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Function of a viral genome packaging motor from bacteriophage T4 is insensitive to DNA sequence

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Abstract

Many viruses employ ATP-powered motors during assembly to translocate DNA into procapsid shells. Previous reports raise the question if motor function is modulated by substrate DNA sequence: (i) the phage T4 motor exhibits large translocation rate fluctuations and pauses and slips; (ii) evidence suggests that the phage phi29 motor contacts DNA bases during translocation; and (iii) one theoretical model, the 'B-A scrunchworm', predicts that 'A-philic' sequences that transition more easily to A-form would alter motor function. Here, we use single-molecule optical tweezers measurements to compare translocation of phage, plasmid, and synthetic A-philic, GC rich sequences by the T4 motor. We observed no significant differences in motor velocities, even with A-philic sequences predicted to show higher translocation rate at

high applied force. We also observed no significant changes in motor pausing and only modest changes in slipping. To more generally test for sequence dependence, we conducted correlation analyses across pairs of packaging events. No significant correlations in packaging rate, pausing or slipping versus sequence position were detected across repeated measurements with several different DNA sequences. These studies suggest that viral genome packaging is insensitive to DNA sequence and fluctuations in packaging motor velocity, pausing and slipping are primarily stochastic temporal events.

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Figures

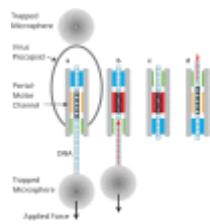


Figure 1.

Schematic illustration of the single...

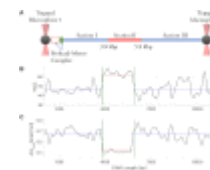


Figure 2.

Schematic illustration of the DNA...

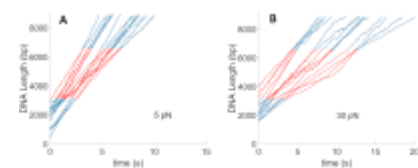


Figure 3.

Measurements of length of DNA...

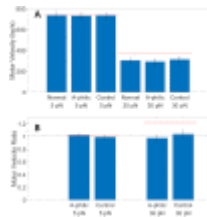


Figure 4.

(A) Average motor...

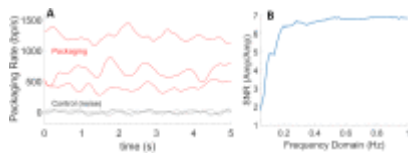


Figure 5.

(A) Examples of...

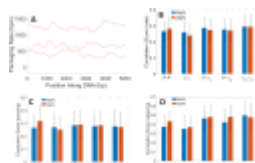


Figure 6.

Correlation analyses. (A)...

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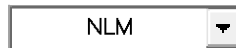
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