

Outline for Lasing Without Inversion SUPASTA Essay

Berke Vow Ricketti

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References

- [1] S. E. Harris, “Lasers without inversion: Interference of lifetime-broadened resonances,” *Physical Review Letters*, vol. 62, no. 9, p. 1033, 1989.
- [2] M. O. Scully and M. Fleischhauer, “Lasers Without Inversion,” *Science*, vol. 263, pp. 337 LP – 338, jan 1994.
- [3] A. Kocharovskaya and Y. I. Khanin, “Population trapping and coherent bleaching of a three-level medium by a periodic train of ultrashort pulses,” *Zh. Eksp. Teor. Fiz.*, vol. 90, pp. 1610–1618, 1986.
- [4] P. Mandel, “Lasing without inversion: a useful concept?,” *Contemporary Physics*, vol. 34, no. 5, pp. 235–246, 1993.
- [5] S. Y. Kilin, K. T. Kapale, and M. O. Scully, “Lasing without inversion: Counterintuitive population dynamics in the transient regime,” *Physical Review Letters*, vol. 100, no. 17, pp. 5–8, 2008.
- [6] A. A. Ukhanov, “Lasing without inversion,” vol. 87131, no. November, 1999.
- [7] S. Y. Zhu, M. O. Scully, H. Fearn, and L. M. Narducci, “Lasing without inversion,” *Zeitschrift für Physik D Atoms, Molecules and Clusters*, vol. 22, pp. 483–493, jun 1992.
- [8] M. Marthaler, Y. Utsumi, D. S. Golubev, A. Shnirman, and G. Schön, “Lasing without inversion in circuit quantum electrodynamics,” *Physical Review Letters*, vol. 107, no. 9, pp. 1–5, 2011.
- [9] J. Mompart and R. Corbalán, “Lasing without inversion,” *Journal of Optics B: Quantum and Semiclassical Optics*, vol. 2, no. 3, 2000.
- [10] A. Nottelmann, C. Peters, and W. Lange, “Inversionless amplification of picosecond pulses due to Zeeman coherence,” *Physical review letters*, vol. 70, no. 12, p. 1783, 1993.

- [11] E. S. Fry, X. Li, D. Nikonov, G. G. Padmabandu, M. O. Scully, A. V. Smith, F. K. Tittel, C. Wang, S. R. Wilkinson, and S.-Y. Zhu, “Atomic coherence effects within the sodium D1 line: Lasing without inversion via population trapping,” *Phys. Rev. Lett.*, vol. 70, pp. 3235–3238, may 1993.
- [12] W. E. van der Veer, R. J. J. van Diest, A. Dönszelmann, and H. B. van Linden van den Heuvell, “Experimental demonstration of light amplification without population inversion,” *Phys. Rev. Lett.*, vol. 70, pp. 3243–3246, may 1993.

1 Abstract (~100 words)

2 Introduction (~300 words)

[1, 2, 3, 4, 5, 6, 7, 8, 9]

3 Theoretical Methodology (~750)

3.1 Normal Laser with Inversion 2-level system) (~250 words)

3.2 Amplification without Inversion (AwI) 3-level system (~250 words)

3.3 Amplification without Inversion (AwI) Multi-level system (~250 words)

4 Experimental Confirmation (~750 words)

4.1 First confirmation of AwI, Zeeman coherence (~250 words)

Nottelmann et al. 1993 [10]

4.2 2nd confirmation of AwI, D₁ line atomic sodium (~250 words)

Fry et al. 1993 [11]

4.3 3rd confirmation of AwI, Cadmium Vapour (~250 words)

van der Veer et al. 1993 [12]

5 Applications (~ 750 words)

5.1 Short wavelength lasers

5.1.1 X-ray lasers (~ 250 words)

5.1.2 γ - ray lasers (~ 250 words)

5.2 Electromagnetically Induced Transparency (~ 250 words)

6 State-of-the-art and Future Development (~ 300 words)

7 Conclusion (~ 100 words)

Word count: ~ 3050