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Encapsidation of Linear Polyelectrolyte in a Viral Nanocontainer

YUFANG HU, ROYA ZANDI, CHARLES KNOBLER, WILLIAM GELBART, UCLA — We present the results from a combined experimental and theoretical study on the self-assembly of a model icosahedral virus, Cowpea Chlorotic Mottle Virus (CCMV). The formation of native CCMV capsids is believed to be driven primarily by the electrostatic interactions between the viral RNA and the positively charged capsid interior, as well as by the hydrophobic interactions between capsid protein subunits. To probe these molecular interactions, *in vitro* self-assembly reactions are carried out using the CCMV capsid protein and a synthetic linear polyelectrolyte, sodium polystyrene sulfonate (NaPSS), which functions as the analog of viral RNA. Under appropriate solutions conditions, NaPSS is encapsidated by the viral capsid. The molecular weight of NaPSS is systematically varied and the resulting average capsid size, size distribution, and particle morphology are measured by transmission electron microscopy. The correlation between capsid size and packaged cargo size, as well as the upper limit of capsid packaging capacity, are characterized. To elucidate the physical role played by the encapsidated polyelectrolyte in determining the preferred size of spherical viruses, we have used a mean-field approach to calculate the free energy of the virus-like particle as a function of chain length (and of the strength of chain/capsid attractive interaction). We find good agreement with our analytical calculations and experimental results.

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