Abstract Submitted
for the MAR09 Meeting of
The American Physical Society

Elasticity in Ionically Cross-Linked Neurofilament Networks[1]
NORMAN YAO, YI-CHIA LIN, Harvard University Department of Physics, CHASE BROEDERSZ, Vrije University , KAREN KASZA, Harvard University SEAS, FREDERICK MACKINTOSH, Vrije University , DAVID WEITZ, Harvard University Department of Physics and SEAS — Neurofilaments are found in abundance in the cytoskeleton of neurons, where they act as an intracellular framework protecting the neuron from external stresses. To elucidate the nature of the mechanical properties that provide this protection, we measure the linear and nonlinear viscoelastic properties of networks of neurofilaments. These networks are soft solids that exhibit dramatic strain stiffening above critical strains of 30-70%. Surprisingly, divalent ions, such as Mg^{2+}, Ca^{2+}, and Zn^{2+}, act as effective cross-linkers for neurofilament networks, controlling their solid-like elastic response. This behavior is comparable to that of actin-binding proteins in reconstituted filamentous actin. We show that the elasticity of neurofilament networks is entropic in origin and is consistent with a model for cross-linked semiflexible networks, which we use to quantify the cross-linking by divalent ions. Ultimately, we are able to extract microstructural network parameters such as the persistence length and the average distance between cross-links directly from bulk rheology.

[1]This work was supported in part by the NSF (DMR-0602684 and CTS-0505929), the Harvard MRSEC (DMR-0213805), and the Stichting voor Fundamenteel Onderzoek der Materie (FOM/NWO).

Norman Yao
Harvard University

Date submitted: 12 Nov 2008 Electronic form version 1.4