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Theoretical model for Sub-Doppler Cooling with EIT System PEIRU HE, PHOEBE TENGDIN, DANA ANDERSON, Univ of Colorado Boulder, JILA, ANA MARIA REY, NIST, JILA, MURRAY HOLLAND, Univ of Colorado Boulder, JILA — We propose a of sub-Doppler cooling mechanism that takes advantage of the unique spectral features and extreme dispersion generated by the so-called Electromagnetically Induced Transparency (EIT) effect, a destructive quantum interference phenomenon experienced by atoms with Lambda-shaped energy levels when illuminated by two light fields with appropriate frequencies. By detuning the probe lasers slightly from the "dark resonance", we observe that atoms can be significantly cooled down by the strong viscous force within the transparency window, while being just slightly heated by the diffusion caused by the small absorption near resonance. In contrast to polarization gradient cooling[1] or EIT sideband cooling [2], no external magnetic field or external confining potential are required. Using a semi-classical method, analytical expressions, and numerical simulations, we demonstrate that the proposed EIT cooling method can lead to temperatures well below the Doppler limit. This work is supported by NSF and NIST. [1] JOSA B6.11 (1989): 2023-2045 [2] Physical review letters 85.21 (2000): 4458.

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