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Out of equilibrium GigaPa Young modulus of water nanobridge probed by Force Feedback Microscopy SIMON CARPENTIER, CNRS, Inst NEEL, F-38042 Grenoble, France, MARIO S.RODRIGUES, MIGUEL VITORINO, University of Lisboa, Falculty of Sciences, BioISI-Biosystems Integrative Sciences Institute, Campo Grande, Lisboa, P-1749-016, Portugal, LUCA COSTA, ESRF, The European Synchrotron, 71 Rue des Martyrs, 38000 Grenoble, France, ELISABETH CHARLAIX, CNRS, LIPhy, Grenoble, F-38402, France, JOEL CHEVRIER, CNRS, Inst NEEL, F-38042 Grenoble, France — Because of capillary condensation, water droplets appear in nano/micropores. We report that dynamical properties of such nanobridge dramatically change when probed at different time scales [1]. Using a Force Feedback Microscope [2], the gap between the nano-tip and the surface is continuously varied, and we observe this change in the simultaneous measurements, at different frequencies, of the stiffness G'(N/m), the dissipative coefficient G"(kg/sec) together with the static force. This is made possible thanks to feedback force which cancels in real time the force acting on the tip. It avoids the mechanical instabilities due to the nucleation of the nanobridge. As the measuring time approaches the microsecond, the liquid droplet exhibits a large positive stiffness (it is small and negative in the long time limit). Although clearly controlled by surface effects, it compares to the stiffness of a solid nanobridge with a 1 GigaPa Young modulus. [1] Carpentier et al. arXiv preprint arXiv:1503.06756, 2015. [2] Rodrigues et al. Applied Physics Letters, 101(20):203105, 2012.

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