

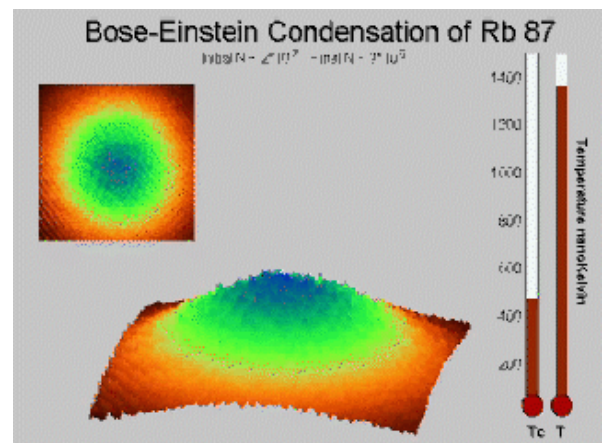
Construction of a Tapered Amplifier For Use in Ultracold Atom Experiments

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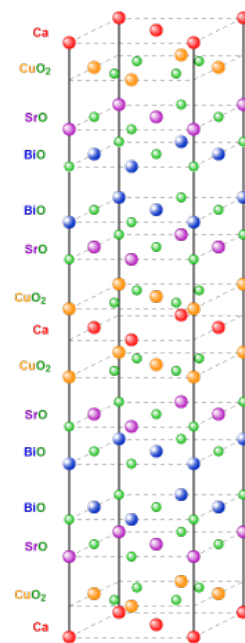
Why Cold Atoms? Cold Is the New Hot

- At temperatures fractions of a degree away from absolute zero, atoms move into a single ground state



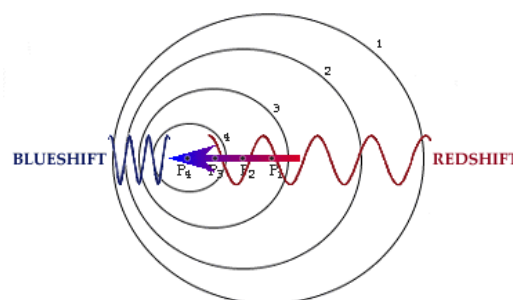
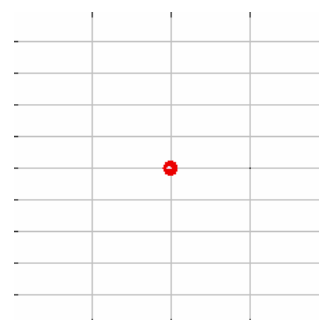
Why Cold Atoms? (contd.)

- We can model electron movement in crystals (Lattices) using cold atoms
- Since the atoms are cold, they move slowly and we can more easily observe them
- Applications in high-temperature superconductors
 - Most high T_c superconductors are complex crystals!



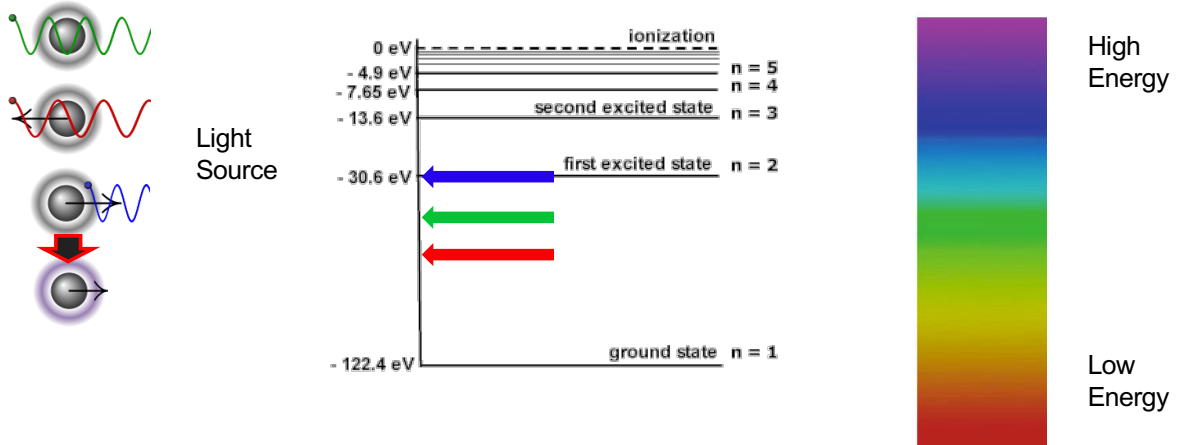
We Use Laser Light to Cool Atoms

- To cool the atoms, we exploit an effect called 'The Doppler Shift'
- Light waves behave in the same way
 - A change in frequency = a change in color



We Use Laser Light to Cool Atoms (cont.)

- Atoms have set energy levels – the energy of a photon must match



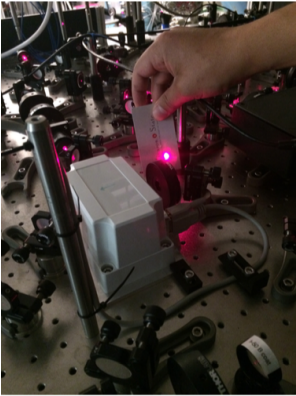
So Why Do We Need the Amplifier?

- With more light, we will be able to cool the atoms faster
- Small savings in time will amplify after a large amount of data is taken
- Commercial TA's are ~\$40,000, this one is \$5,000

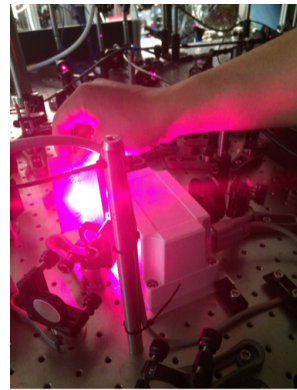
Our Goal: Increase Beam Power Tenfold

- The input beam will have 30mW of power
- The goal for the output power is 500 mW

Without TA

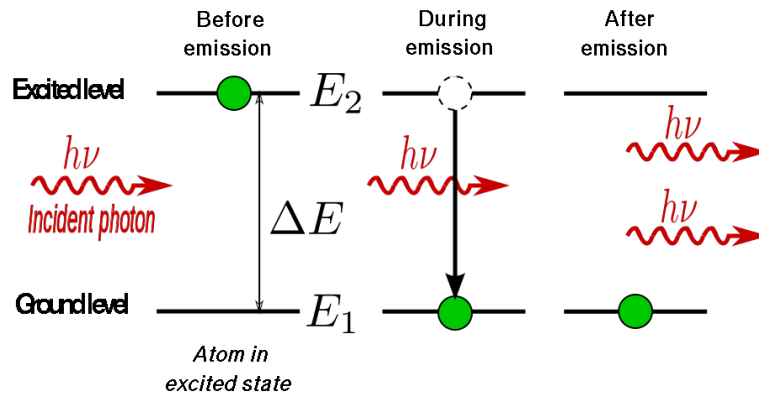


With TA

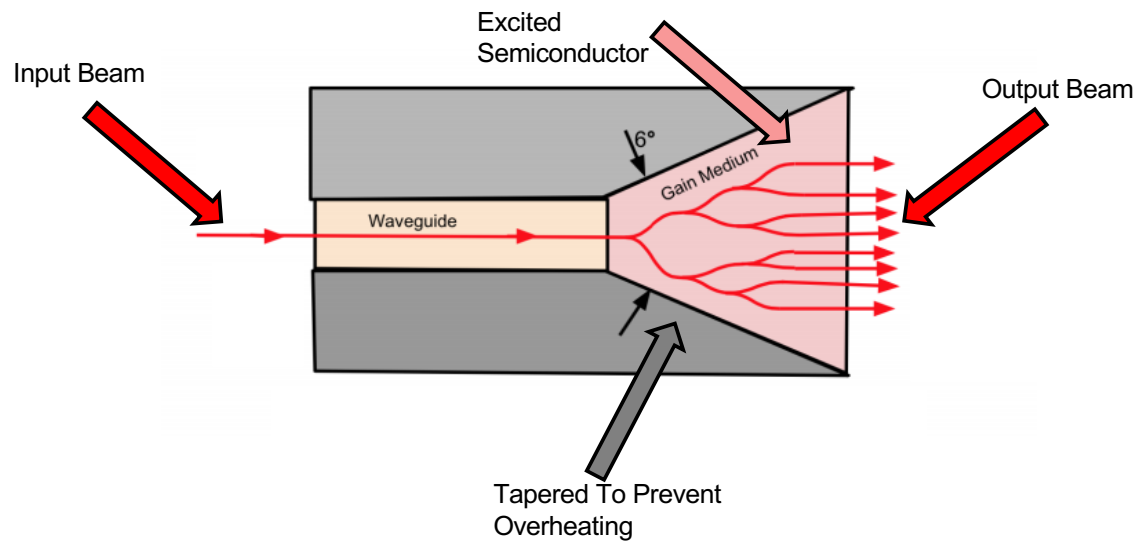


We Increase Power By Adding More Photons

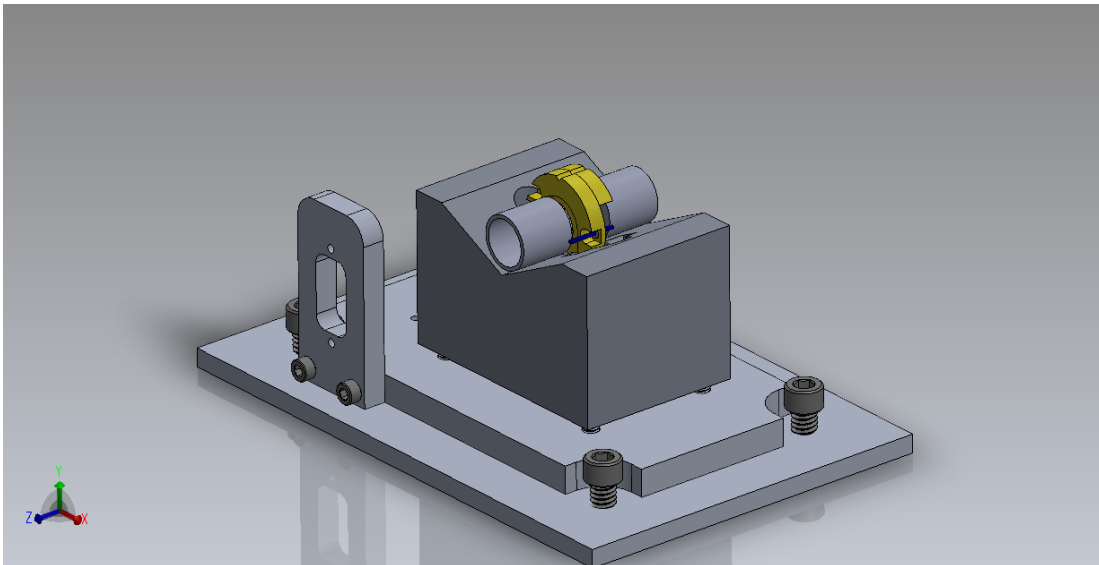
- We add more photons using stimulated emission

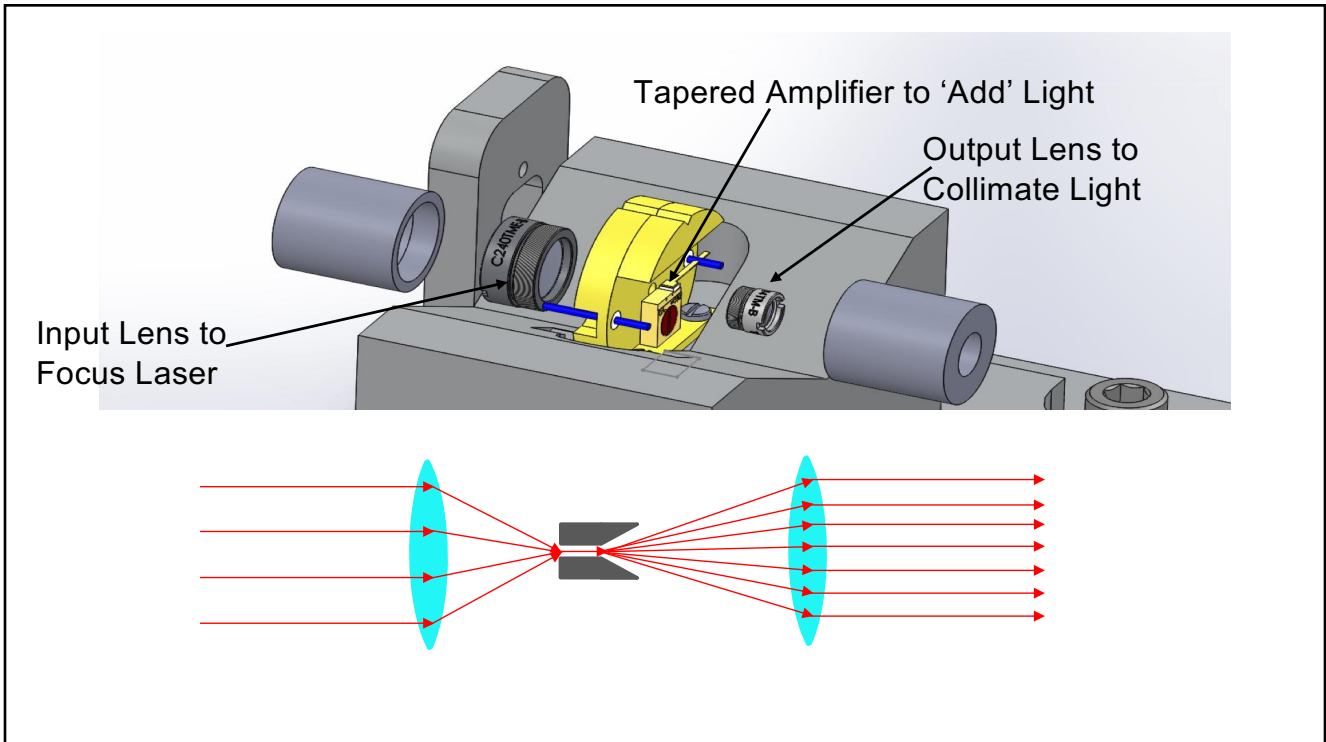


How Do We add More Photons?



How Do We Implement The Tapered Amplifier?

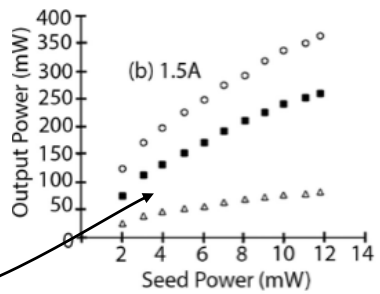




Predicted Results

- Results achieved on the same device in a similar setting
- Seed Power = Input Power

Because amplification decreases, Amplifier 'Saturates'



Conclusion

- We will obtain 10X more power, at a fraction of the cost
- With more power, the experiment will take less time
- Over 1000's of iterations per day, we will save time and take more data

Science

