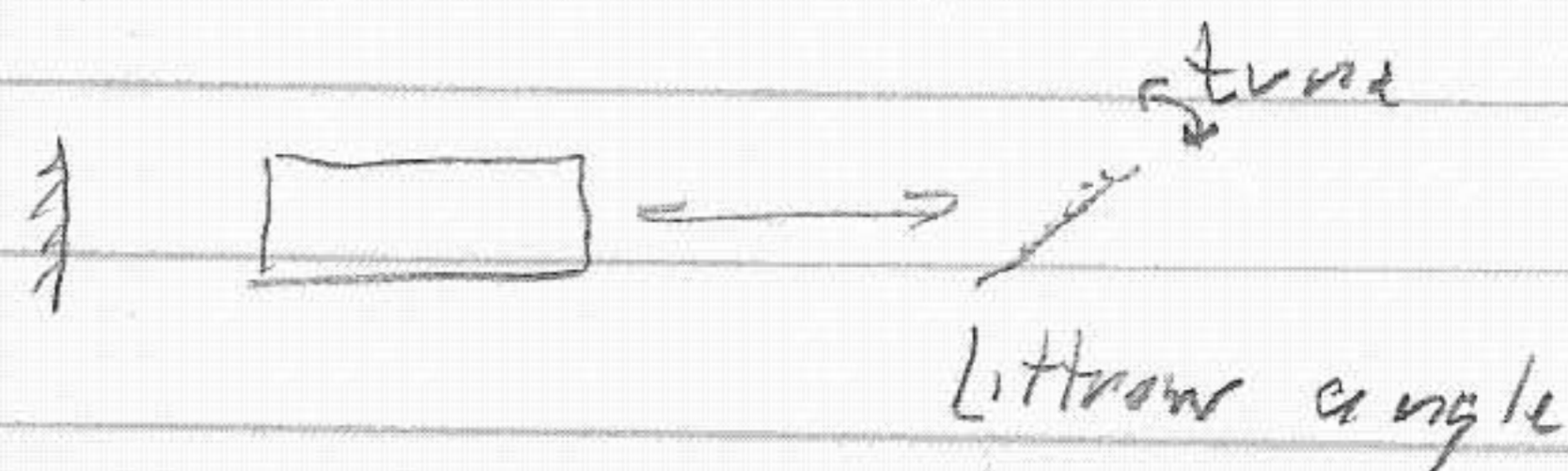


Polarization selection: add Brewster window if gain is unpolarized.

Wavelength selection:

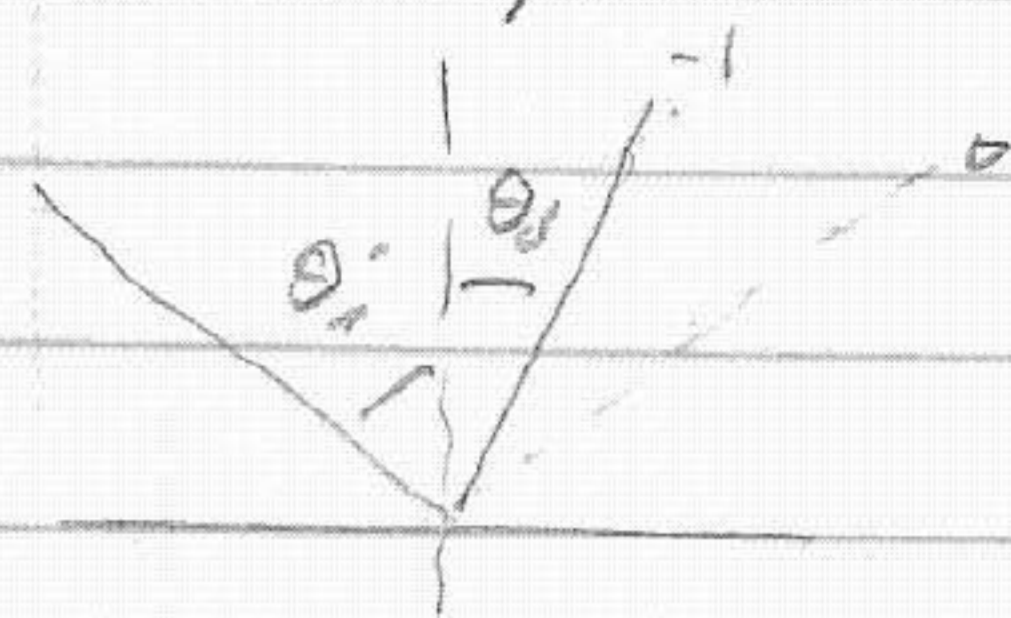
grating:



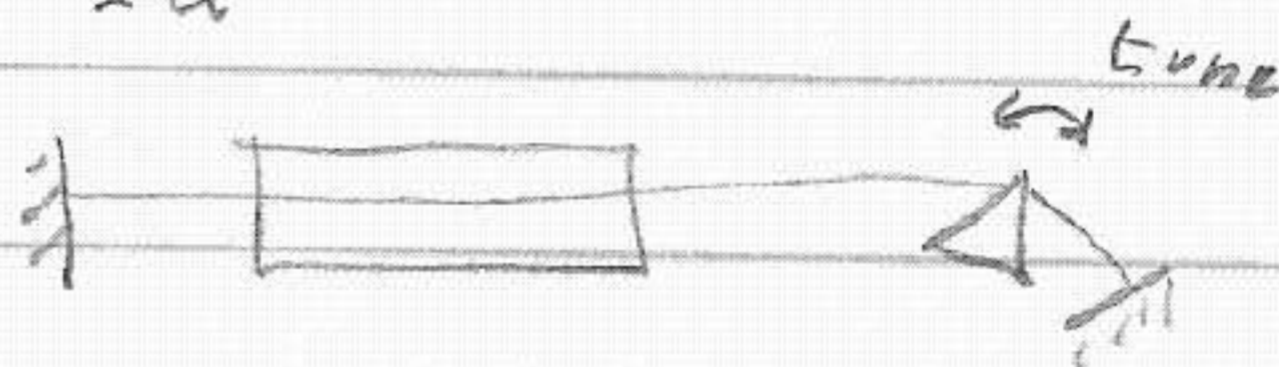
$$\sin \theta_d - \sin \theta_i = \frac{m\lambda}{d}$$

at Littrow  $m = -1$   $\theta_d = -\theta_i$

$$\sin \theta_i = \frac{\lambda}{2d}$$

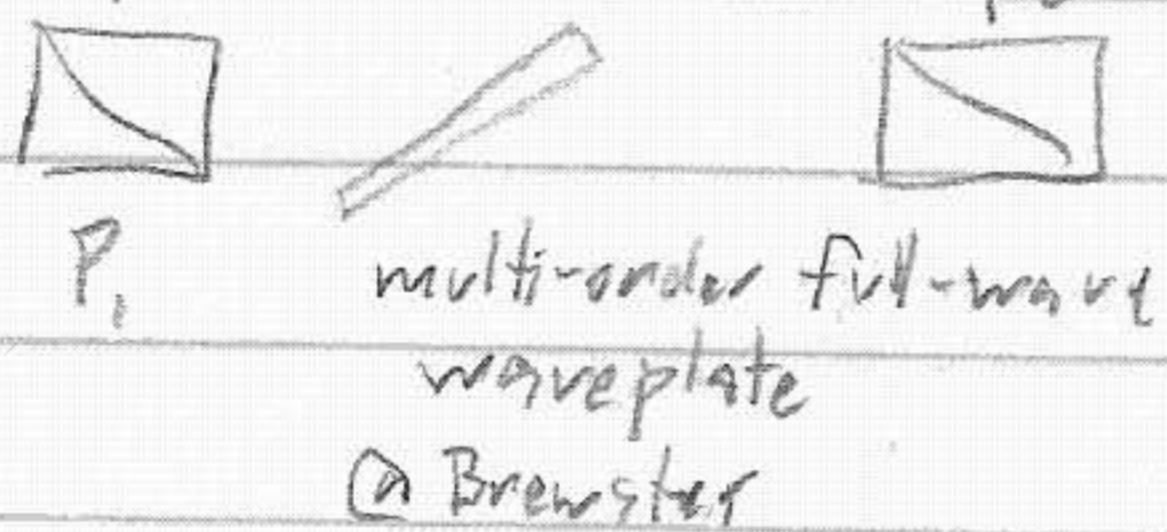


prism:



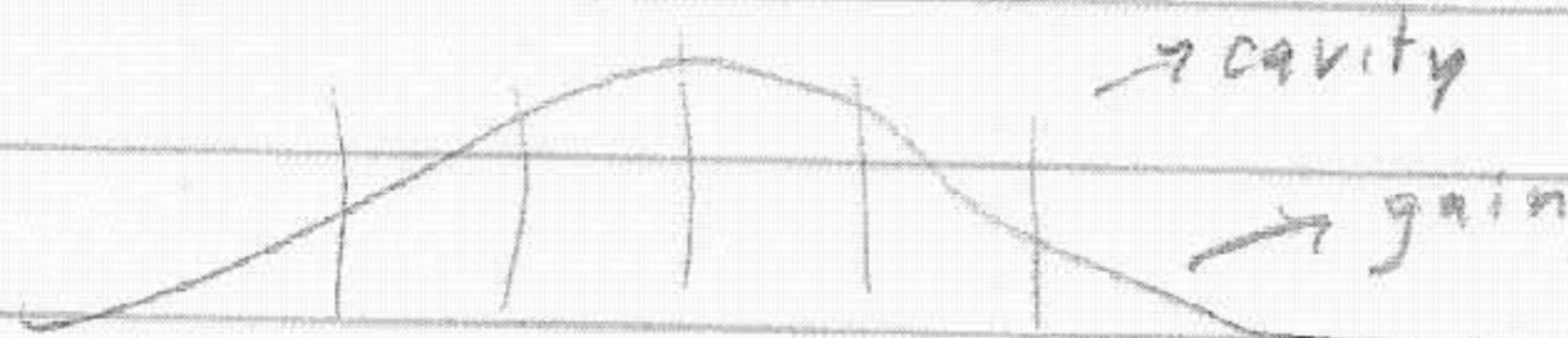
coatings: pick out one  $\lambda$ , loss for rest

birefringent filter

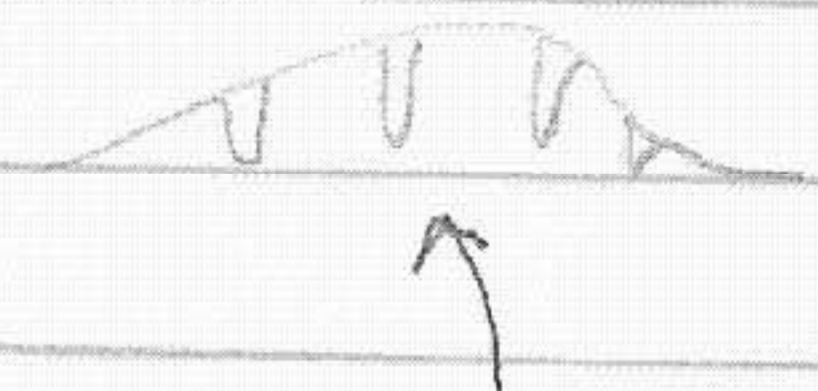


- tune plate rotation  $\rightarrow$  full  $\lambda$  for diff't  $\lambda_0$
- no polarizers required if gain is polarized or Brewster is enough.

Longitudinal modes:



emission: spectral hole burning



in homogeneous  $\rightarrow$  each long. mode interacts with diff't atoms  
 homog. - all same, spectrally.  $\therefore$  expect single mode.

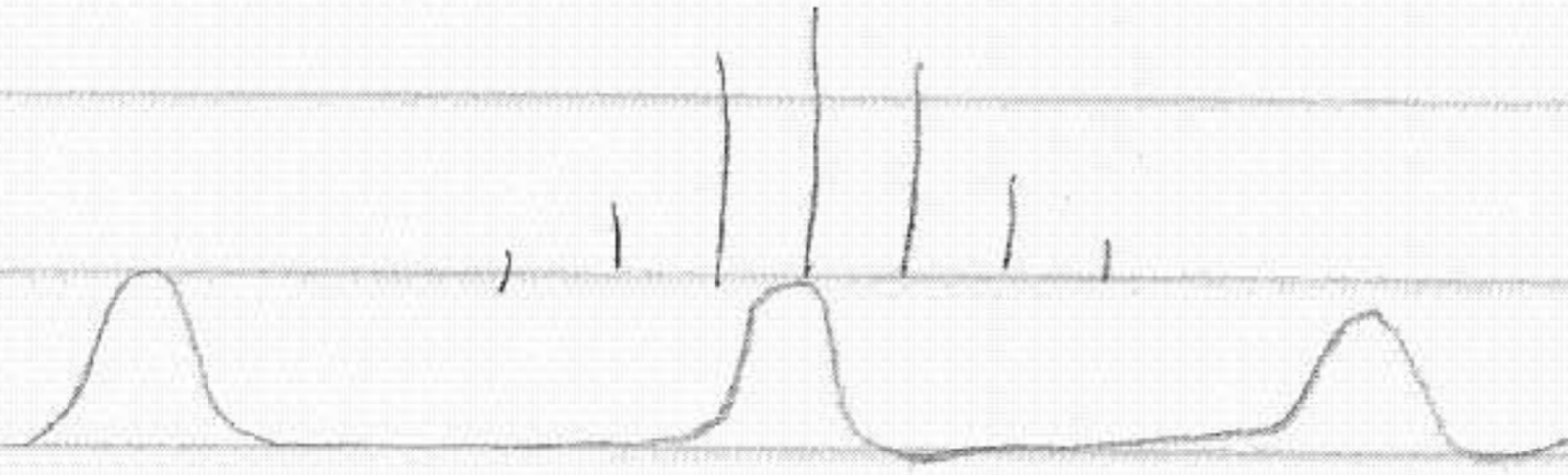
but standing waves  $\rightarrow$  spatial hole burning.

- SW pattern differs w/  $\lambda$   $\therefore$  all see gain.



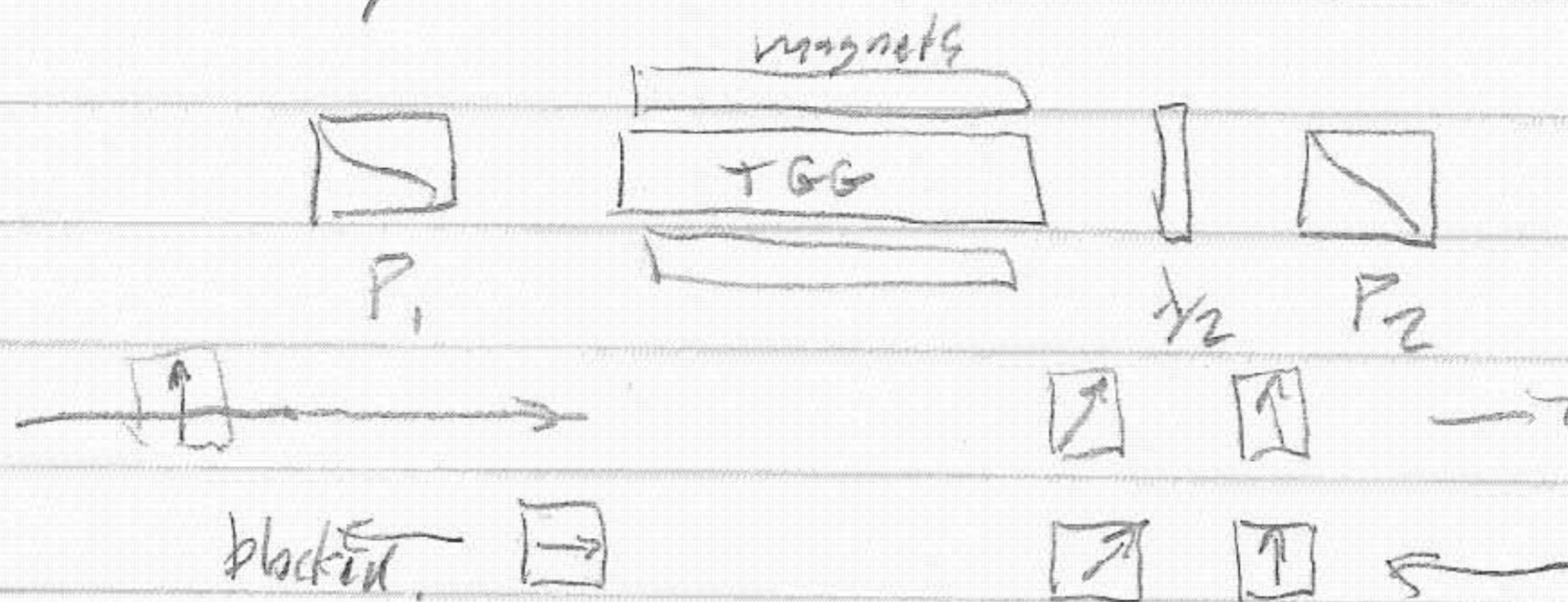
## Longitudinal mode selection:

- etalon: Fabry-Perot w/ large free-spectral range.

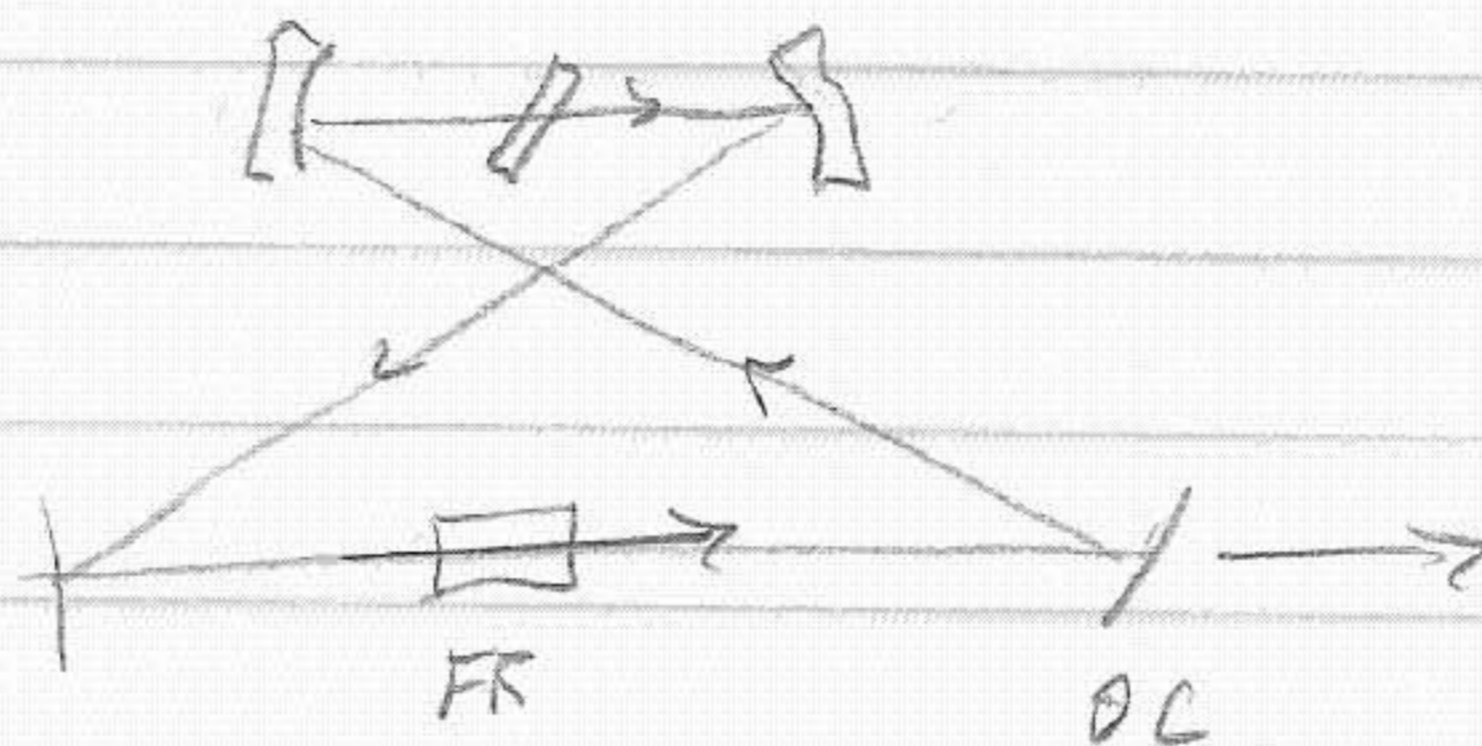


- ring resonator:

Faraday rotator (optical diode)



Isolator forces light one way



no spatial hole burning.

- injection seeding: for pulsed lasers - initiate w/ single-mode CW beam.

## Stabilization:

- elim. vibrations + thermal changes to cavity length.
  - > optics on Invar rod, thermal stabilize.
  - > float table, → no cooling vibration (TE cooling)
  - > sealed enclosure. - heat above ambient.
- eliminate pump fluctuations



## Active stabilization:

- piezo end mirror to lock frequency to a reference.

→ FP interferometer · finesse  $> 10^5$

stable to few kHz

→ atomic absorption line.  
or molec.

Applications: gravitational wave detection

optical frequency/time standards, clocks.