Department of
Biomedical Engineering
UNIVERSITY OF WISCONSIN–MADISON

Fall 2017 Seminar Series

Spatiotemporal Organization of the E. coli Cytoplasm

About the Speaker

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Jim Weisshaar received the B.S. in Chemistry degree from Michigan State in 1974 and the Ph.D. degree in Physical Chemistry from UC Berkeley in 1979.

After postdoctoral study at the University ofColorado, in 1981 he became an assistant professor in the UW-Madison Department of Chemistry. He has lived in Madison ever since. His original area of study was gas phase spectroscopy and reaction dynamics. About 12 years ago he changed fields completely, turning to molecular biophysics.

Current research interests include the spatial and temporal organization of the bacterial cytoplasm and the mechanisms by which antimicrobial peptides attack and kill bacterial cells.

Superresolution fluorescence microscopy has enabled us to locate and track single ribosomes, RNA polymerase copies, ribosomal elongation factors EF-P and EF-Tu, and DNA loci in live E. coli cells.

Spatial localization accuracy can be σ ~ 30 nm and the time resolution can be 2-10 ms when needed. Ribosome-RNAP segregation is strong, arguing against co-transcriptional translation as the primary means of protein synthesis. Diffusion of both ribosomes and RNAP is heterogeneous. This enables us to distinguish translating 70S-polysomes from 30S subunits searching for translation initiation sites. We can also distinguish transcribing RNAP copies from those searching for transcription initiation sites.

The combination of these new experimental data with coarse-grained models of DNA-ribosome mixing suggests a picture in which expansion of the nucleoid by transertion (co-translational transcription and simultaneous membrane protein insertion) is important for optimal cell function. The expanded nucleoid enables facile recycling of ribosomal subunits from ribosome-rich regions (where most translation occurs) to the nucleoids (where they can initiate co-transcriptional translation). At the same time, free polysomes are excluded from the nucleoids. The resulting spatial segregation may enhance overall growth rate by restricting the space within which RNAP searches for transcription initiation sites and ribosomal subunits search for translation initiation sites.

Monday, September 18, 2017
12 - 1 PM in Tong Auditorium (1003 Engineering Centers)