Abstract Submitted
for the DAMOP20 Meeting of
The American Physical Society

**Laser-cooled polyatomic molecules for improved electron electric dipole moment searches**[1] ZACK LASNER, BENJAMIN AUGENBRAUN, ALEXANDER FRENETT, HIROMITSU SAWAOKA, CALDER MILLER, ZHIJING NIU, JOHN DOYLE, Harvard University, POLYEDM COLLABORATION — Polyatomic molecules are promising for searches for beyond-the-Standard-Model physics due to their doubly-degenerate vibrational modes with nuclear orbital angular momentum. For example, YbOH has been identified as a species for the next generation of electron electric dipole moment (eEDM) searches [Phys. Rev. Lett. 119, 133002]. We report direct laser cooling of YbOH to $< 600$ $\mu$K via magnetically-assisted Sisyphus cooling. This bound is limited by experimental resolution and corresponds to an increase in phase-space density by $> 6\times$. We construct a model with a single free parameter that shows excellent agreement with observations, and predicts that cooling to $10\mu$K already occurs. Further cooling and capture in a magneto-optical trap (MOT) of YbOH molecules will require increasing the number of photons scattered before an electronically excited molecule decays into a vibrationally dark state. Spectroscopic searches for vibrational dark states are currently underway. We also report on progress toward slowing molecules to near the capture velocity of the MOT using only a few scattered photons via Zeeman-Sisyphus slowing with superconducting magnetic stages, thus significantly reducing the number of vibrational repumpers needed.

[1]Heising-Simons Foundation

Zack Lasner
Harvard University

Date submitted: 31 Jan 2020 Electronic form version 1.4