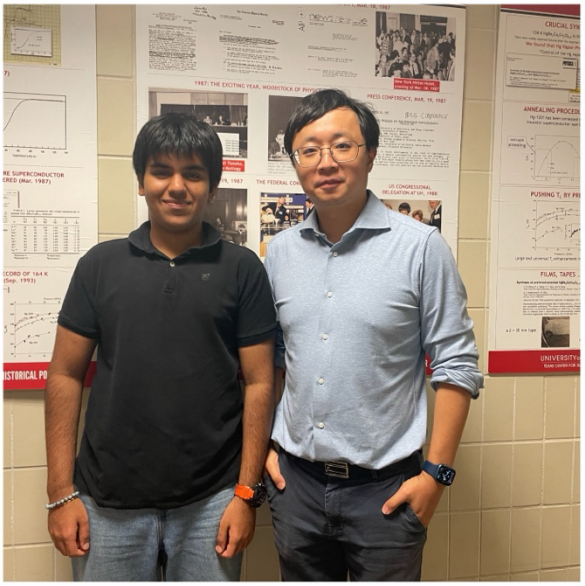
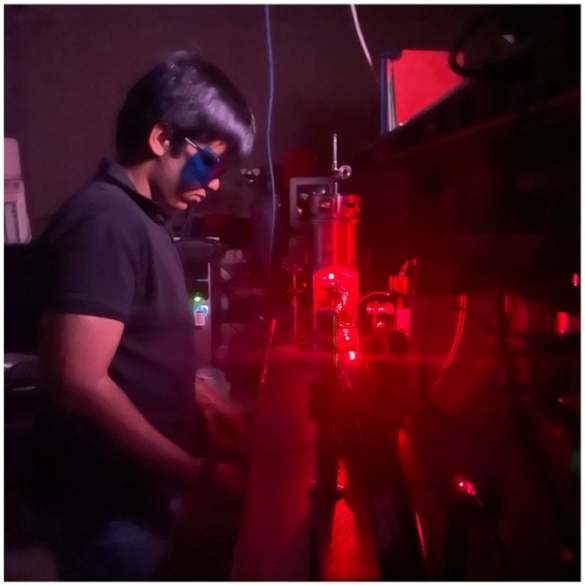
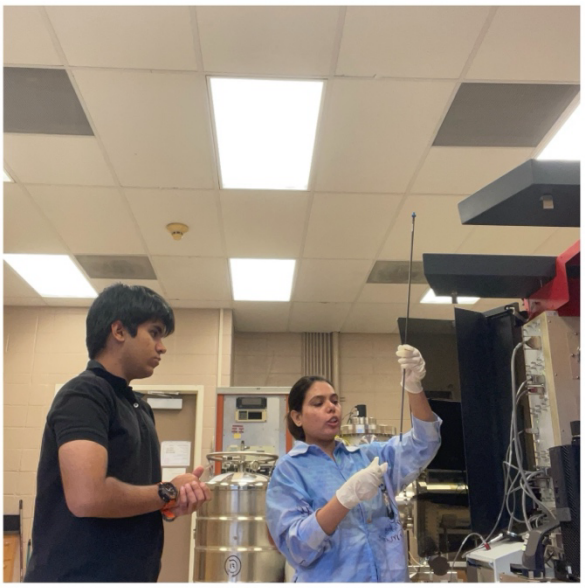
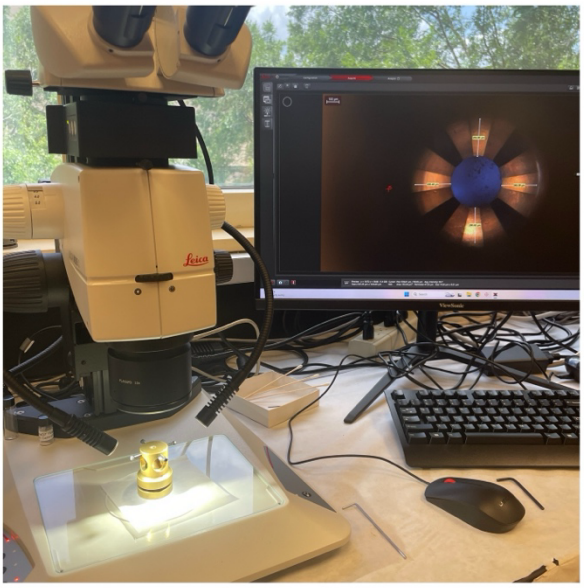
TcSUH Research Lab Experience - (May 2025-Jun2025)









In the summer, I undertook six weeks of research internship at the renowned Texas Center for Superconductivity in University of Houston. I worked in Professor Paul Chu's lab under the guidance of Dr. Liangzi Deng and PhD researcher Ms. Iqra Zahid.

At TcSUH, I had the opportunity to experience firsthand how lab research is carried out and was able to contribute to the lab's ongoing research. The following are some of my learnings and experiences:

Conducted experimental research on high-pressure superconductivity using Diamond Anvil Cells (DACs) and Clamp Cells, studying resistivity and magnetic behavior of thin-film RuO_2 samples on TiO_2 substrates.

Operated advanced instruments including PPMS and MPMS to perform low-temperature measurements (down to 2K) of resistivity and magnetic properties.

Performed multi-day sample preparation involving platinum wire connections ($I\pm$, $V\pm$) with silver paint and embedded samples in pucks for multi-channel resistance measurements under varying temperatures.

Centralized and mounted diamond anvils using Stycast epoxy and catalysts for high-pressure Diamond Anvil Cell (DAC) experiments (150–200 GPa), ensuring mechanical stability and accurate pressure transmission to prevent diamond failure.

Fabricated and aligned gaskets for DAC use; drilled and cleaned via sonication, then filled with CBN-epoxy mixtures to isolate and secure sample contact with diamond culet.

Utilized a Raman spectroscopy system to measure pressure applied to DAC setups based on wavelength shifts and calibrated using an online diamond pressure calculator.

Gained experience with Clamp Cell mechanics, using BeCu caps and thermocouple wiring to record sample temperatures under pressures up to 2–3 GPa, applied via hydraulic piston.

Built measurement-ready MPMS straws for cryogenic use, ensuring mechanical stability and gas flow via escape holes, special tape, and non-magnetic materials.

Learn how to use OriginPro software; processed and analyzed resistivity data (20nm & 30nm thin films) using OriginPro software; created measurement straws and ensured sample stability in cryogenic environments.

Designed and executed resistance measurement setups, determining whether samples were in series or parallel configurations by adjusting soldered wire channels (using 6–8 pin contacts on the 12-pin puck).

Applied Ohm's Law with constant current to calculate voltage across samples; tested alternative configurations to ensure accurate superconductivity readings

Reflection

It is difficult to put into words how enriching the experience was. Both Dr Deng and Ms. Zahid were extremely patient and supportive, ensuring I gained meaningful exposure to the lab's work. I not only deepened my understanding of superconductivity and superconducting materials but also learned how real-world research is conducted in a professional laboratory environment.

Working under Ms. Iqra Zahid, I found it fascinating to observe how PhD researchers conduct their experiments and manage projects, which opened a new window of opportunity and inspiration for my future career.

What surprised me most was the judgement required when doing research. Knowing whether a datapoint is not useful or a clue to follow is a skill to have. I learnt to slow down and mark my steps as I go forward with research. Tasks in a professional lab felt worlds apart from those in school labs. Even the tiniest of tasks took hours of meticulous tinkering and demanded patience from the researcher to ensure everything went accordingly to plan.

One such example was the task to align 2 diamonds in a Diamond Anvil Cell (DAC). When I first was assigned to help with the task to construct a DAC, I did not think much of it. How hard could simple alignment be? Little did I know that this alignment would take nearly an entire day of continuous work. Ms. Zahid taught me that the DAC had to be perfect, and even the slightest misalignment would result in the diamonds shattering due to the pressure: an expensive mistake. This specific task taught me the value of patience and perfection, skills I continue to implement in my current and future tasks.

In retrospect, I believe this experience sparked a fire under me to conduct some form of research on my own. It allowed me to grasp an image of what kind of researcher I want to be: careful, curious, and persistent. This research internship did not just teach me techniques. It taught me a powerful mindset, a mindset that I am excited to carry forward into future projects.