ISPP REMINDER

April 2017

OUR NEXT MEETING . . .

. . . is at Lake Forest College
Wednesday
April 12, 2017
6:30 - 9:00 p.m.

Scroll down for a map and directions.

THE FREE GIVEAWAY . . .

. . . something you should find useful to excite student interest in physics - and who knows? - maybe even your own!

FUTURE MEETINGS. . .

April 12	(Wednesday)	Lake Forest College –	Mike Kash, Scott Schappe
May 8	(Monday)	Northwestern University	Art Schmidt

AT OUR LAST MEETING . . .

Gordon Ramsey (Loyola University) opened the meeting welcoming us to Loyola. Up and coming meetings: ISPP April 12 at Lake Forest and May 8 at Northwestern, the NAAPT is in Cincinnati July 22 -26 at the Marriot Cincinnati River Front Convention Center (really in Covington Kentucky). Gordon is planning a special Eclipse fest. Sir John Brown from Glasgow Scotland will talk about solar eclipses.

Pete Insley reminded us of the purpose of the ISPP to promote Phenomenological Physics. In traditional physics the teacher prepares lecture, explains the principles and shows equations followed by good demo to tie at all together. The teacher has knowledge and gives it to the students. In phenomenological physics the process is reversed. We start with good demo then draw from students the principles and relationships. Students develop the knowledge themselves and that way, it stays with them. Thanks, Pete**. Debbie Lojkutz** (Joliet West High School) gave out new teacher bags to Dr. Sherita Moses who has been at Loyola University since August 2016.

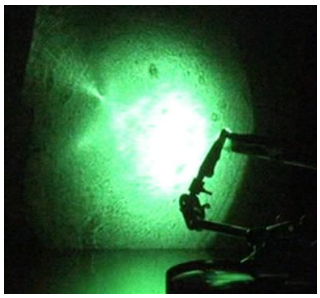
Gordon started off with a phenomenon in the form of an exercise handout that he gives his students early on in an introductory Physics class. Gordon listed data that described his typical drive to campus from his home in Frankfort, an 80-km. trip. He described each key segment with an odometer reading and corresponding time. Students must choose the plot size for showing distance against time and demarcations appropriate for the data. They then plot the data and connect the dots to obtain an average velocity for each leg of the trip from the slope of the line. They use the grid squares to calculate the average velocity be counting the squares under the curve. It's a good intro to the relationships between distance and velocity.

Art Schmidt (Northwestern University) showed us a box which he said has something in it. He used the phenomena in a class about cameras. With the lights in the room dimmed we could see a curly bright wire which was the filament of an old lightbulb. He opened the box to reveal the lit bulb upside down.

Then he used a fluorescent bulb as an object to show how a pinhole can project an image of the long thin light onto a screen. The pinhole in an opaque card was rather large, about two centimeters. Still we could make out the elongated image projected on the screen. Art passed his hand in front of the bulb and we could see the shadow it made where it blocked the light source.

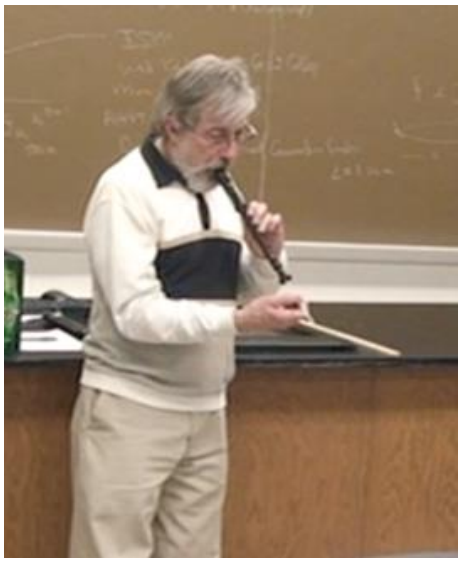
Art then exchanged the opaque card with a transparent sheet with a black dot on it. This was an inverse pinhole camera. The projected image appeared as a negative image of the light. Indeed, instead of a bright image we saw a black elongated shadow projected on the screen. The he asked what we might expect if he again passed his hand I front of the light. Logic would dictate that the hand would appear as a bright smudge in the image. When Art placed his hand in front of the bulb, we indeed saw the bright swath. Art asked us how it was that while he blocked light with his hand, the negative image of his hand appeared brighter. We puzzled on that for a while. Can you guess?

Peter Insley (retired) passed out filters from the last meeting at Lane Tech. The he passed out lenses that he had removed from LED's. The lenses were extremely small with a focal length of a negative quarter millimeter. Pete placed the divergent lens in front of his green laser and projected the diverging beam spot onto a white card. He called our attention to the speckle pattern in the laser light. When you move your head back and forth the pattern moves relative to your motion. The pattern appears to be projected in front of the image.



We discovered several properties. The dots appear in focus even without your glasses on. If you are nearsighted the dots appear to move opposite to your head motion and if you are farsighted they move faster than your head in the same direction. Art had learned about the phenomena from Sonny Jeong at Lake Forest. The speckle pattern is formed by interference on your retina. If your eye forma images behind your retina the speckle pattern moves ahead of the motion of your head. If your eyes form images in front of your retina the rays of light pass through the focus and flip their relative positions before getting to the retina and the speckle moves slower than your head movement and sometimes can be seen to even reverse the direction of movement relative to the movement of your head. As you move to the left you will see the speckles move to the right. Bill Blunk noticed that up - down motion also has an effect not always the same as the right-left motion. Pete suggested that this may be due to astigmatism. Art remembers that an astigmatism will result in diagonal movement. Roy Coleman remembers just before cataract surgery he could see distant red lights fine but green double up sideways. It when away when his eyes were corrected for astigmatism.

John Milton (DePaul University retired) worked in X-ray reflection microscopy at St Louis University. They used K-B mirrors to study total x-ray reflection off of thin metallic coatings. When an anomalous pattern was reported to be observed, some speculated it was due to scattering off dust particles on the surface of the glass, His advisor went to look at the phenomena directly and realized it was the pinhole image of the filament of the x-ray tube.



Gordon Ramsey (Loyola University) mounted a wire piano string on a meter stock to make a one string guitar. He made use of a guitar tension mechanism to show how the tension increased with increased tension. He explained how on a guitar there are different densities of strings and that the thicker or more massive strings gave lower pitches in resonance than for lighter strings of the same length. When working with his students they observed several resonances in the acoustic spectrum. They filmed the motion of the string in high speed and observed several modes that corresponded to the two acoustic resonances. He showed us how to play an octave of the open string frequency by fretting the string to half its open length.

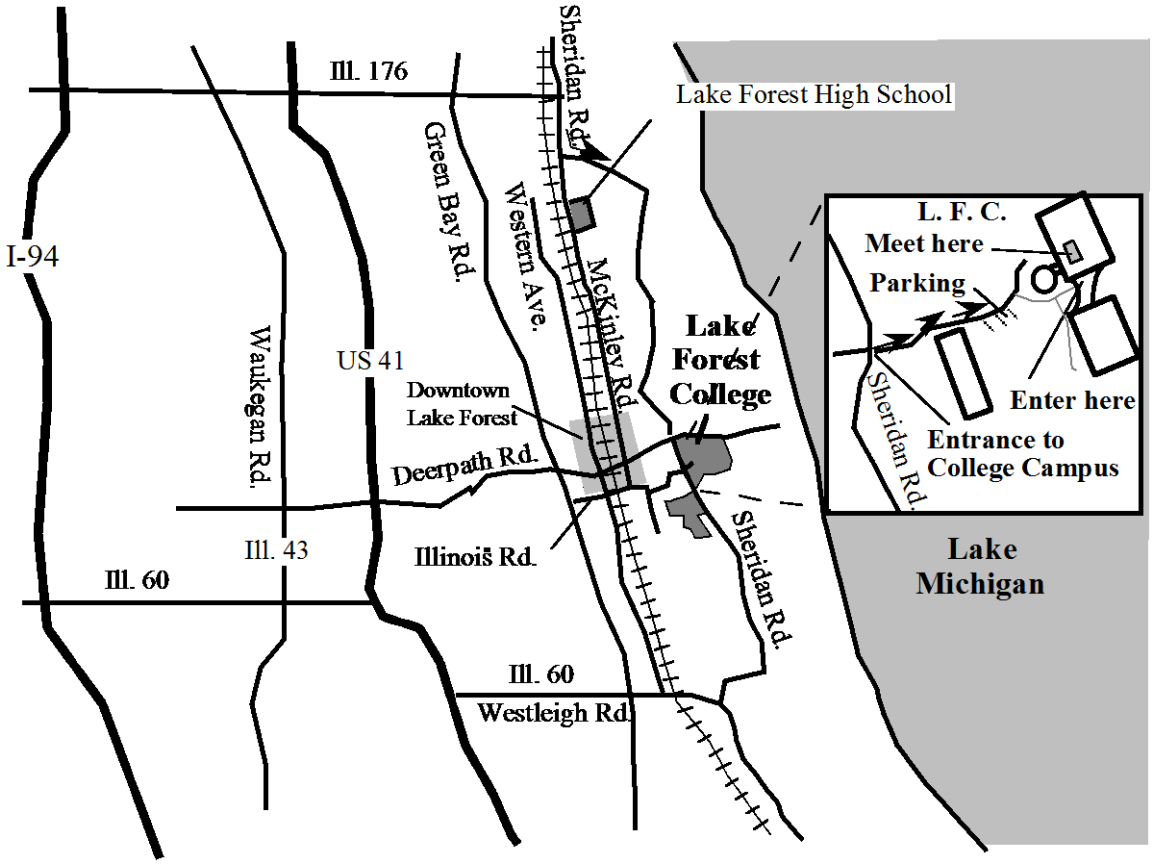
Gordon passed out a handout with frequencies of musical intervals. An octave is a frequency twice that of the fundamental with an interval of 2/1. Pythagoras worked out the ratios based on the perfect fifth. A perfect 5^{th} has a ratio of 3/2 meaning that if you shorten the string by a 3^{rd} leaving the free length of $2/3^{rd}$ of the total length you would get a tone 3/2 of the fundamental. In an equal temperament scale 12 tones are

equally spaced through an octave. So, if you play a piano tuned this way and start with middle C the octaves sound good. But if you start with D the octaves don't match the keys. Bach noticed this and devised the scale based on the frequencies determined by multiples of the 12^{th} root of two raised to the n power where n increases in integer multiples from zero to 12. This is called the equal temperament scale. Gordon constructed a travelling (compact) version of his one string guitar which folded at the midpoint. By itself, the stick didn't make much sound when he strummed the rubber band string. But when he held it firmly against the wood panel of the front of the lecture table we could hear the tone.

Pete Insley observed that Pythagoras attributed more to the musical ratios to something spiritual. Pete has a sense that math teachers hold a similar intrinsic value to numbers.

It was time for our free giveaway. Gordon pulled out a case of beer. Instead of beer bottles the case held a bunch of recorder instruments. He explained that a standing wave in the air column resonates in a similar way as vibrational waves resonate on a string.

The meeting adjourned and we went home pleased and informed. Art Schmidt



From Chicago — Take I-94 (Edens Expressway) north toward Waukegan. When I-94 splits off toward Milwaukee, stay on the Edens, which becomes U.S. Route 41. Exit at Deerpath Road, turn right (east) onto Deerpath and continue through the town of Lake Forest and toward the College.

From points North — Take I-94 south from Milwaukee. Just south of the Wisconsin-Illinois line, stay left and follow U.S. Route 41. Exit at Deerpath Road, turn left (east) onto Deerpath, and continue through the town of Lake Forest and toward the College.

From points West & Southwest (including O'Hare Airport) — Take I-294 (Tri-State Tollway), which becomes I-94, north to Illinois 60 (Town Line Road). Exit and turn right (east) on Route 60. Continue east to Route 43 (Waukegan Road), turn left (north) for 1/2 mile to Deerpath Road. Turn right (east) onto Deerpath and continue through the town of Lake Forest and toward the College.