NSRRC

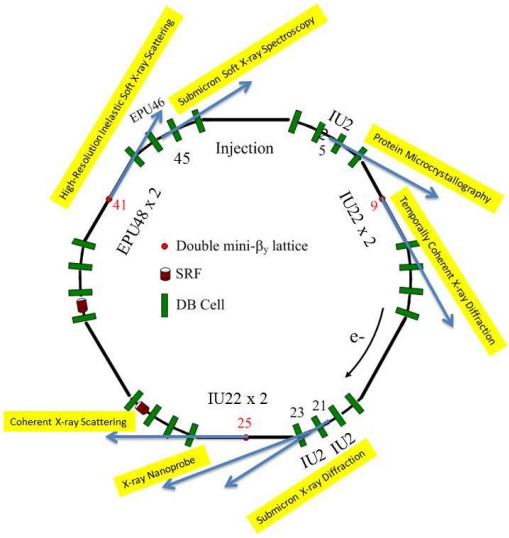
General Information

Located in Hsinchu Science Park Taiwan, NSRRC has been operating its first high-performance synchrotron light source, Taiwan Light Source (TLS), since 1994, providing broad spectra from IR to X-rays of great brightness that is unattainable in conventional laboratories and that draws to NSRRC users from academic and technological communities worldwide. Each year, scientists and students have been paying over ten thousand visits to the NSRRC to perform experiments in various scientific fields, using cutting-edge technologies and apparatus. These endeavors aim to explore the vast universe, scrutinize the complicated structures of life, discover novel nanomaterials, create a sustainable environment of green energy, unveil living things in the distant past, and deliver better and richer material and spiritual lives to mankind.

- User operations : started from 1994.
- 1.5 GeV 360 mA top-up operations within 0.3 % current variation (top-up mode since 2005).
- TLS operation in 2013 FY: 5,150 h of operation with 114,470.4 h user time (25 beamlines combined), 1,666 h maintenance time, and ~28 h down time.
- Operation Budget (including TPS construction): US$74.36 million in 2013 FY, US$103.06 million in 2012 FY (1 USD = 29.05 TWD).
- 2,036 users in 2013 FY.
- 2,100 proposals submitted, 1,586 approved (75.5 %) in 2013 FY.
- User affiliation: 13.7% from abroad, 86.3% from domestic institutions in 2013 FY.
- ~320 SCI papers published in 2013 FY (~56 top 5% papers).

Aerial view of TLS and TPS rings.

TPS Phase-I Beamline Layout

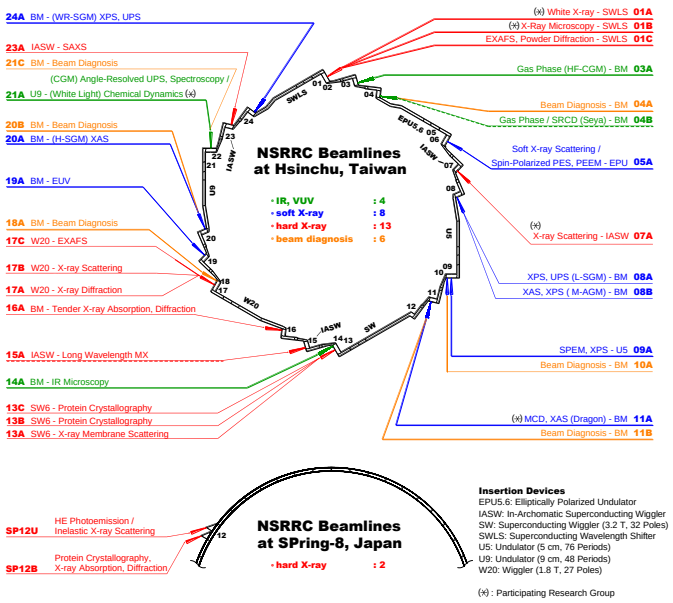


Schedules for completing commissioning:

5 beamlines by the end of 2015

2 beamlines by August 2016

TLS Beamlines & Taiwan Contract Beamlines at SPring-8



27 beamlines in operation

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Current Activities

TLS was made available to domestic and foreign researchers in April 1994. With the gradual completion of attendant experimental facilities, the number of beamlines has increased from 4 to 25 with spectra in a range from infrared to hard X-ray. In addition, NSRRC operates 2 Taiwan Contract Beamlines at SPring-8 in Japan. Since the inauguration of the TLS user program, the number of user-stints from users worldwide has been increasing rapidly, and both the quantity and quality of research output have grown significantly, which includes a sizable amount of world-class experiments in many fields.

Domestic and international researchers have been applying the light source broadly to diverse fields of basic and applied science since the inception of operation. TLS has become a world-class research facility given its operation quality, substantial research results and international collaborations. TLS sets numerous world records and is known as:

- the first third-generation synchrotron light source in Asia;
- the second synchrotron light source equipped with a superconducting radio frequency cavity in the world;
- the fourth synchrotron light facility operating in top-up mode in the globe; and
- the synchrotron light source with the densest insertion devices worldwide.

TLS storage ring building.

With rapid advancements in global technology as well as increasing users' demands, the NSRRC, with approval from the government in Taiwan, decided to build the Taiwan Photon Source (TPS) which will establish a new, low-emittance synchrotron light source on the current campus with an electron beam energy of 3 GeV, a circumference of 518 meters, and a 24-DBA-cell design. The ground-breaking ceremony of the TPS project was held on February 7, 2010. Seven beamlines are expected to come on-line in phase-I of TPS operation:

- protein microcrystallography
- high-resolution inelastic soft X-ray scattering
- submicron soft X-ray spectroscopy
- coherent X-ray scattering
- submicron X-ray diffraction
- X-ray nanoprobe
- temporally coherent X-ray diffraction

The first 5 and the last 2 beamlines will complete commissioning by the end of 2015 and by August 2016, respectively.

Top: TPS accelerator.

Bottom: Group photo of the 20th anniversary of operation. (in front of the TPS Administration & Operation Center)

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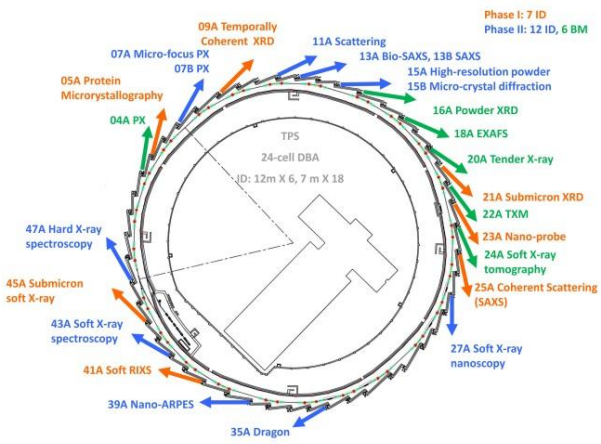
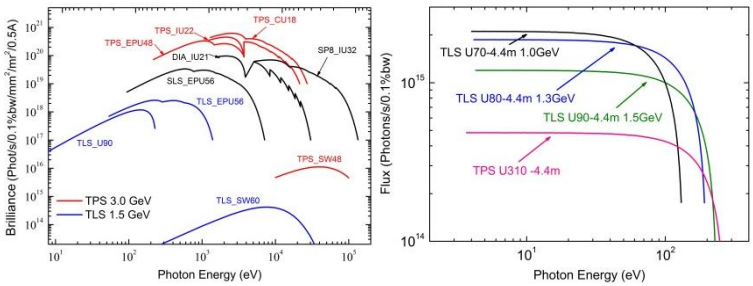
Future Perspective

TPS is scheduled to open to the academic and scientific communities to conduct advanced research by the end of 2015. Now TPS construction is progressing and NSRRC will build 7 beamlines in TPS in phase I. The phase II of TPS beamline construction plans to build 3 additional new beamlines before 2022. In the meantime, 15 beamlines and end stations in TLS will also be relocated in TPS. By then, NSRRC reaches another milestone with 25 newly-built or relocated beamlines in TPS. Considering the complementarity of TPS and TLS, the operation plan for TLS and TPS will take multiple factors into consideration, such as source characteristics, the complementary nature of the two light sources, scientific opportunities, user communities and economic efficiency.

Looking forward to the completion of TPS, we hold a grand vision of it:

- to make TPS one of the brightest synchrotron light sources in the world, build a world-class interdisciplinary experimental facility, and achieve a premier position in the international synchrotron community;
- to develop innovative experimental techniques and expand fields of scientific research, especially in biomedicine and nanoscience technologies, to catapult academic research in Taiwan to the top of the world;
- to assist high-technology industries in their research and development of products and in optimization of production processes, which in turn will improve our country's international competitiveness in the knowledge economy;
- to attract more international research groups to conduct experiments at NSRRC, or to build their exclusive beamlines jointly, and to promote international collaboration to advance Taiwan's international recognition;
- to be an important incentive for internationally renowned scientists to engage in long-term advanced interdisciplinary research in Taiwan, and
- to entice and foster students to devote themselves to advanced research that can lead to important scientific discoveries.





Either TLS or TPS has its own unique advantages to deliver synchrotron radiation of great quality over a broad spectral range. TLS is a 1.5-GeV third-generation storage ring with low- & medium-energy that provides optimum sources of photons in the IR, VUV and soft X-ray region. TPS is a 3-GeV medium-energy storage ring which is optimum for hard X-ray region. For instance, the photon flux of VUV at TLS is better than TPS's. However, when it comes to the X-ray region, TPS is much better than TLS. The figures above are the comparative corresponding relation of brilliance vs. photon energy, and flux vs. photon energy for TLS and TPS.

TLS provides an optimum photon source in the VUV and IR regions, and it is an outstanding scientific research facility for photophysics and photochemistry in space science, photochemistry for atmospheric science, chemical dynamics, photodecomposition, free radicals, interstellar chemistry, energy transfer of highly vibrationally excited molecules, palaeontological fossils, cancer screening, and development of cutting-edge cancer therapy.

In addition to scientific possibilities of photon beams, to create TLS new competitive advantages, TLS booster ring with high operation efficiency could be developed into proton or carbon ion medical accelerator, to explore the medium-energy proton beam for industrial and the light-ion for medical applications.