

Single Ba⁺ Ion Trapping and Laser Modulation

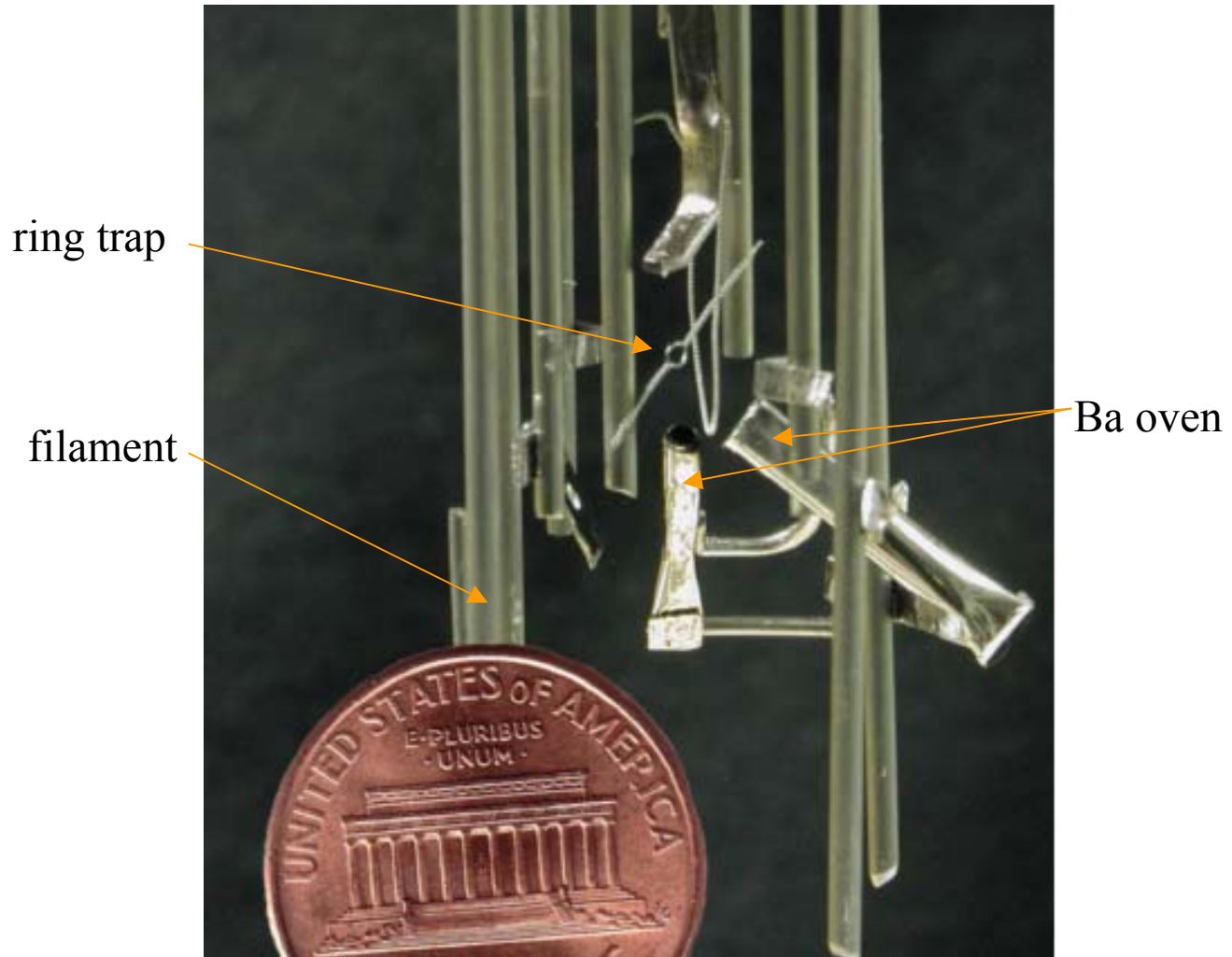
Amelia Bloom

Outline

- Ion Trap
- Measurements
- The Switch From $^{138}\text{Ba}^+$ to $^{137}\text{Ba}^+$
 - Laser Modulation
- Conclusions

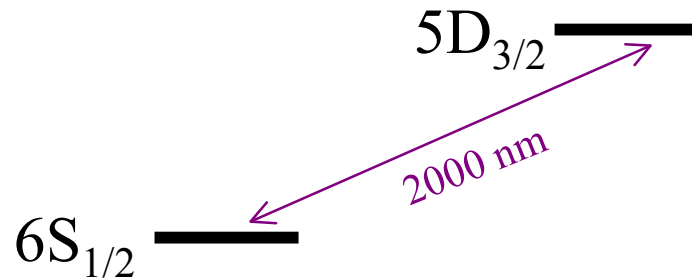
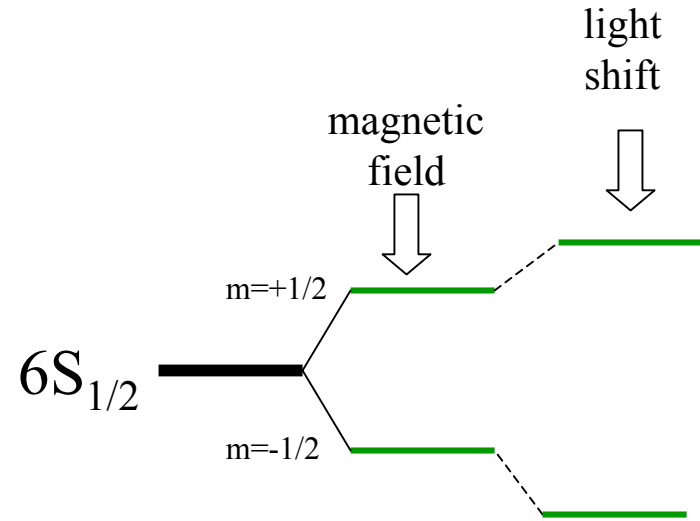


Ion Trap

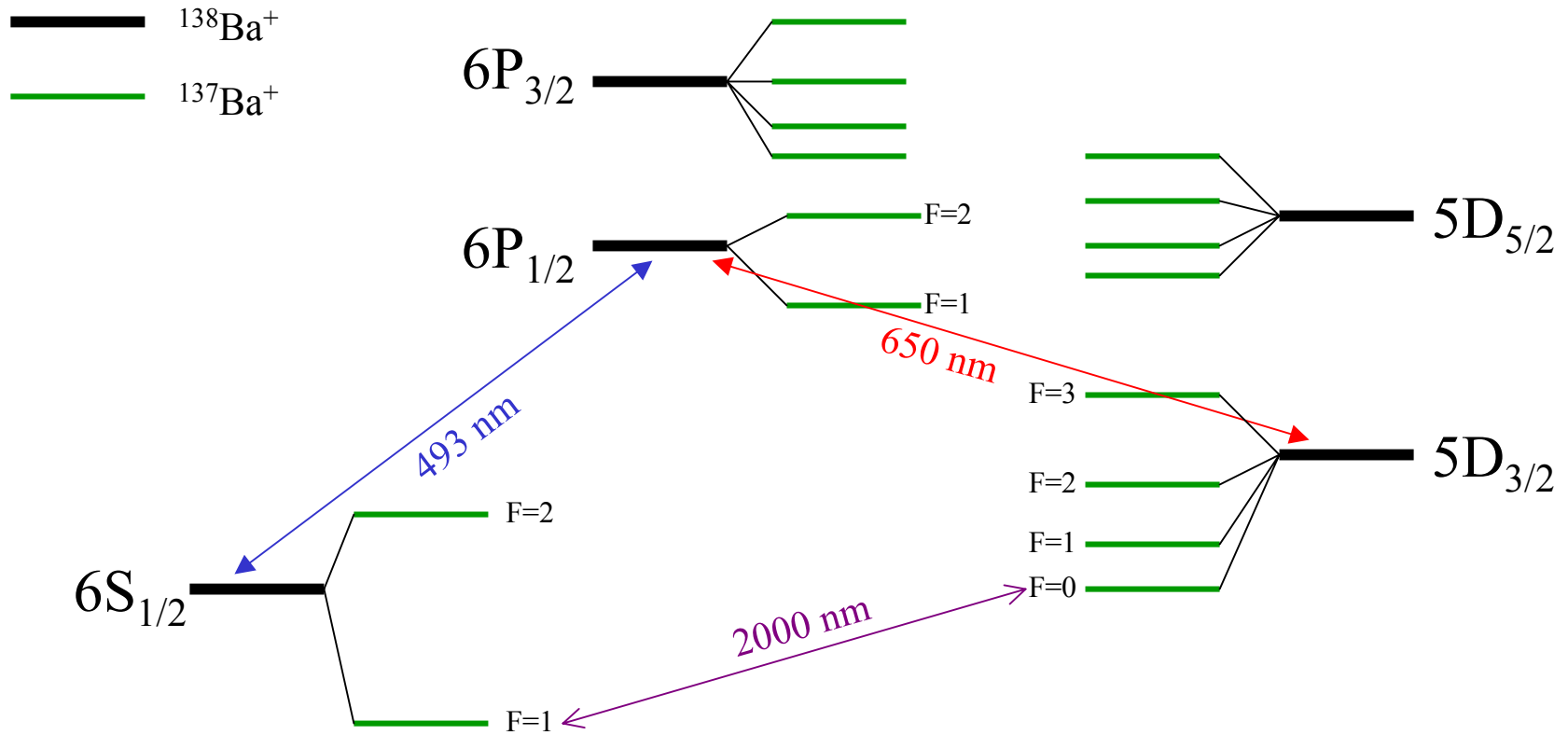


Measurements

- Zeeman Effect
 - due to magnetic fields
- Light Shift
 - due to off resonant circularly polarized light source
- Parity Nonconservation
 - what is parity?
 - it's been well measured in high energy systems
 - requires $^{137}\text{Ba}^+$



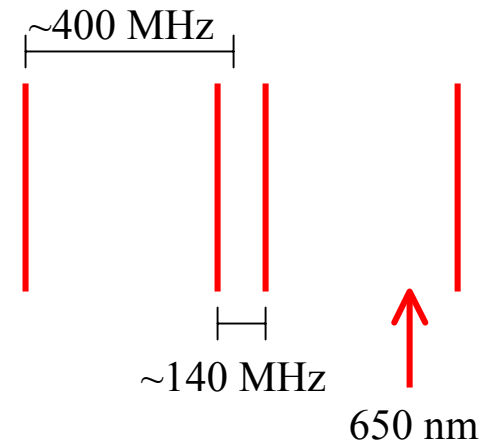
Switching From $^{138}\text{Ba}^+$ to $^{137}\text{Ba}^+$



Switching From $^{138}\text{Ba}^+$ to $^{137}\text{Ba}^+$

Red Laser

- We now need four red frequencies instead of one but want to use a single laser to produce them.
- We would like to be able to turn the individual frequencies off and on independently.

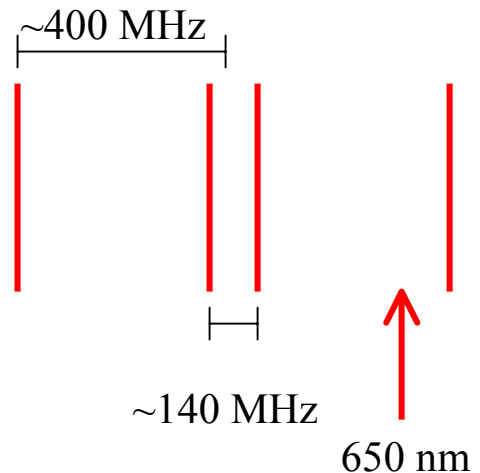


Possible Red Laser Modulation Schemes

- Double Pass Acousto-Optic Modulator (AOM)
- Resonate Electro-Optic Modulator (EOM) with Sideband Selector
- Frequency Cycling a Broadband EOM

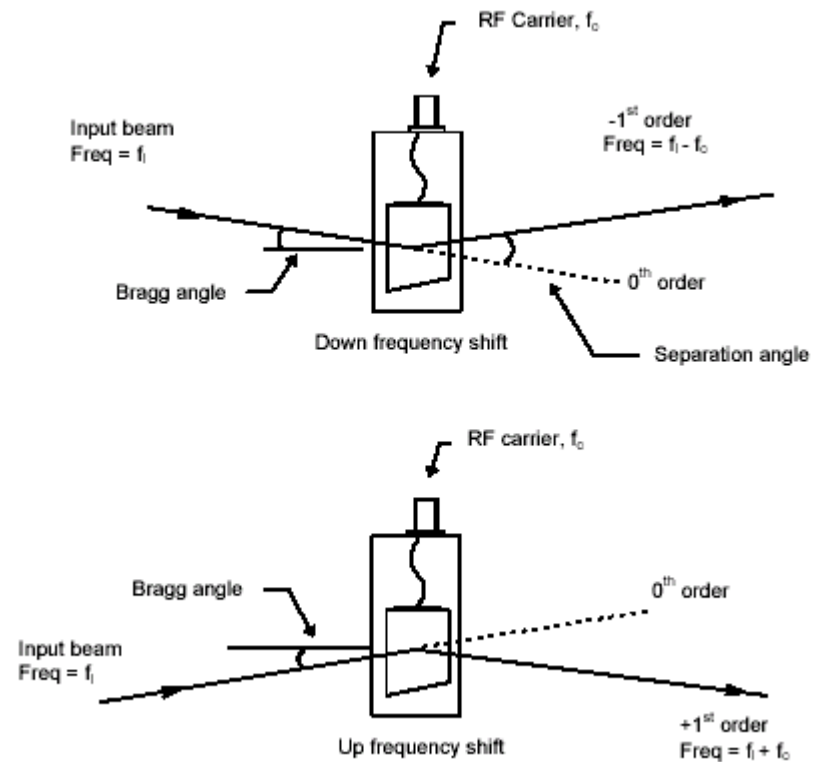
Require:

- shifting the laser frequency to the center of the needed frequencies
- broadening the laser to a width of 140 MHz

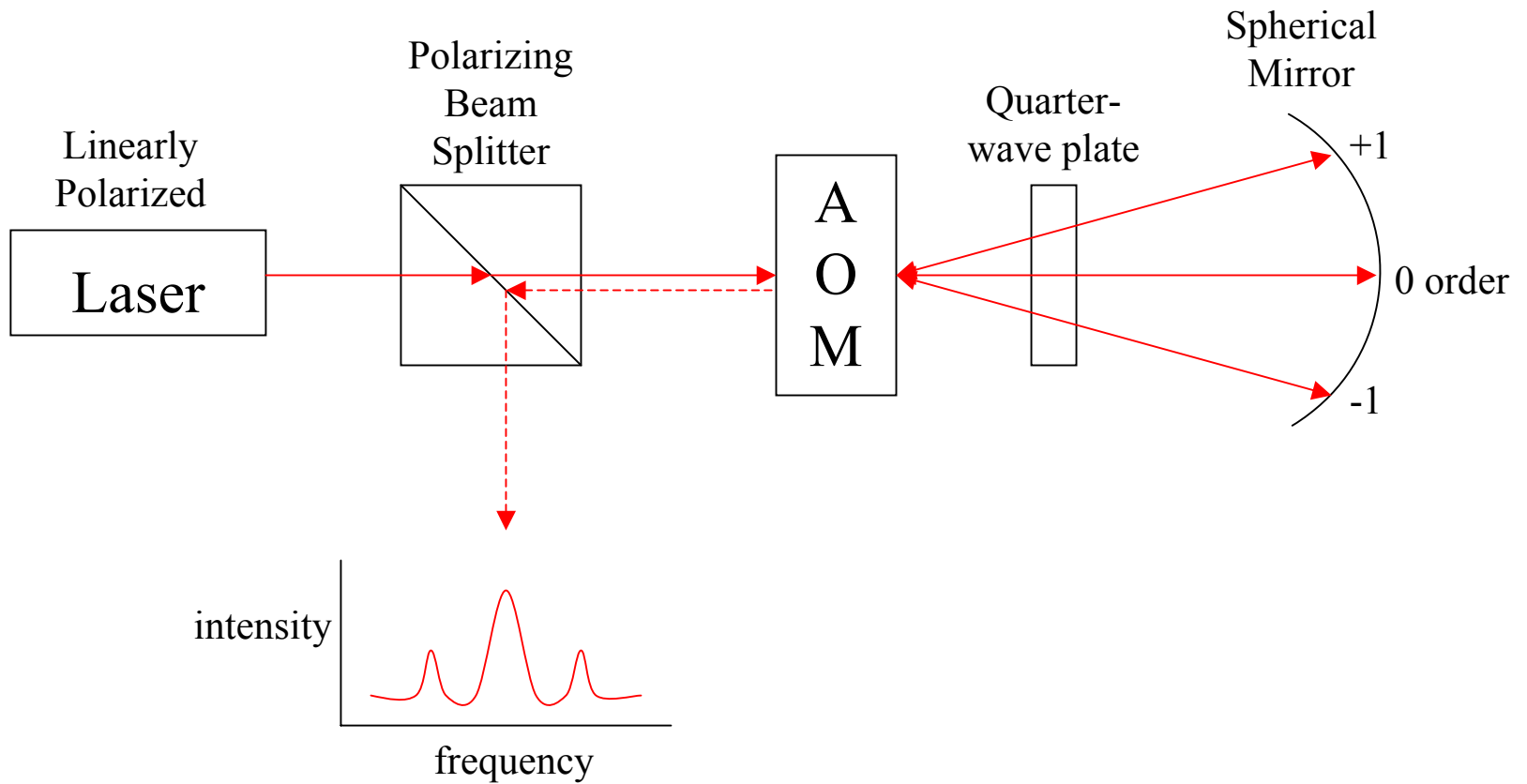


AOM

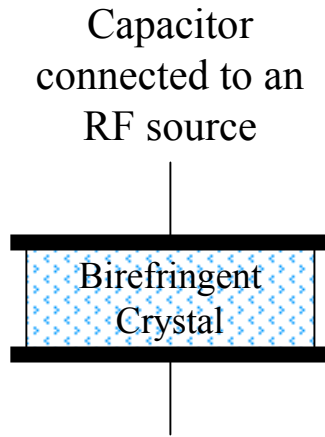
The inputted RF is converted into sound which travels through the crystal and creates a sinusoidally changing index of refraction. This causes the light to diffract and shifts the frequency by multiples of the applied RF.



Double Pass AOM

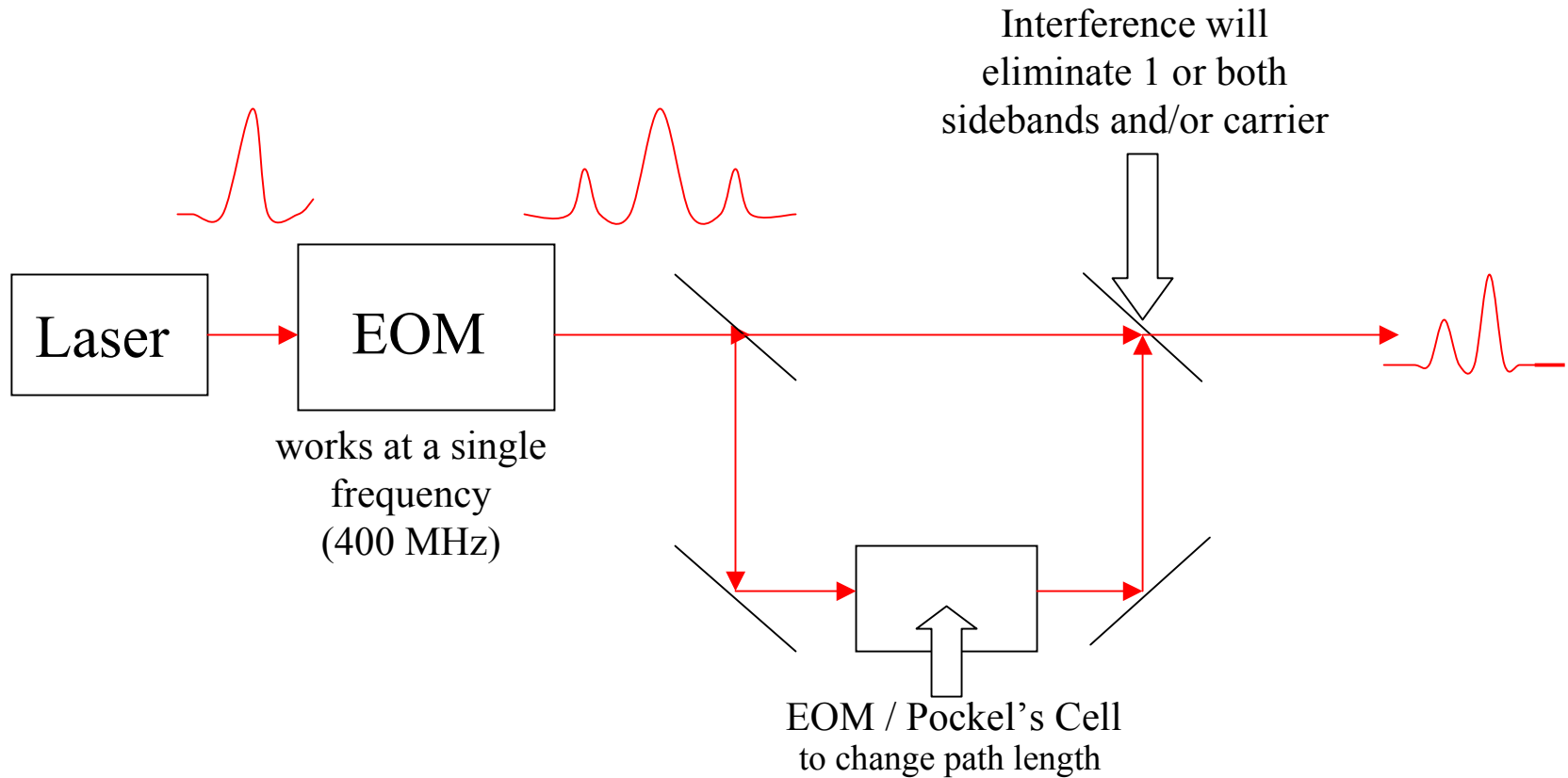


EOM



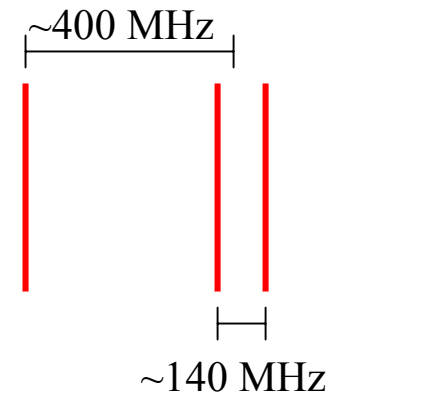
- The capacitor creates a strong electric field through the crystal causing the index of refraction to change.
- If the light is polarized to align with the fast axis of the crystal, frequency modulation will occur at the applied RF.

Resonate EOM With Sideband Selector



Frequency Cycling a Broadband EOM

- The EOM would work for a wide range of input frequencies.
- The input frequency would be electronically controlled to cycle through all four needed lines.
- This is the only scheme in which the center lines could be independently controlled.
- This is also the only scheme in which the laser frequency doesn't have to be shifted initially.



Conclusions

- Measurements of the power in the sidebands will be taken for the AOM scheme.
- Much more research needs to be done before it can be decided which laser modulation scheme will work best.

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