

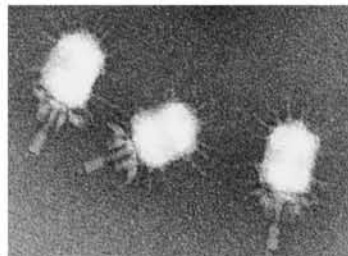
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## BIOPHYSICS

**Ionic screening determines DNA packing forces in phages**

The bacteriophage  $\phi 29$  enlists an ATP-powered motor protein to fill its capsid with DNA. The potential energy of the packed DNA may help the virus inject its genome into host cells during



Electron micrograph of bacteriophage  $\phi 29$  viruses.

infection. Energy is stored in both the bending of DNA and electrostatic repulsion of its negatively charged backbone. Theory predicts that screening by positive ions may reduce the packing forces. Using optical tweezers to assess the force exerted by the motor protein, Derek Fuller *et al.* explored the influence of ions on viral DNA packing. The authors measured how the rate of packing depends on the fraction of capsid filled; they also observed how the motor velocity depends on an applied force. From these relationships, they determined the internal force resisting DNA confinement as a function of filling. Ionic content of the experimental buffer had a strong effect, confirming the influence of screening. In buffers containing  $Mg^{2+}$  or  $Co^{3+}$ , capsid pressure and, therefore, stored energy was less than when  $Na^+$  was the dominant ion. The authors note that the inferred internal forces are up to six times greater than predicted, assuming a certain DNA–DNA interaction potential and capsid volume and regular spooling of the DNA inside the capsid. — K.M.

*“Ionic effects on viral DNA packaging and portal motor function in bacteriophage  $\phi 29$ ” by Derek N. Fuller, John Peter Rickgauer, Paul J. Jardine, Shelley Grimes, Dwight L. Anderson, and Douglas E. Smith (see pages 11245–11250)*