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Nanolaser Spectroscopy of Genetically Engineered Yeast: New Tool for a Better Brew? PAUL L. GOURLEY, JUDY K. HENDRICKS, Sandia National Laboratories, ROBERT K. NAVIAUX, MICHAEL P. YAFFE, UC San Diego — A basic function of the cell membrane is to selectively uptake ions or molecules from its environment to concentrate them into the interior. This concentration difference results in an osmostic pressure difference across the membrane. Ultimately, this pressure and its fluctuation from cell to cell will be limited by the availability and fluctuations of the solute concentrations in solution, the extent of inter-cell communication, and the state of respiring intracellular mitochondria that fuel the process. To measure these fluctuations, we have employed a high-speed nanolaser technique that samples the osmotic pressure in individual yeast cells and isolated mitochondria. We analyzed 2 yeast cell strains, normal bakers yeast and a genetically-altered version, that differ only by the presence of mitochondrial DNA. The absence of mitochondrial DNA results in the complete loss of all the mtDNA-encoded proteins and RNAs, and loss of the pigmented, heme-containing cytochromes. These cells have mitochondria, but the mitochondria lack most normal respiratory chain complexes. The frequency distributions in the nanolaser spectra produced by wild-type and modified cells and mitochondria show a striking shift from Gaussian to Poissonian distributions, revealing a powerful novel method for studying statistical physics of yeast.

Paul L. Gourley
Sandia National Laboratories

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