Physics Update

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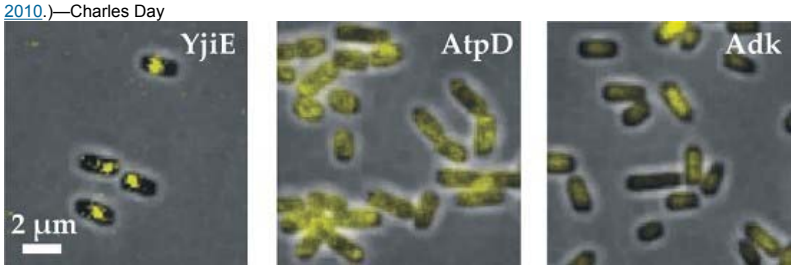
The noisy expression of genes into proteins

By Physics Today on July 29, 2010 2:00 PM | No Comments | No TrackBacks

Genetic information is transcribed from DNA to RNA and translated from RNA to make proteins. Because each step entails a modest number of molecules, gene expression, as the DNA-to-protein conversion is termed, is inevitably noisy: Identical genes in identical cells don't yield identical numbers of proteins. But how noisy? Sunney Xie of Harvard University and his collaborators have used single-molecule fluorescence microscopy and microfluidics to find out. They started by modifying the DNA of *Escherichia coli* to create 1018 different strains of the single-celled bacterium. In each strain, the code for a yellow fluorescent protein (YFP) was inserted after the gene for a different protein. To see the rate at which one gene is expressed in one cell of one strain, you'd illuminate the cell with a laser and measure the YFP emission through a microscope. To gather gene-expression statistics for a sample of cells from all 1018 strains, the Harvard team sent streams of cells through channels cut in a microfluidic chip and imaged them. The figure shows sample images for three proteins, YjiE, AtpD, and Adk. Ninety-six strains could be processed at once at a total throughput of 160 cells per second. The team found that the least abundant proteins appear at 10^{-1} molecules per cell; the most abundant, at 10^{4} per cell. Gene expression is indeed noisy, but with a twist. As you'd expect, the least abundant proteins have the largest cell-to-cell fluctuations. But for proteins whose mean abundance is 10 per cell or higher, the expression noise saturates, presumably because the various molecules that mediate gene expression inside a cell are in limited supply. (Y. Taniguchi et al., *Science* **329**, 533, 2010.)—Charles Day



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