

Modulation transfer technique for tunable Rydberg RF receiver

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Rydberg atoms are promising for highly sensitive RF receivers, first demonstrated with a three-level ladder EIT protocol in thermal ⁸⁷Rb vapor[1]. In this work we have demonstrated a modulation-transfer technique to enhance the tunability of Rydberg RF receivers using ⁸⁵Rb vapor. We phase modulate the coupling field, and this modulation is transferred to the probe field due to nonlinear atomic interaction. The transmitted probe field exhibits increased sensitivity to detuned RF fields. Our approach enhances RF receiver sensitivity to detuned RF fields, thereby improving detector tunability compared to conventional methods[2].

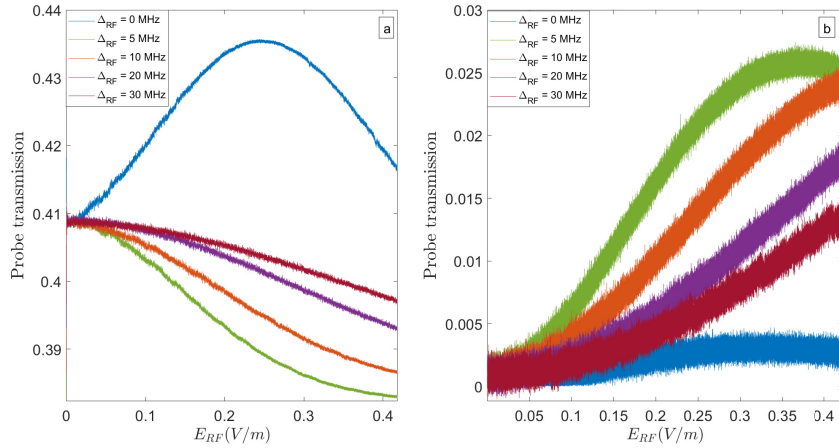


Figure 1. Probe transmission as a function of electric field amplitude (E_{RF}) for different RF detunings (Δ_{RF}). (a) Conventional protocol at $\Delta_p/2\pi = 2$. (b) Modulation transfer protocol at $\Delta_p/2\pi = 0$ and $\omega_{mod}/2\pi = 3$.

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[1] J. A. Sedlacek, A. Schwettmann, H. Köubler, R. Löw, T. Pfau, and J. P. Shaffer, “Microwave electrometry with rydberg atoms in a vapour cell using bright atomic resonances,” *Nature Physics*, **8**, 11, 819-824, (2012).

[2] Duc-Anh Trinh, Adwaith K.V, Mickael Branco, Alienor Rouxel, Sacha Welinski, Perrine Berger, Fabienne Goldfarb and Fabien Bretenaker, Modulation transfer protocol for Rydberg RF receivers, arXiv:2405.03618v1 [quant-ph] 6 May (2024).