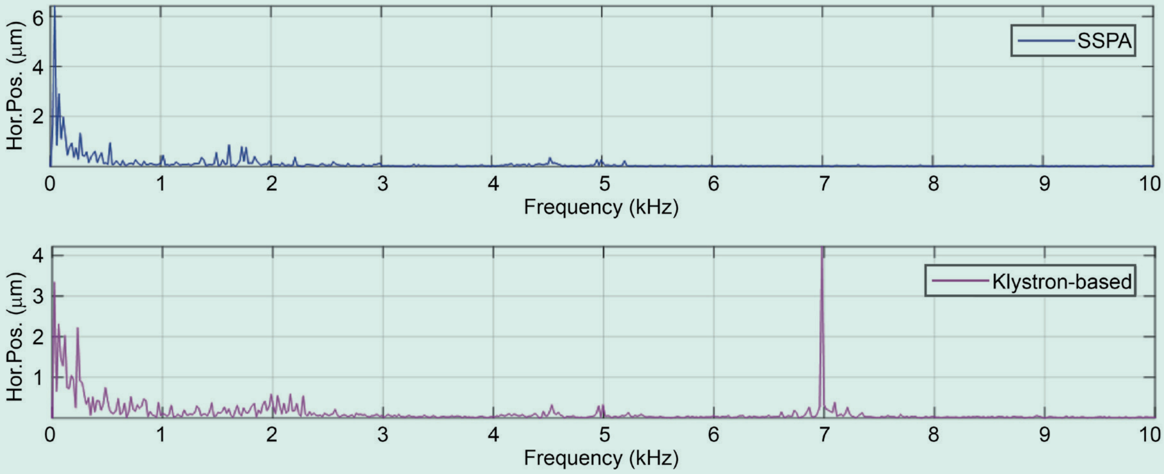

Fig. 3: Spectra of the electron beam orbit in the horizontal direction when using the SSPA RF transmitter and the klystron-based RF transmitter. [Figure courtesy of Chih-Hsien Huang]

approximately 7 kHz.

The trend in the accelerator field is the application of SSPAs as high-power RF sources. We have dedicated efforts to solid-state technology development and constructed a 500-MHz and 300-kW SSPA RF transmitter system at the TPS. This SSPA RF transmitter has been employed during routine operations at the TPS, enhancing the RF system power efficiency and stability. This approach effectively reduces disturbances to the electron beam and minimizes trip events. (Reported by Fu-Tsai Chung, Fu-Yu Chang, Shian-Wen Chang and Zong-Kai Liu)

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Micro-Focused Single Crystal X-ray Diffraction Beamline at Taiwan Photon Source

TPS 15A is a new Taiwan Photon Source synchrotron beamline designed for the analysis of challenging materials and phenomenon thanks to single-crystal X-ray diffraction techniques.[1]

The X-ray source of this beamline comes from a CUT18 cryo-undulator allowing an X-ray energy range of 9 to 35 KeV. A double crystal monochromator allows for the selection of an appropriate wavelength for monochromatic measurements. The undulator can also be used in tapered mode which, combined with a double multilayer monochromator, will allow the generation of an X-ray "pink beam" (poly-chromatic, with bandwidth 3% or 5%). This setting allows for a higher flux, which is particularly useful for ultrafast measurements despite the fact that this requires more complex data analysis.

TPS 15A X-ray optics allow investigations of samples structural properties down to just a few microns in size, owing to its X-ray micro-focussing capability, as well as up to very high resolution, due to its high brightness. This allows for fine and detailed analysis of materials atomic scale structures.

TPS 15A has two endstations (**15A1** and **15A2**, **Fig. 1**). The first endstation has a beam size at sample position of 150 microns (adjustable by slits) and is equipped with a vertical Eulerian cradle goniometer (four circles goniometer) with a photon

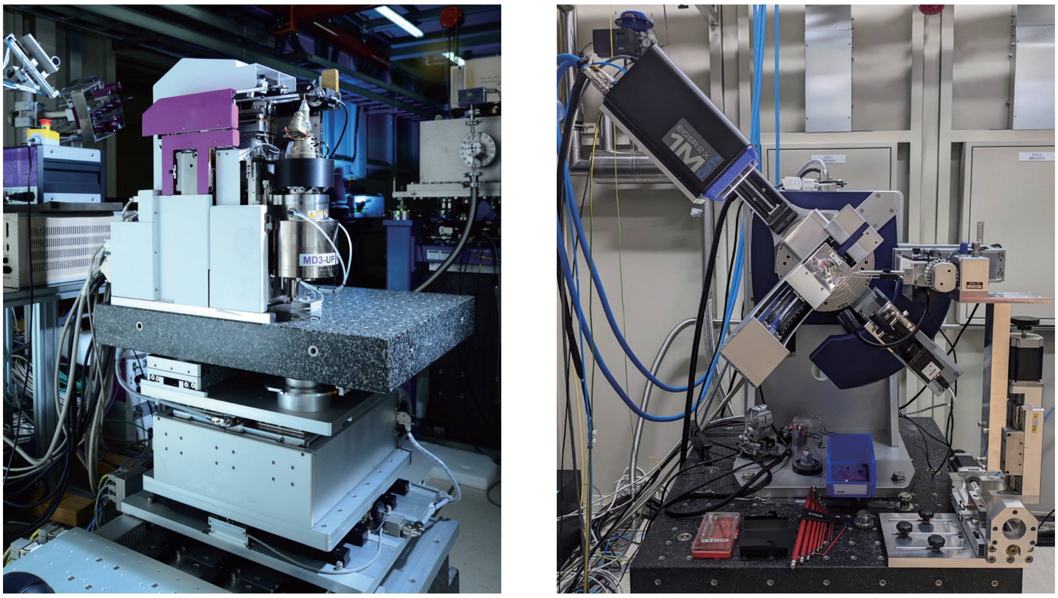
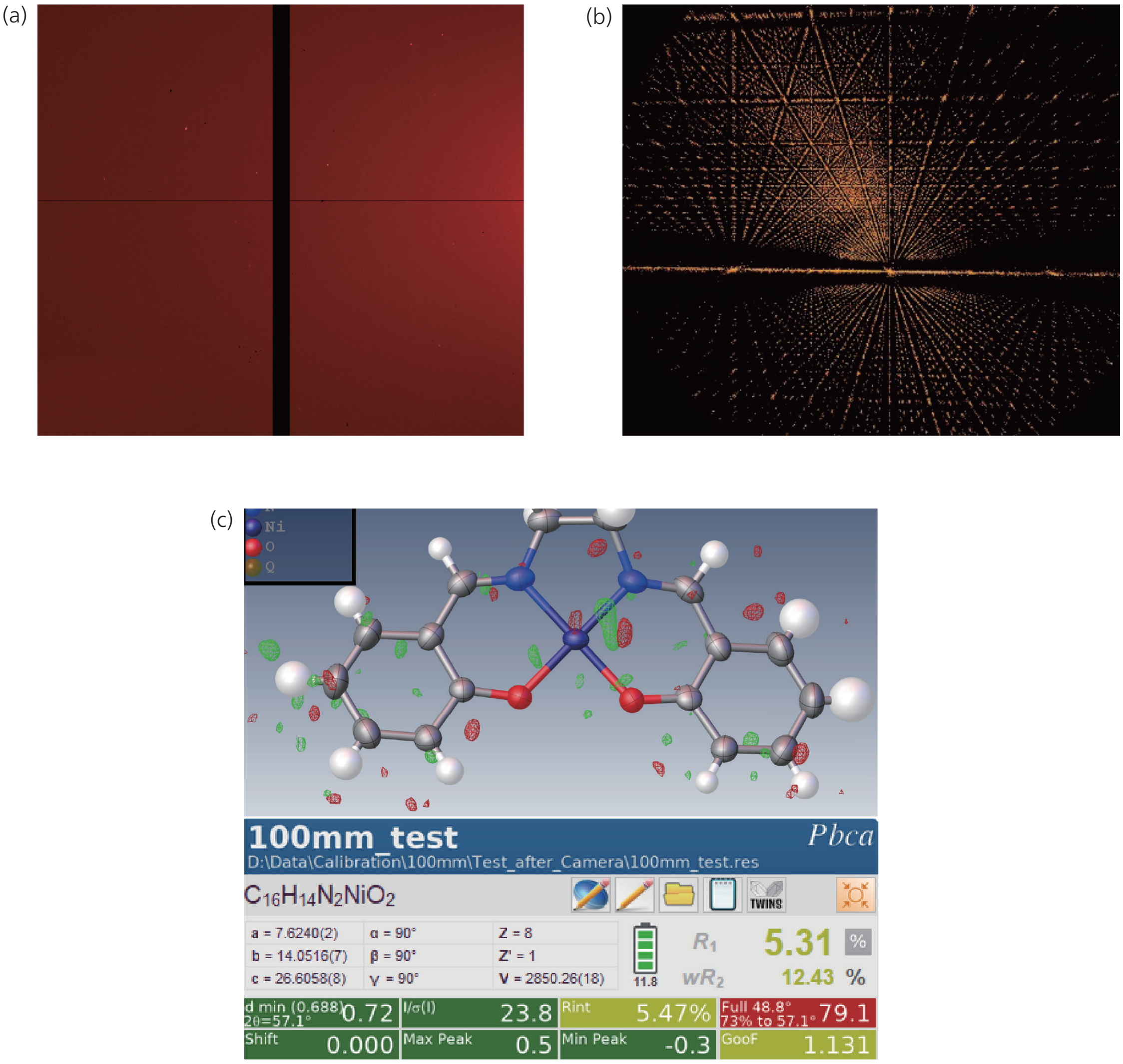


Fig. 1: Goniometer of **15A1** (left) and **15A2** (right).



100mm_test Pbca

D:\Data\Calibration\100mm\Test_after_Camera\100mm_test.res

$C_{16}H_{14}N_2NiO_2$

a = 7.6240(2) α = 90° Z = 8

b = 14.0516(7) β = 90° Z' = 1

c = 26.6058(8) γ = 90° V = 2850.26(18)

R_1 5.31 %

wR_2 12.43 %

d min (0.688) 2θ=57.1° 0.72 | I/σ(I) 23.8 | Rint 5.47% | Full 48.8° 73% to 57.1° 79.1

Shift 0.000 | Max Peak 0.5 | Min Peak -0.3 | GooF 1.131

Fig. 2: (a) X-ray diffraction frame, (b) reciprocal space projection, and (c) structure of test crystal.

counting detector—EIGER 2X CdTe 1M. This setting allows the measurement of the full diffraction sphere up to very high resolution and avoids X-ray polarisation related issues.

The second endstation has additional X-ray optics that reduces the X-ray focussing down to 10 microns at sample position and can be further reduced by pinholes down to 2 microns. It is equipped with an ultra-precise horizontal kappa goniometer and a large-area photon counting detector—EIGER 2X CdTe 9M. This design allows to keep data completeness very high for fast and precise measurements.

The beamline is equipped with a wide variety of devices for the control of samples environment, allowing advanced analysis of materials properties under various conditions. Measurements can be performed at very low temperatures (down to 4 K), high temperatures (up to 400 K), and at high pressure (up to 20 GPa or higher, depending on the diamond culet size). Additionally, photo-excited state measurements can be achieved thanks to a solid-state laser (static excitation) or a femto-second laser (**15A2** only) for time-resolved ultra-fast measurements. The combination of measurements under controlled temperature, pressure, and photo excitation can also be done on demand.

The large combination of instrument capabilities and sample environments allow for a wide variety of possibilities for the investigation of structural properties of materials.

TPS 15A1 received its first X-ray in 2023; subsequently, after a period of tests and calibrations, it was possible to obtain the first crystal structure just before the end of 2023. The diffraction spots looks sharp (**Fig. 2(a)**); the reciprocal space is well ordered (**Fig. 2(b)**); and the crystal structure quality is very good (**Fig. 2(c)**).

The data collection strategy still requires further optimization to reach full completeness as well as appropriate redundancy. The installation of low-temperature devices will further improve the quality as well. Further development of **15A1** will include the installation of a fully automated goniometer head to reduce the crystal centering time. Tests will be performed to use it in combination with a deep learning algorithm to fully automate the crystal centering process. Additionally, a robotic arm will be installed to fully automate the crystal mounting/unmounting process, with the aim to have **15A1** fully automated. Data processing performance tests will also be performed and automated to the best of possibilities. **TPS 15A2** is still under construction and should start the commissioning process by mid-2024. (Reported by Arnaud Grosjean and Lai-Chin Wu)

Reference

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Advancements in the NanoARPES Beamline for Investigating Emergent Quantum Materials

The exploration of emergent quantum materials serves as a critical foundation for technological innovation. This article examines the significance of investigating electronic structures in these materials, presenting opportunities for advancements in electrical, optical, and magnetic properties, with implications for quantum computing, energy storage, catalysis, and more. Additionally, the role of angle-resolved photoemission spectroscopy (ARPES) is highlighted as a crucial tool for probing the band structure of novel materials. In the initial stages of material discovery, insights into electronic structures provide valuable clues to expedite development. ARPES, with its unique capability to directly probe momentum-resolved electronic structures, facilitates the mapping of band dispersion and Fermi surface topology. Moreover, it enables a comprehensive understanding of momentum- and energy-dependent phenomena in advanced materials. A central challenge in condensed-matter physics lies in investigating many-body systems where strong interactions lead to novel ordered ground states. Examples encompass a diverse range of materials, including high-Tc superconductors, complex oxides, graphene-based materials, 2D materials, transition-metal dichalcogenides, topological insulators, unconventional superconductors, heavy Fermion materials, Dirac semimetals, and Weyl semimetals.