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Sub-Hz Linewidth harmonics in a microwave frequency comb generated by focusing a mode-locked ultrafast laser on the tunneling junction of a scanning tunneling microscope[1] MARK HAGMANN, Dept. Electrical and Computer Engineering, University of Utah, FRANK STENGER, School of Computing, University of Utah, DMITRY YAROTSKI, Center for Integrated Nanotechnologies, Materials Physics and Applications Division, Los Alamos National Laboratory — A microwave frequency comb (MFC) with hundreds of measurable harmonics superimposed on the DC tunneling current is generated by optical rectification when focusing a mode-locked ultrafast laser on the tip-sample junction of a scanning tunneling microscope (STM). Using a Kerr-lens passively mode-locked Ti:Sapphire laser (CompactPro, Femtolasers) having a pulse repetition frequency of 74.25 MHz with a STM (UHV700, RHK Technology) operated in air, 200 harmonics from 74.25 MHz to 14.85 GHz have reproducible measured linewidths equal to the 1 Hz resolution bandwidth (RBW) of the spectrum analyzer. At the 200^{th} harmonic the signal-to-noise ratio is 20 dB. When the RBW exceeds 1 Hz the measured linewidth increases to remain equal to the RBW. However, for a RBW of 0.1 Hz the measured linewidth is distributed from 0.1 Hz to 1.2 Hz which we attribute to the stochastic behavior of the pulse repetition frequency in the unstabilized laser. Measurements of drift in the pulse repetition frequency and a derivation showing the effects of timing jitter support this hypothesis.

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Mark Hagmann
Dept. Electrical and Computer Engineering, University of Utah

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