Contribution ID: **89** Type: **Short-talk only**

A compact Druantia defense clears phage infections via single-stranded DNA recognition and directional duplex unwinding

Wednesday, 7 October 2026 11:45 (20 minutes)

Bacteria encode diverse anti-phage defense systems triggered by invader-specific molecular cues. Here, we report that the compact type III-A Druantia system recognizes exposed single-stranded DNA to drive phage clearance. Using representative systems from Escherichia coli, we show that the two encoded proteins, DruE and DruH, together clear restriction-sensitive or recombination-prone phages without affecting cell growth or viability. DruE dimerizes and engages DNA at exposed single-stranded regions to unwind DNA with 3′-to-5′ directionality, resorting to unique molecular lock, wedge, and clamp elements that aid strand separation and processive translocation. DruH is a monomer in isolation and indirectly interacts with DruE and other host proteins under uninfected conditions, with an infection resulting in the dissociation of the complex. Taken together, our results reveal that exposed single-stranded DNA can trigger bacterial immunity through the directional helicase activity of type III-A Druantia.

Reference #1

Reference #2

Reference #3

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Session Classification: Novel anti-viral defence systems

Track Classification: Novel anti-viral defence systems