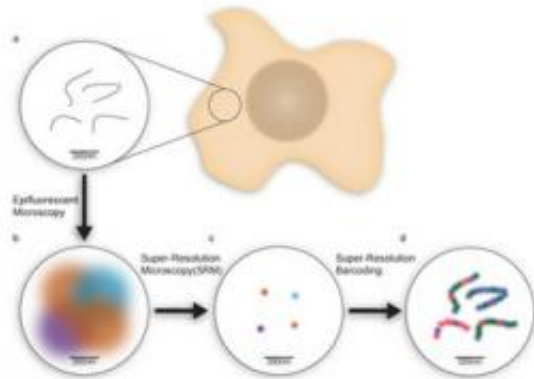


Zooming in on single cells

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Long Cai's new imaging technique (d.) can zoom in on and identify genetic information within a single cell. [Credit: Long Cai/Caltech]

(Phys.org) -- Last fall, assistant professor of chemistry Long Cai received a New Innovator Award from the National Institutes of Health (NIH). Now, just nine months later, Cai has published the first results of his supported research.

Cai and his colleagues are working to use high-powered microscopy to help them better understand the genetic programs in individual [cells](#).

"We developed a new technique to show that super-resolution microscopy (SRM)—which is a cool, single-molecule-based technology that has been used to zoom in on structures and organelles in cells—can also be used to look at genetic information within a cell, like RNA and proteins," says Cai, who joined the Caltech faculty in 2010.

His paper, "Single-cell systems biology by super-resolution imaging and combinatorial labeling," is available as an advance online publication of the journal *Nature Methods*.

With the help of coauthor Eric Lubeck, a graduate student in biochemistry and molecular biophysics, Cai labeled individual mRNA molecules within a cell with distinct molecular barcodes. When the cell is imaged using SRM, the barcodes can be resolved and used to read the gene expression levels.

"If you want to look at a genetic network, then you want to look at many of the individual genes at the same time—this is a way to allow you to do that in single cells," says Cai. "This technique may provide valuable information about rogue cells that are involved in cancer and other diseases, and look at gene expression in single cells within their native environments."

He says that the idea was sparked after a discussion with Barbara Wold, Bren Professor of Biology, about transcription regulation and new advances in single- molecule techniques. "It's really great to have ideas stimulated from an afternoon discussion over coffee," says Cai, "and this is part of what makes Caltech special." The project was started nearly three years ago, when Cai was a Beckman Fellow in the laboratory of Michael Elowitz, professor of biology and a Howard Hughes Medical Institute investigator. "Michael was very generous in letting me use his microscopes and lab to start the experiment," he says. "The NIH award helped us to finish the work when I set up my own lab."

Cai explains that their new method combines two existing technologies. In their proof-of-principle study, the duo was able to measure mRNA molecules in 32 genes simultaneously and within the same cell.

"Now we're trying to show that it is possible to look at 100 genes at the

same time," says Cai, who thinks it will be possible to measure thousands of genes concurrently. "It's just a matter of time."

Provided by California Institute of Technology

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