Forecast:
30%
More Spin
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The Relaxation Times

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MAGNETIC TORQUE

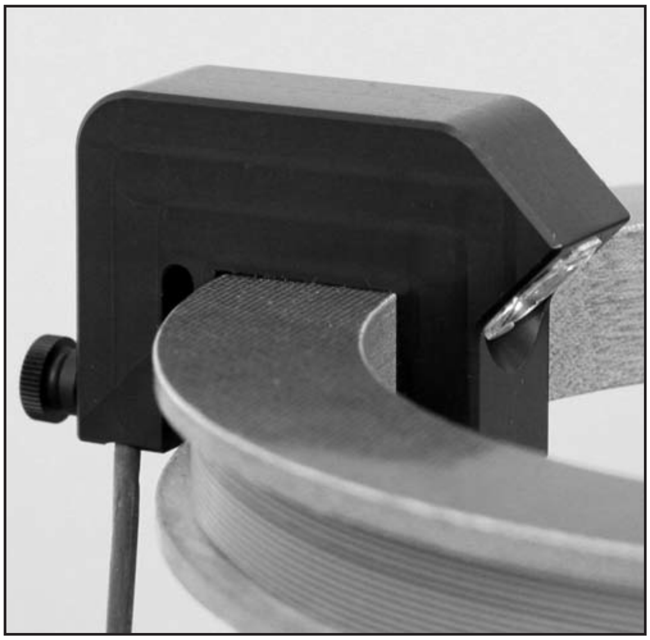
A "Classic" Made Even Better

The second instrument that TeachSpin developed has undergone a significant renovation. All the basic physical measurements remain the same, but the new unit is more user-friendly and these new components will enhance the accuracy of the student's measurements. **Three things have changed.**

The new units have a new internal air pump. This industrial flap-valve pump provides the bearing with air at a higher pressure and a greater flow rate. Our measurements indicate that the balls now spin about 30% longer than with our previous pump. It also provides a lower friction bearing for the oscillation and static torque experiments. This lower friction bearing improves the reproducibility and accuracy of these experiments. And with all these enhanced features, the pump has less vibration and less noise than the older ones. We really like everything about this pump, and are grateful to one of our customers who found it, and told us about it. We really appreciate ***all*** customer feedback.

The second modification is in the electronic counter that measures the frequency of the flashes from the strobe light. The original unit actually counted the flashes for a ten second time interval and displayed the number of counts on the LED readouts. The problem with that method is that a student could wait as long as 20 seconds (10 second to count and almost 10 seconds because you changed the flash rate at the end of a 10 second counting period) to determine the rotational frequency of the spinning sphere. This is an annoyingly long time to wait. But more importantly, students might want to measure this rotation frequency at the beginning and end of the experiment, since the rotation frequency is not exactly constant over an experiment. This was difficult to accomplish with the original counter.

The new unit electronically synthesizes the variable frequency of the strobe flashes. The student adjusts the frequency so as to synchronize the flashes to the rotation of the sphere floating in the air bearing. The frequency readout LED's are directly connected to the electronic synthesizer so that the frequency of the strobe unit is "instantaneously" available to the student. Thus it is possible to measure rotation frequency multiple times during, for example, a precession experiment.



Along with the new frequency synthesizer board, we have built a new strobe lamp. This new lamp is no longer a high voltage discharge tube, but a modern high intensity white LED. This very bright light source operates at low voltages and has an exceptionally long life (50,000 hours). Since we are operating the units at less than their maximum output rating, these LED's should last your lifetime (or more). The new strobe light has another advantage; it is movable. Students can now position the light where it is easiest to observe the white dot on the balls' "handle". This makes synchronizing the flashes significantly easier.

For all of you that have the original models of magnetic torque, we have designed these new "upgrades" to be compatible with the original units. This substantially reduces the cost of retrofitting these improvements into your units. If you just want to replace the pump, that can be accomplished relatively easily at your school, but it does require some woodworking. If you wish to replace the counter, that does require that you also replace the strobe light. This can also be done in-house, but we recommend that the unit be returned to the factory for the modifications. All these issues can be discussed with a brief phone call to the company. Don't leave this beautiful experiment on the shelf just because an air pump has died – send it back – we will return it polished and ready for another generation to learn "all there is to know about magnetic moments". Well almost!

After all, where can you find an apparatus that allows students to measure one very important physical parameter **five** independent ways: two experiments using statics, two using dynamics and one measuring a field. These experiments tie together the first two topics usually covered in an undergraduate physics program, mechanics and electricity and magnetism. The data analysis, the units, the systematic "errors", all challenge the students to defend the "best" values of the magnetic moment. ***We are still in love with this "classic".***

IMMERSIONS

We're doing them again! More sites, more experiments, and, hopefully, more participants. But, I get ahead of myself. First, let's review what happened last summer with the first round of Immersions.

I think it is fair to boast that the Immersions were a glorious success. The feed-back from the participants at all four sites, Dickinson College, AAPT Portland, Buffalo State College, and Caltech, were extremely positive. Each of the first four Immersions was distinct, with different demands and different access to instruments, but all received praise from both participants and mentors. Many participants expressed strong interest in doing another Immersion in the next round and all thought it had been a worth-while experience. The mentors also filed positive evaluations, and many felt the Immersions could easily be made even better in subsequent offerings. All of the mentors agreed to offer their sessions again. Needless to say, the members of the ALPhA committee responsible for the oversight, headed by Lowell McCann, were more than delighted.

Building on this initial success, ALPhA is offering an expanded version of the Immersion Program for this summer. There will now be six sites, adding Colgate University and the University of Rochester to the list. Exciting new experiments will also be offered, including Quantum Eraser, Single Photon Sources, Images of Shock Waves, Nanoscale Heterodyne Interferometry, and more. The complete list is on the back of this newsletter, along with the dates and places for the Immersion 2011.

Please forgive me for bragging about my personal involvement with three participants at Buffalo State. I was mentoring the Pulsed NMR experiment, an instrument I helped design. Pulsed NMR is, in fact, a whole field of physics and one certainly will not master this topic in 2 ½ days. In fact, it is quite a trick to develop confident facility with the instrument in this time period. But all my "kids" came well prepared, and all worked really hard during the all-day sessions. Some even came back at night to get more data. They all measured the spin-spin and spin-lattice relaxation times of a series of water samples with different concentrations of copper sulfate. They even made their own samples for the experiments. We all worked hard for this three day period, but the concerted effort seemed to really pay off. I will be offering this experiment again this August.

ALPhA is always looking for more sites and more experiments to expand the program. We are applying for two NSF grants. One "bridge" grant would fund Immersions for the coming year (that has already been submitted) and another is for an expanded multi-year program and an Advanced Laboratory Topical Conference. But don't only think in terms of being a participant at an Immersion. You, yourself, may well be an expert in certain experiments, using either homemade or commercial apparatus. Perhaps, along with colleagues from your own and/or other schools, you might be willing to host an Immersion program at your school. Please let us know. ALPhA looks forward to the time when there will be Immersion programs all over the country, carried out both in the summer and in the winter during the semester break. We believe these programs are the best way to create a networked community of faculty dedicated to creating the best possible advanced undergraduate experimental physics education. Consider doing your part!

TeachSpin Going VIRAL on YouTube

TeachSpin's Two-Slit Interference, One Photon at a Time has been publicly declared "a thing of beauty" on a Kenyon College You Tube posting. Dubbing Cricket "essentially a Geiger counter for photons", Professor Ben Schumacher a theorist, no less, comfortably puts the instrument through its paces. As he carefully blocks one of the slits at a pattern minimum, he even demonstrates that we were "hearing" destructive interference. Check it out on the first page of Two-Slit on the TeachSpin website, www.teachspin.com.

Add your voice to making TeachSpin go Viral. Send us links to your videos of TeachSpin experiments in action and, perhaps, you will be making your video debut on the TeachSpin website. (jreichert@teachspin.com) What a great – and *modern* – way to highlight your undergraduate experimental physics program.

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Immersion Schedule for Summer 2011

visit **www.advlab.org** for full descriptions

WHEN & Where	**WHAT** Experiments will be Done	**WHO** will Mentor
July 20 – 21 **Bethel University** St. Paul, MN	• Imaging of Shock Waves in Flows • Stabilized Laser Diode Experiments • Homebuilt Wavemeter Experiments • Nanoscale Heterodyne Interferometry • Stroboscopic Holographic Interferometry	Chad Hoyt Keith Stein Richard Peterson
August 8 – 10 **Buffalo State College** Buffalo , NY	• Pulsed NMR • Optical Pumping • Modern Interferometry • Mossbauer Spectroscopy • High Temperature Superconductivity	Jonathan Reichert David Van Baak Mike DeMarco Ram Rai
August 10 – 12 **Caltech** Pasadena, CA	• Saturated & Resonant Absorption Spectroscopy • Thin Film Deposition & Vacuum Techniques • Low Noise Signal Detection with Lock-Ins	Eric Black Ken Libbrecht
August 15 – 16 **Reed College** Portland, OR	• LabVIEW Instruction for the Advanced Lab	John Essick
August 15 – 17 **Colgate University** Hamilton, NY	• Quantum Eraser • Biphoton Interference	Enrique ‘Kiko’ Galvez
August 18 – 20 **Rochester University** Rochester, NY	• Entanglement and Bell’s Inequalities • Single-Photon Source	Svetlana Lukishova