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Femtosecond Laser Cooling of Trapped Ions D. KIELPINSKI, MIT-Harvard Center for Ultracold Atoms and Research Laboratory of Electronics, Massachusetts Institute of Technology, B. GASSEND, F.X. KAERTNER, MIT — We present work toward laser cooling of trapped ions with femtosecond pulse trains. Our scheme is applicable to hydrogen and other elements that are not currently laser cooled. In this proof-of-principle experiment, we confine approximately $10^5\,\mathrm{Yb}^+$ ions in a linear Paul trap and probe them on the strong $\mathrm{S}_{1/2}-\mathrm{P}_{1/2}$ transition at 370 nm. A high-repetition-rate mode-locked laser drives the two-photon $\mathrm{S}_{1/2}-\mathrm{D}_{3/2}$ transition at 871 nm for laser cooling. An optical resonator enhances the mode-locked laser intensity applied to the ions, greatly increasing the two-photon transition rate.

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