Biomedical Engineering

Thesis Defense

Untwisting the mystery of supercoiling: Mbl configuration in growing bacterial filaments

By

Sulav Mukherjee

BME Program
University of Connecticut

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Abstract:

How bacterial cells create and maintain their shape is poorly understood. The recent discoveries of prokaryotic homologs of actin, tubulin, and intermediate filaments have established that bacteria possess a dynamic cytoskeleton which maintains cell shape and is required for cell division[2-5]. The physical coupling of these cytoskeletal proteins to the bacterial cell wall somehow confers form to the bacterium. This process must require a coupling between the growth of the bacterial cell wall and the cytoskeleton. Therefore, when growth is disturbed, it can lead to unique bacterial morphologies, such as the supercoiling of *Bacillus subtilis* filaments[6].

Past observations have shown that some mutants of *B. subtilis* form long filaments, or chains of cells, when the cells fail to separate upon replication. These mutants undergo supercoiling where the bacterial filament buckles and wraps about itself like an over-twisted phone cord. A recently discovered actin-like protein, Mbl, forms helical structures under the cell wall and controls cell morphogenesis in *B. subtilis*. Here we show how growth affects the configuration of the bacterial cytoskeletal protein, Mbl, in a filamentous form of *B. subtilis*, and how a discrepancy between the growth rates of the cytoskeleton and the cell wall can lead to supercoiling in these filaments.