Graduate School Event

Thesis Defense: Genetic Strategies Enabling Bacterial Adaptation to Selective Pressures

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Guet Group

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Bacteria inhabit an extraordinary range of environments, each shaped by its own selective pressures that can fluctuate within seconds to seasons. A persistent selective pressure across these environments is imposed by viruses that infect bacteria, called phages. This ongoing coevolution between bacteria and phages has led to multiple defense strategies on both sides. Bacteria have defense strategies at multiple levels: at the cell surface, physical barriers such as capsules, exopolysaccharides, and receptor modifications limit phage adsorption, while intracellularly, molecular defense systems degrade or restrict invading genomes. However, how these spatially distinct layers are coordinated during infection remains largely unexplored.To address this, we investigated the genome-clustered anti-phage defense island of Escherichia coli K-12, which encodes four anti-phage systems. We found that a single system dominated intracellular defense across diverse phages. Strikingly, under sustained phage pressure, a second extracellular layer of defense emerges: phage-induced mucoidy. This is a regulator of capsule synthesis (Rcs)-dependent and quorum-sensing-independent response that generates protective extracellular matrix. This mucoid matrix confers broad resistance, protecting against 29 of the 31 phages tested. Critically, the two layers are not independent; the strength of the defense system-mediated restriction directly sets the phage dose threshold at which mucoidy is induced. Therefore, intracellular and extracellular defenses do not operate in isolation but as a single, quantitatively coupled immune response.By revealing a direct mechanistic link between intracellular anti-phage systems and phenotypic switching to mucoidy, this work reframes bacterial immunity as an integrated, multi-layered process, with broad implications for phage–host coevolution and for the design of phage therapies against mucoid variants, which are associated with increased patient mortality.

Thursday, September 3, 2026 01:00pm - 02:00pm

Central Bldg / O1 / Ballroom (I01.O1.006) and Zoom

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