The Implementation and Status of Quasi-constant Current Operation at Taiwan Light Source

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The Taiwan Light Source (TLS) is a third generation light source with strong focusing quadrupoles and chromatic sexptupoles. The Triple-Bend-Archromat (TBA) is the base lattice cell to form a six-period structure with six straight sections. Four of the straight sections are occupied by conventional normal-conducting insertion-devices, U9, U5, W20 and Elliptical Polarized Undulator EPU5.6. One straight section was used as injection taken by 4 kickers. A 3-poles and 6.5 Tesla superconducting wavelength shifter was installed at downstream of the injection kicker #3 to provide high photon flux in x-ray regime. A SRF cavity and a 32-poles' 3.2 Tesla superconducting wiggler occupied the RF straight section. An In-Archromat-Superconducting-Wiggler (IASW) was installed and commissioned. The associated beamlines with IASW will be commissioned in the second half-year of 2006. Two more IASWs will be installed at symmetric positions in the storage ring next year.

Quasi-constant current operation, Top-up injection, is an operation mode in which the beam current in the storage ring is maintained above certain level by frequent injections. The routine current stability is in the range of 10^{-3} for long period of operation. The Top-up injection provides much more flexibility for various operation scenarios such as lower emittance, higher current, smaller coupling, smaller ID gaps, exotic bunch filling patterns, and higher bunch charge. It also provides constant thermal loading on all components in the storage ring and the optics components of beamlines, as well as constant signal to the beam position monitor.

In recent years, the Advanced Photon Source, the Swiss Light Source and the SPring-8 have demonstrated the top-up mode in partial- or full-time operation very successfully. Several top-up experimental tests were also carried out at various stages of Taiwan Light Source's (TLS) upgrade path. Many obstacles prevented the realization of top-up injection in a routine fashion. After a series of beam parameters measurement, subsystem checkout, installing of various sensors, control program modification, and hardware upgrade made the top-up injection a feasible option in routine operation between 2003 and 2005. Figure 1 shows the routine operation of top-up injection during users shift. Discussions on the results of some measurements of booster and storage ring, the requirement of hardware upgrade and the summary of routine operation of Top-up injection will be presented in this paper.

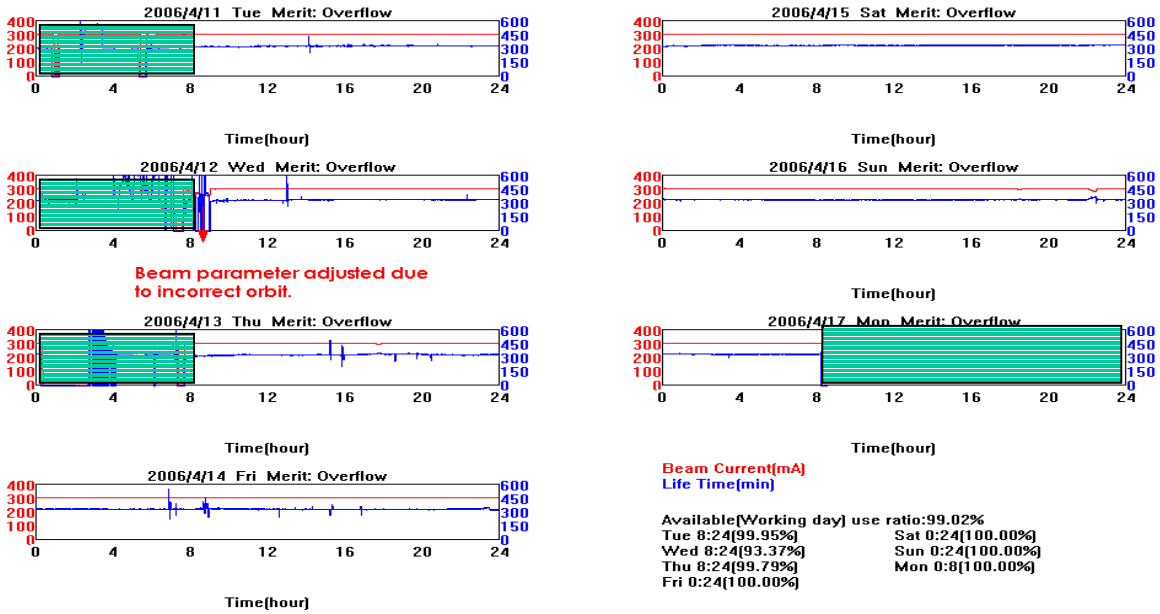

Figure 1. Weekly report of the operation status of TLS. The red- and blue-line indicate the stored beam current and lifetime, respectively. The green-shaded area indicates the machine development and shutdown for maintenance.