Abstract Submitted
for the DAMOP20 Meeting of
The American Physical Society

All-optical sub-amu ion mass spectrometry[1] MINGYU FAN, CRAIG A. HOLLIMAN, XIAOYANG SHI, MICHAEL W. STRAUS, University of California, Santa Barbara, XINGHUA LI, Key Laboratory for Physical Electronics and Devices of the Ministry of Education Shaanxi Key Lab of Information Photonic Technique, Xian Jiaotong Uni, SEAN W. BUECHELE, ANDREW M. JAYICH, University of California, Santa Barbara — Ions that are difficult to laser cool, and hence cannot be detected with fluorescence, are promising for fundamental physics research and quantum information science. We present a method to rapidly and nondestructively identify trapped dark ions by measuring the motional frequencies of dark ions co-trapped with laser-coolable bright ions. We use the $S_{1/2}$, $P_{1/2}$ and $D_{3/2}$ level structure of Sr^+, and separately Ra^+, to controllably amplify the ions motion by modifying the optical spectrum with coherent population trapping. The amplified ion motion modulates the scattered light, which we collect and Fourier transform to extract the motional frequencies, and from this the dark ion mass. The technique can be used with ions that have a lambda level structure, such as Ca^+ and Ba^+, and only utilizes the two lasers already required for laser cooling.

[1]The authors acknowledge support from NSF (1912665).

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Date submitted: 02 Feb 2020 Electronic form version 1.4