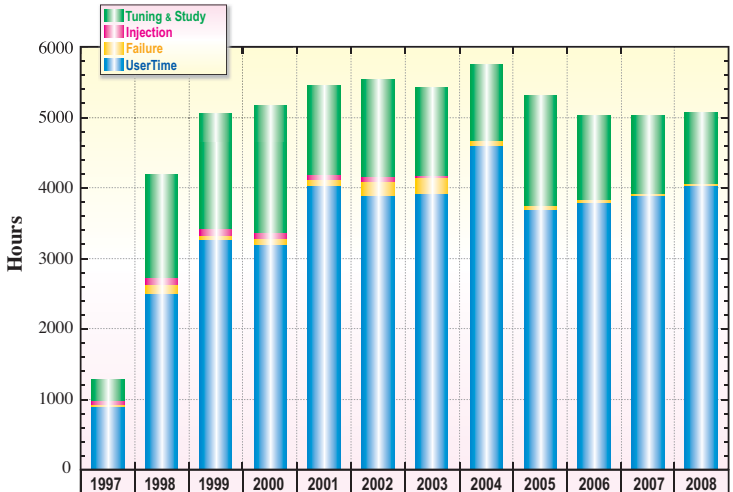
Currently, an X-ray free electron laser (XFEL) facility is being constructed at the SPring-8 campus with completion slated for 2011. Owing to juxtaposing XFEL, the SPring-8 will become a unique large-scale third-generation synchrotron radiation facility, forming a center-of-excellence for advanced photon science. Also currently under construction is the electron beam transport system designed to inject the high quality electron beam generated by the XFEL linac to the SPring-8 storage ring.

II. Machine Operation

The operation statistics since the facility was opened to users are shown in Fig. 1. In 2008, the total operation time of the accelerator complex was 5078.5 hours. The operation time of the storage ring was 5063.4 hours, of which 79.7% (4037.8 hours) was made available to the users. The down time resulting from failure accounted for 0.76% (30.7 hours) of the user time; in 2008, no great loss of user time exceeding several hours occurred. Since 2004, there has been no injection time because top-up injection was introduced. Concerning user service operation, the high availability (ratio of net user time to planned user time) was achieved, e.g., 99.0% in 2008. The total tuning and study time of 1010 hours was used for machine tuning, and the study of the linac, booster synchrotron and storage ring, and also for the beamline tuning and study.

Operations in three different filling modes were provided for the following user time: percentages 18.7% in the multi-bunch mode, 44.2% in the several bunch mode, such as the 203-bunch mode (203 equally spaced bunches) and 37.1% in the hybrid filling mode such as a 1/14- partially filled multi-bunch with 12-isolated bunches. In 2008, the several bunch mode was the dominant filling mode. In particular, 203-bunch mode reached 24.1% of the total user time. For the hybrid filling mode, 1.0 mA, 1.4 mA, 1.6 mA, or 3.0 mA, is stored in each isolated bunch. An isolated bunch purity better than 10^{-10} is routinely maintained in the top-up operation. Table III shows a summary of the beam filling patterns.

Table IV shows a summary of the useful beam parameters of the storage ring.



	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008
Accelerator Operation Time	1286.0	4189.6	5051.6	5167.5	5456.1	5542.9	5419.5	5759.2	5317.1	5026.2	5027.9	5078.5
Storage Ring Operation Time	1270.6	4135.4	4863.9	4972.9	5340.6	5484.1	5328.5	5736.7	4781.3	5008.5	5019.2	5063.4
Tuning & Study (Acc. & BL)	304	1457.6	1624.2	1815	1276.5	1394.9	1245.8	1085.9	1559.2	1193.6	1100.3	1010
Injection	50	110	95.2	70.4	59.3	60.8	39.2	0	0	0	0	0
Failure	26	110	57.2	88.7	87.1	190.5	208.5	82.4	59.7	42.5	27.6	30.7
User Time	906	2512	3275	3193.4	4033.2	3896.7	3926	4590.9	3698.2	3790.1	3900	4037.8
Planned Time	984	2712	3432	3352	4176	4152	4176	4680	3762	3840	3936	4080
Availability (%)	97.2	96.7	98.2	97.4	98	95.3	95	98.1	98.3	98.7	99.1	99

Fig. 1. Operation statistics since the facility became available to users.