Forecast:
Continued Growth
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The Relaxation Times

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THE FABRY-PEROT ADDITION EDITION

The Caltech-TeachSpin collaboration continues to deliver value to our TeachSpin customers. We are currently in the final stages of developing a series of exciting experiments your students can perform with the addition of our affordable Fabry-Perot etalon to the Diode Laser Spectroscopy (DLS1-A) apparatus. At present, we have a working prototype unit, which allows us to show our readers some representative data from a few student experiments.

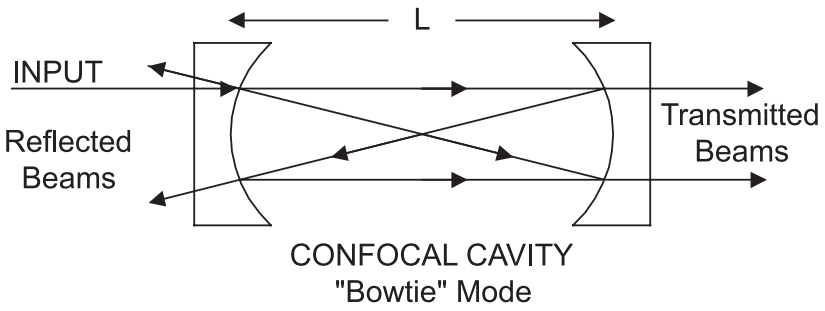


FIGURE 1

Fabry-Perot cavities are ubiquitous elements in optical physics. In our application, they will be used primarily to calibrate the laser sweep and to observe sidebands on the current modulated laser output. Figure 1 shows the basic cavity set up. The curved surface mirrors are coated for high reflectivity while the outer flat surfaces are anti-reflection coated.

The curved surface mirrors "trap" light in a stable, sometimes referred to as bow-tie, mode. There will be a build up of the light intensity inside the cavity whenever the round trip path length of the laser beam is equal to an integral number of wave lengths. These are called longitudinal modes. The frequency separation between the longitudinal modes is called the "Free Spectral Range" of the cavity and is given by the equation: $\Delta f = c/4L$.

Besides longitudinal modes, there are also transverse modes in an optical cavity. Transverse modes may be characterized by differences in the intensity of the light within a cavity in directions transverse to the direction of propagation. Usually, each transverse mode has a different wavelength. However, in a configuration called a confocal cavity, where each mirror has the same radius of curvature and the cavity length is equal to the radius of curvature, all transverse modes become degenerate and resonant at the same frequency.

Students can adjust the cavity length and observe the collapse of the transverse modes.

Figure 2 shows the Doppler broadened absorption spectrum of natural rubidium vapor simultaneous with the Fabry-Perot transmitted light intensity. The overall decrease in the F-P output is due to the current modulation of the diode laser. This modulation affects both the laser output frequency and power. The length of our etalon cannot be modulated, therefore, the variation in the optical transmission is due to the frequency sweep of the laser.

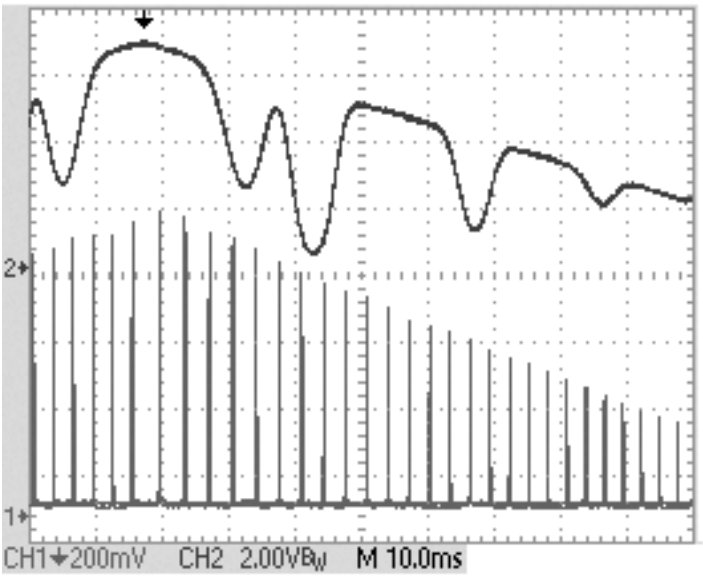


FIGURE 2

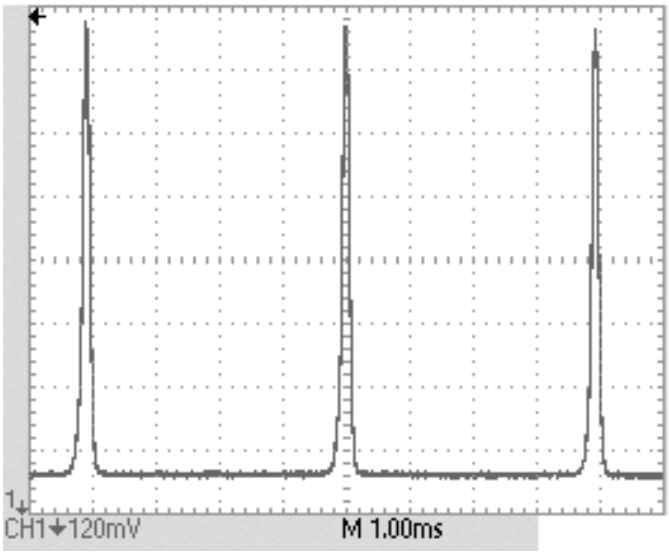


FIGURE 3

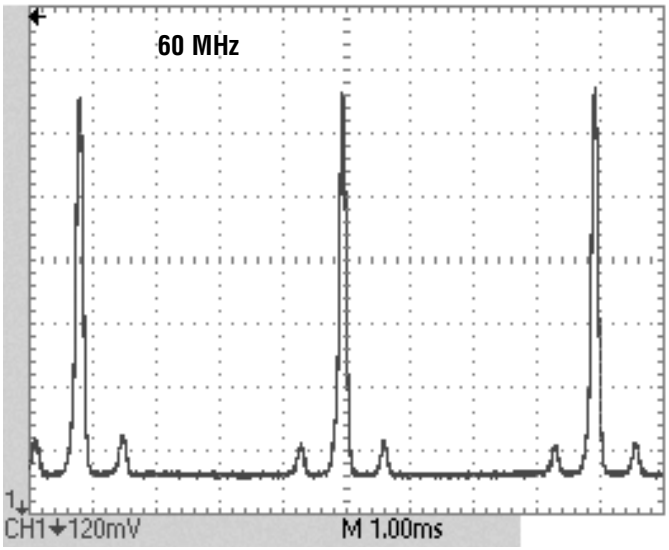


FIGURE 4

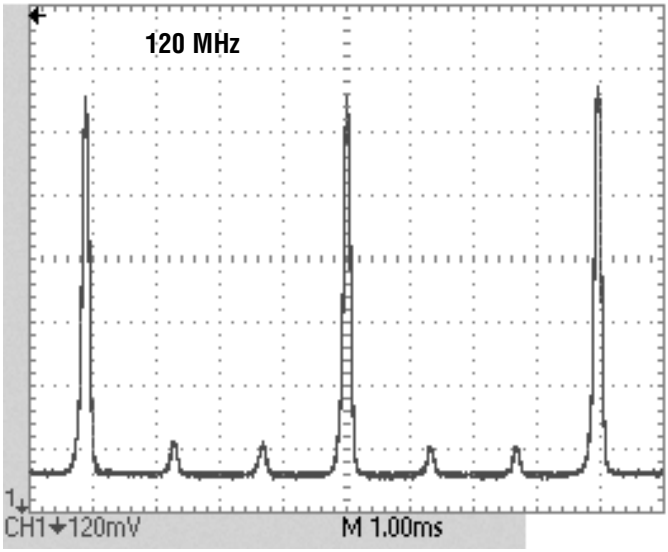


FIGURE 5

To calibrate the Free Spectral Range, the student modulates the diode current using an RF signal generator. These data were taken with the low cost ELNCO SG-9000 signal generator sold with our Optical Pumping apparatus. This current modulation creates optical side bands that can easily be observed on the transmitted output of the F-P etalon.

Figure 3 shows the F-P output for the swept diode laser, where the oscilloscope sweep has been expanded to clearly observe the Free Spectral Range. Figure 4 shows the same sweep with a 60 MHz RF current modulation. Figure 5 shows data from the same configuration with 120 MHz modulation. Since the RF frequency can be measured with an electronic counter, the Free Spectral Range can be accurately and absolutely calibrated. Students should compare this calibration with the Free Spectral Range they can calculate from a crude measurement of the separation of the etalon mirrors.

This etalon has other applications as well. These include observing multimode behavior in the diode laser and external cavity locking of the diode laser. The reflected power from the cavity can be used to lock the diode laser to the cavity. (Caltech's website for its advanced lab at **www.its.caltech.edu/~ph76a/cavities.pdf** has a good discussion of this.) However, the electronics and optical components necessary to build the Pound-Drever-Hall locking system mentioned in the Caltech document are not included in our new unit. If you think TeachSpin should include these components, please let us know. If there is sufficient demand, we would be delighted to provide this equipment.

TeachSpin Is Looking To Hire

an experimental physicist interested in a career developing instruments for our company. We have grown about 35% each of the past three years, yet we still have a long "wish list" of new instruments we would like to offer the physics community. We need an additional physicist to accomplish this goal in a reasonable time.

We are searching for someone with the following skills, background, and interests:

1. Experience in instrumentation including demonstrated skills in both analog and digital circuit design and analysis.
2. A Ph.D. or M.S. in experimental physics
3. Teaching experience in physics, preferable in the advanced lab
4. Breadth of experience and a willingness to explore the development of experiments and apparatus in multiple areas of physics
5. Skill and delight in "making things"
6. Comfort communicating both orally and in writing.

Please do not encourage anyone to apply who does not have both experience in building and a long term interest in creating new instruments.

If you are aware of someone, perhaps a former student or colleague, or even yourself, who would be interested in this unique career opportunity, please contact Jonathan Reichert at TeachSpin by snail mail, phone, or email so we can discuss the possibilities together.

Mid-Year Price Correction

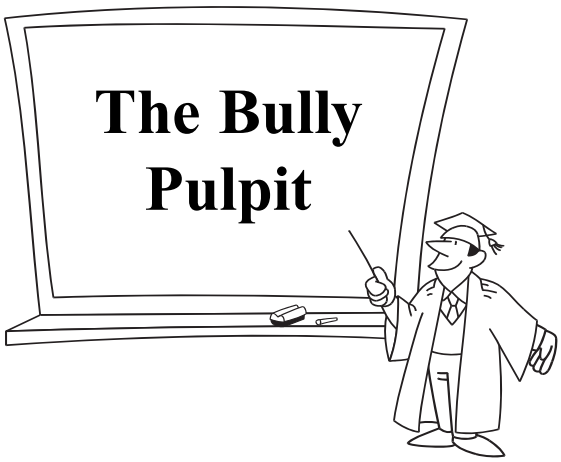
With all the good news we have to share, there is some that is harder to report. Over the last few months, the prices of materials and machined parts for some of our instruments have skyrocketed. We have had price increases from 10 % to over 25 % in the cost of copper, aluminum and even some plastic parts. In spite of our best efforts to buy in quantity and negotiate with suppliers, we will have to increase the prices of some of our instruments.

Because all of us at TeachSpin have taught in student labs, we know just how tight the budgets are and wish we could find a way to stave off this increase. The new prices will take effect October 1, so current pricing will be valid only on Purchase Orders received before that date.

Modern Interferometry

We are still on schedule to deliver the first units of our newest instrument, Modern Interferometry, by the beginning of the fall semester. And, we are still willing to sell the first ten units for $12,000, even though the introductory price will be $12,475.00. As of this writing, two of the first ten units have already been spoken for, so if you want the best price ever on this truly remarkable instrument, we suggest you get your order in soon!

TEACH SPIN



Finding funding – the eternal problem. If only there was a good angel. Well, there just might be!

A friend, who is a development officer for a local university, was complaining that she needed wish-lists from her departments for donors who wanted something concrete to fund. Some donors are just unexcited about contributing to a general fund. They want to see the money they have given put to some specific use and having their name on it would certainly be appealing.

TeachSpin instruments would be perfect for this "directed alumni giving." They are physically beautiful, offer high quality physics, have a long life span, and come in a wide variety of prices to fit any budget from $400 for Magnetic Force to $14,500 for Pulsed NMR.

And, to go with the already heirloom look, we have designed elegant plaques which we will engrave with your citation. We will also provide an acknowledgement package to present to the donor with a thank you certificate, a picture of the instrument, and a description of the physics involved.

The mechanisms for letting alumni and local businesses know about wish-lists, as well as the way the finances are handled, vary from school to school. Contact your school's development office for advice. Some departments may have direct connections to former undergrad majors and graduate students.

If you have found any effective ways of acquiring funding for your department that you'd be willing to share, please let Barbara know. After all, in the physics community, one person's undergrad major is the next person's Ph.D. candidate or assistant professor.

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