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Exploring the remarkable limits of continuum elastic theory to understand the nanomechanics of viruses WOUTER ROOS, Natuur- en Sterrenkunde, Vrije Universiteit, Amsterdam, MELISSA GIBBONS, WILLIAM KLUG, Department of Mechanical and Aerospace Engineering, UCLA, GIJS WUITE, Natuur- en Sterrenkunde, Vrije Universiteit, Amsterdam — We report nanoindentation experiments by atomic force microscopy on capsids of the Hepatitis B Virus (HBV). HBV is investigated because its capsids can form in either a smaller T=3 or a bigger T=4 configuration, making it an ideal system to test the predictive power of continuum elastic theory to describe nanometre-sized objects. It is shown that for small, consecutive indentations the particles behave reversibly linear and no material fatigue occurs. For larger indentations the particles start to deform non-linearly. The experimental force response fits very well with finite element simulations on coarse grained models of HBV capsids. Furthermore, this also fits with thin shell simulations guided by the Föppl- von Kármán (FvK) number (the dimensionless ratio of stretching and bending stiffness of a thin shell). Both the T=3 and T=4 morphology are very well described by the simulations and the capsid material turns out to have the same Young's modulus, as expected. The presented results demonstrate the surprising strength of continuum elastic theory to describe indentation of viral capsids.

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