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Progress in laser cooling and trapping of 174YbF for eEDM Measurements

Ultracold molecules offer a platform for tabletop tests of fundamental physics, including precision measurements of the electron's electric dipole moment (eEDM), where heavy polar molecules provide greatly enhanced sensitivity compared to atoms. Such experiments are interferometric in nature, making long interrogation times essential for improved sensitivity. This can be achieved either by extending the interaction region for a moving molecular beam or, as pursued in the present work, by slowing and trapping the molecules. We report recent progress in radiation-pressure slowing of YbF, resulting in forward beam velocities compatible with capture in a magneto-optical trap. This performance is enabled by improved closure of loss channels in the optical cycling scheme using microwave repumping, together with polarization modulation to destabilize dark states and frequency chirping. These results represent an important step toward long-lived trapping of YbF and lay the groundwork for future eEDM measurements in an optical lattice.

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