

Sharing silicon know-how with Chinese partners

With the quiet, deft manner of a jeweler showing his wares, physicist Cai Xiao opened a black box that, in a James Bond movie, might hold a stash of diamonds. This one held something every bit as precious. Inside lay a small, green circuit board topped with three shining silver strips: a silicon detector.

For Cai (pronounced "sigh"), this was the culmination of an almost year-long collaboration with a team at Fermilab's SiDet. Now that the sensor was finished, it was almost time for him to go home.

Cai is a particle physicist at Beijing's Institute of High Energy Physics (IHEP), where he completed work for his Ph.D. in 2008. He'd been sent halfway across the world all because of that shiny silver stuff in the black box. Silicon has become an essential part of almost every new accelerator experiment under consideration.

"For high-momentum particles, it gives almost the best resolution you can get," said Marcel Demarteau, coordinator of Fermilab's detector R&D.

Demarteau said IHEP had been looking to improve its silicon expertise; Fermilab has lots of silicon experts. A collaboration just made sense. Cai arrived at the laboratory in March of 2009.

His mission was to complete a silicon telescope for a test beam at the Beijing Electron Positron Collider. The telescope doesn't look anything like the kind used for star-gazing; and instead of peering at the largest objects in the universe, Cai's telescope tracks the very smallest.

Made up of silicon sensors placed on different planes, the telescope takes five measurements of the beam as it streaks through, delivering astoundingly precise data on the beam's location and direction. Cai said it's accurate within 10 microns.

Scientists working on future accelerators, including the ILC, may someday use this detector technology in their experiments.

The team labored for months to produce the first sensor. On Cai's desk, stacks of print-outs crammed with dizzying rows of 0s and 1s testified to weeks spent programming and testing software.

All the long hours have paid off. With the sensors complete, Cai was soon on a plane bound for China, where he'll be reunited with his wife and a young daughter, who was just a baby when he left. Cai will install the telescope in Beijing in March.

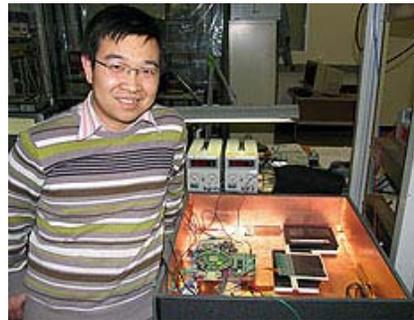
Demarteau was integral in bringing the young physicist to Fermilab and said that Cai's work, all in a foreign language and far from his young family, was an accomplishment worthy of note.

"He's done an incredible job under difficult circumstances to really pull this thing off," Demarteau said. "He's just a really lovely guy."

And since the project was such a success, Demarteau said it could serve as a model for the future.

"Hopefully this is the start of more U.S./China collaboration," he said. Both countries have much to offer one another, and "it could lead to stronger ties in the development of new detector and collider technology."

-- Andrea Mustain



Beijing-based physicist Cai Xiao stands with some of the equipment used to test silicon sensors for IHEP's test-beam telescope.