

**NMIP****Northeast Microelectronics Internship Program***Microelectronics runs the world. Come join us!*

## Hi, I'm Victor Cai and this is my NMIP Story

**Company:** MIT-LL

**University:** Harvard University

**Project Title:** Superconducting Electronics and Ultimate Reduced Instruction Set Computer (URISC) Architectures

**Focus Area:** Superconducting Electronics

With the growing complexity of artificial intelligence (AI), cryptography, and other computationally intensive algorithms, one of the biggest challenges facing supercomputers and data centers is powering and cooling CMOS chips. Superconducting electronics offers a fast and low-power alternative to CMOS, with technologies such as single flux quantum (SFQ) and quantum flux parametron (QFP) that can consume two magnitudes less energy per switch when operating at a similar clock frequency. MIT Lincoln Laboratory has developed the world's most advanced fabrication processes for superconductor integrated circuits, such as its SFQ5ee process, which I've had the pleasure of using to design QFP circuits. Due to its superconducting nature, QFP circuits differ significantly from CMOS in both device operation and design, namely in that it is easier to use current directions rather than voltage levels as the logical states, and subsequently the simplest complete set of gates consists of majority-inverters rather than NAND gates. Learning how to leverage the strengths of this novel compute paradigm pushed me to think outside of the box of the typical CMOS design flow.

**What I enjoyed Most:** I enjoyed working in a real work environment alongside full-time employees who went beyond their own obligations to help mentor me. I am proud to know that I contributed a critical piece to an ongoing project.