Physics IQP

Ongoing Advancement of the Physics Toolbox

Bennie Jones
Bennett Lessard
John McGinley
Konrad Perry
Kyle Pydynkowski

Outline

I. Introduction (Bennie Jones – MGE)
II. Doppler Lab (Kyle Pydynkowski - ME)
III. Applets (Bennett Lessard - ECE)
IV. Energy Lab (Konrad Perry - AE)
V. Energy Video (John McGinley - ME)
VI. Overall Conclusion (Bennie Jones - MGE)

I. Introduction

By Bennie Jones

Project Goals

- Give the first year students a more hands on experience
- Aid in the transition from high school to college
- Develop a Physics toolbox

My Goals

- Help in the designing process for the physics department
- Enhance my knowledge of physics
- Suggest how to grab the attention of incoming freshmen
- Make sure the tools are interesting, eye popping, and comprehensible

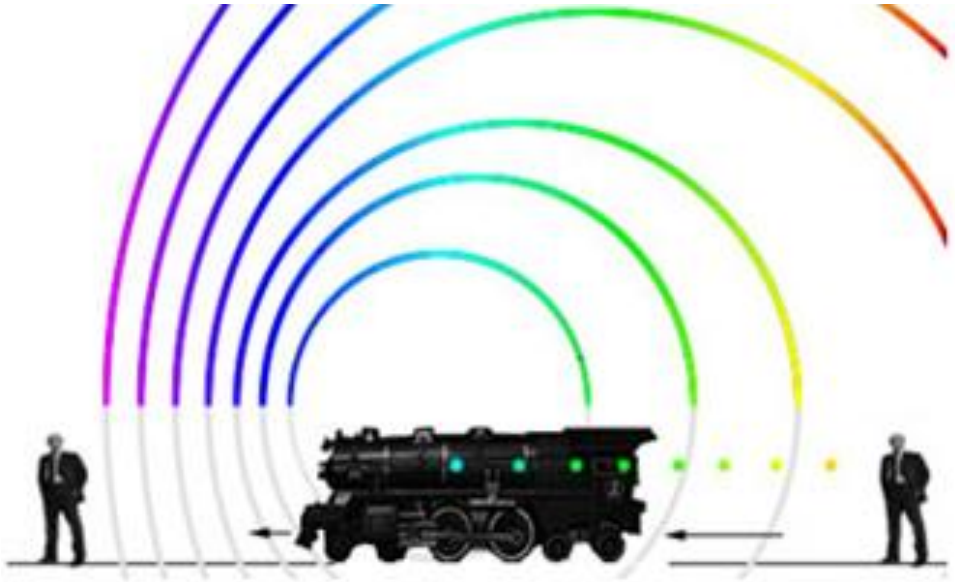
II. Doppler Effect Experiment

By Kyle Pydynkowski

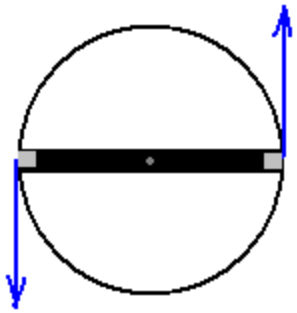
Physics IQP

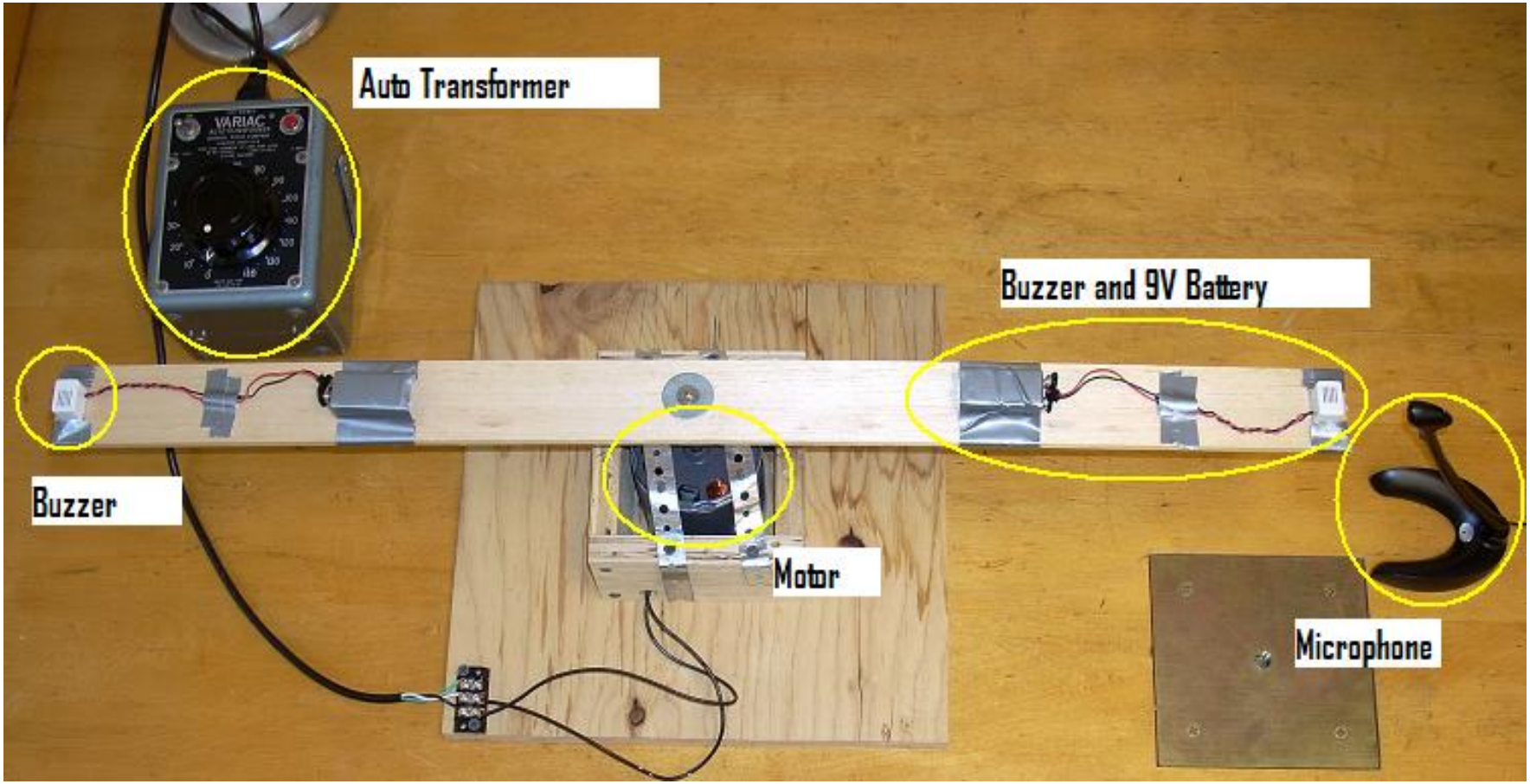
My Goals

- Creative Idea
  - Keep the interest of students
- First Doppler Effect lab
- Use classroom learning and a new idea to explain the same topic

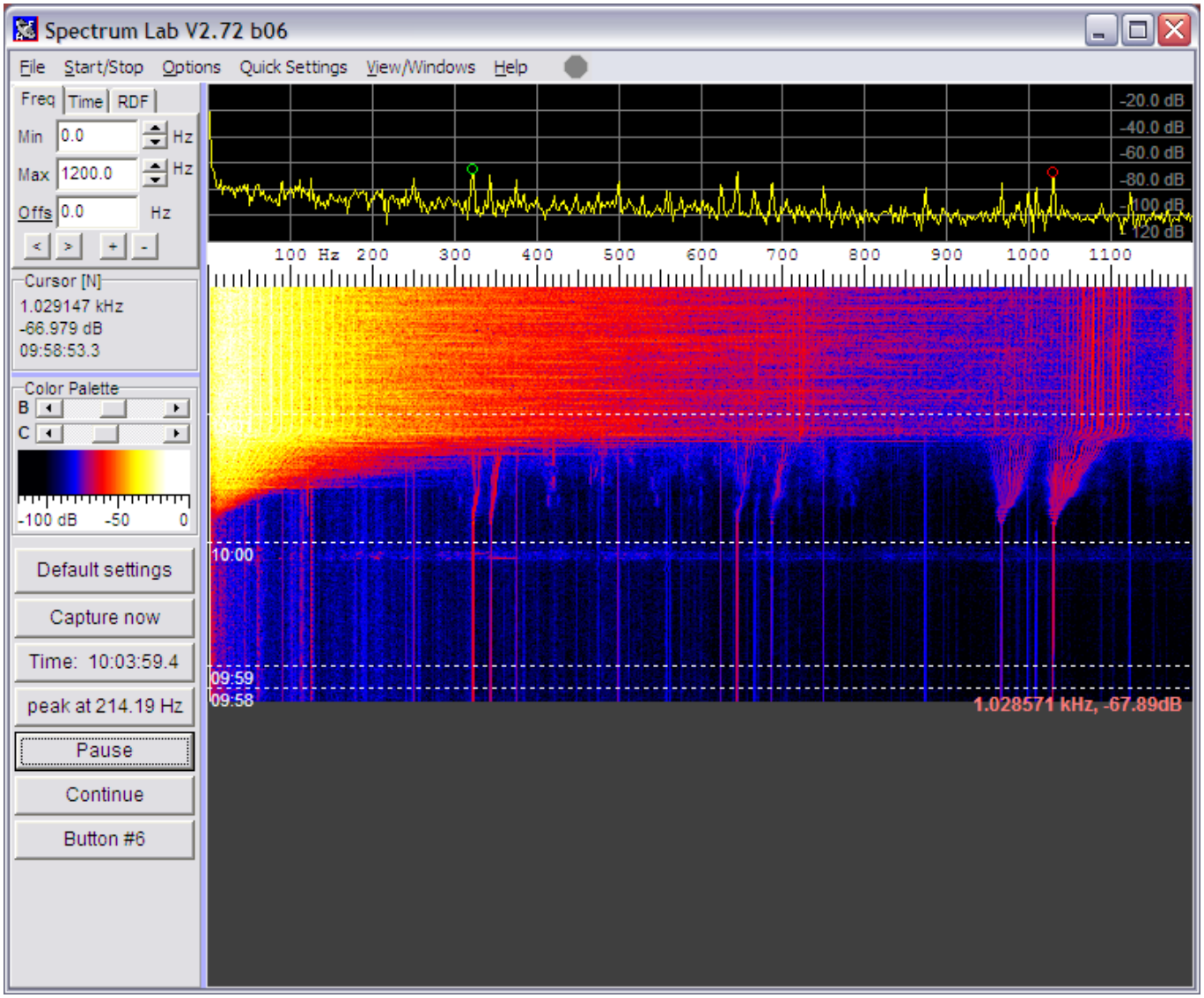


Setup

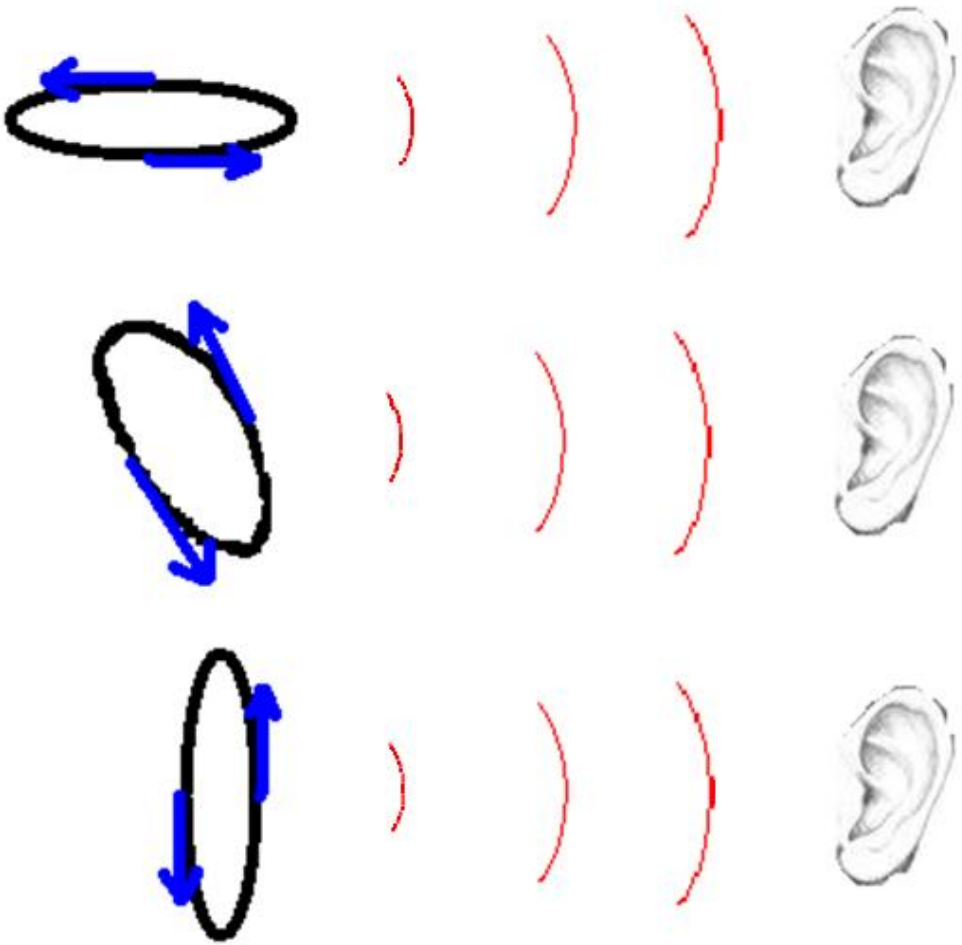



Auto Transformer
VARIAC
Buzzer and 9V Battery
Buzzer
Motor
Microphone

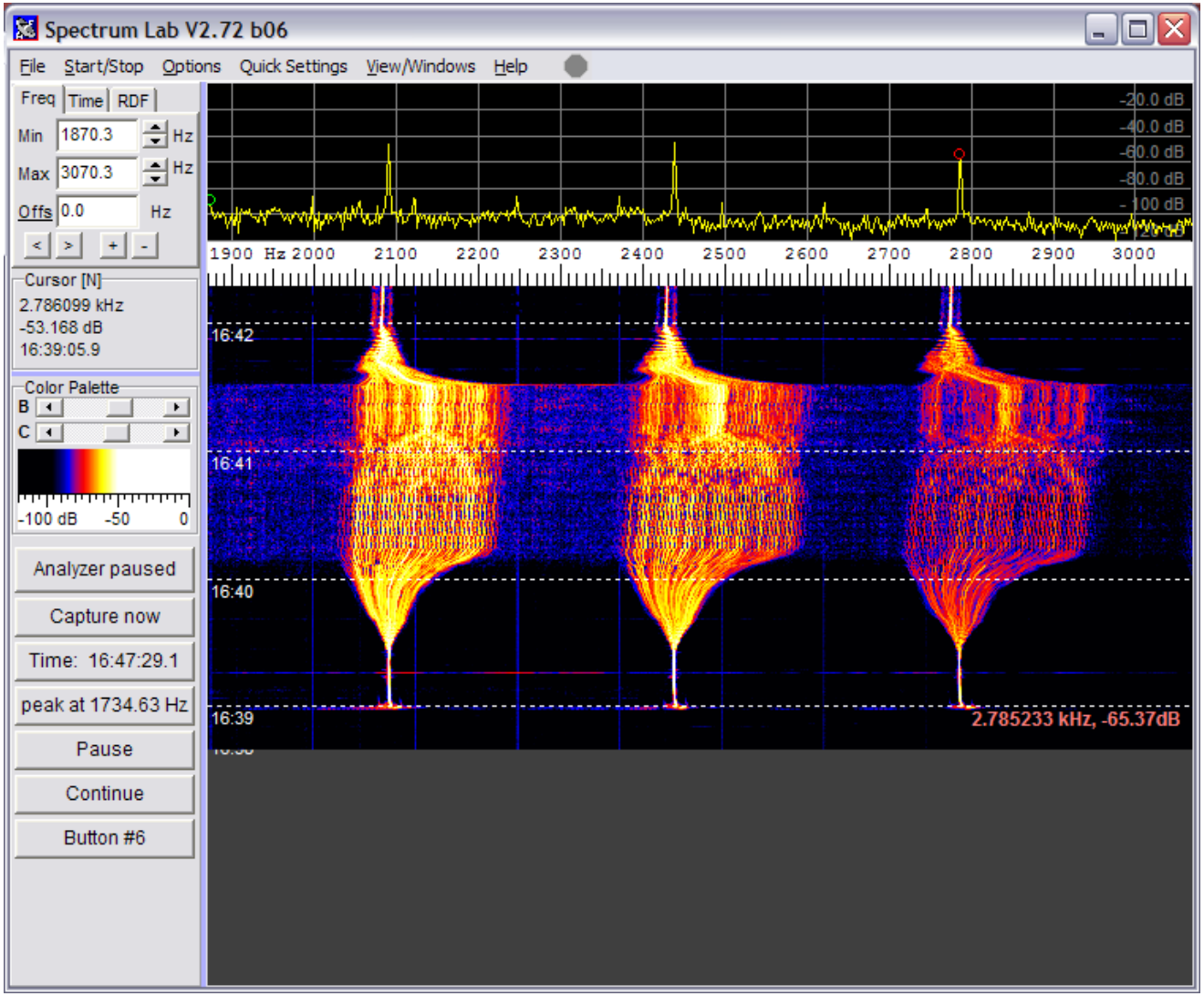
Spectrum Lab



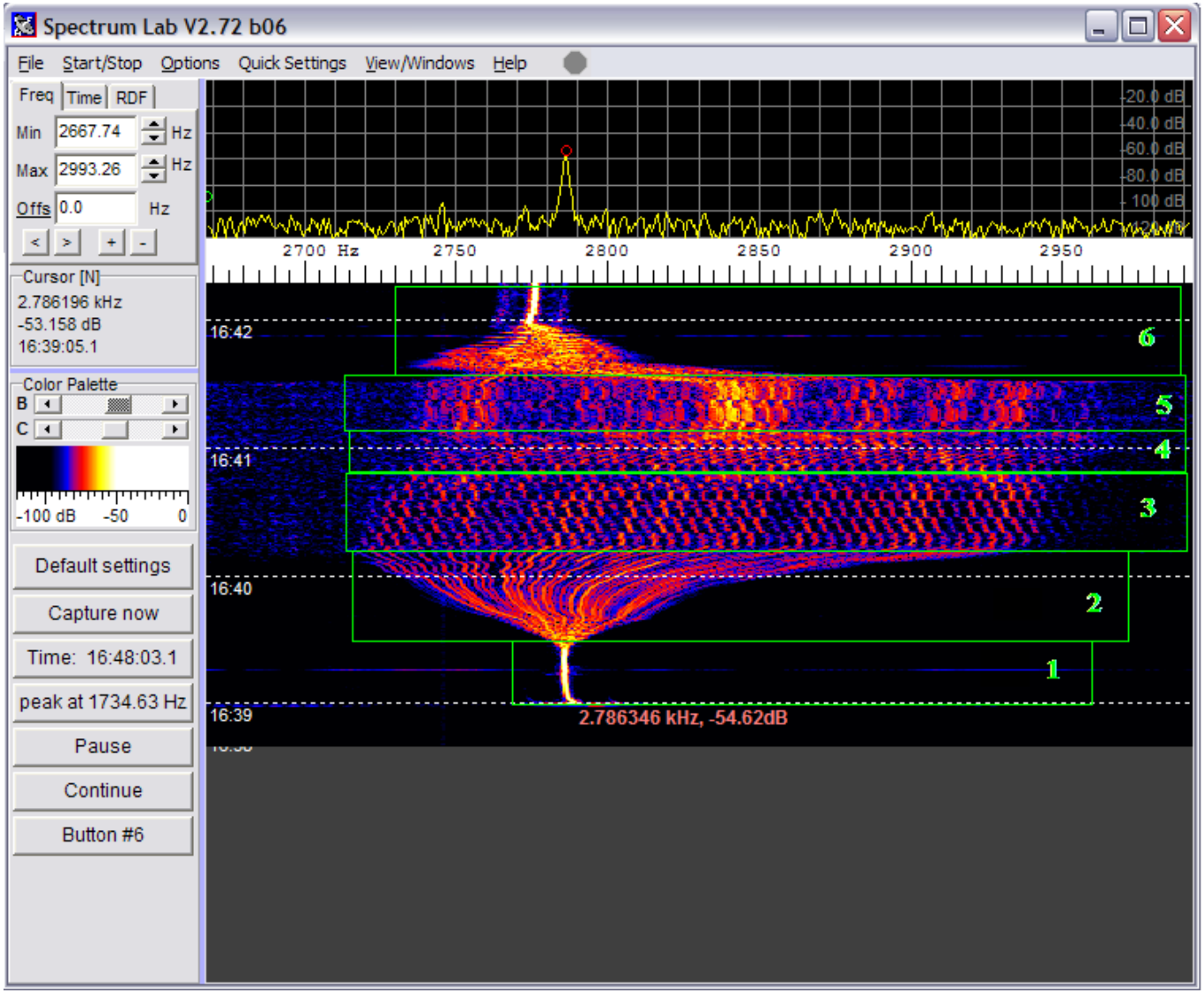
Experiment



Results


Spectrum Lab V2.72 b06
File Start/Stop Options Quick Settings View/Windows Help
Freq Time RDF
Min 1870.3 Hz
Max 3070.3 Hz
Offs 0.0 Hz
Cursor [N]
2.786099 kHz
-53.168 dB
16:39:05.9
Color Palette
B
C
-100 dB -50 0
Analyzer paused
Capture now
Time: 16:47:29.1
peak at 1734.63 Hz
Pause
Continue
Button #6
-20.0 dB
-40.0 dB
-60.0 dB
-80.0 dB
-100 dB
1900 Hz 2000 2100 2200 2300 2400 2500 2600 2700 2800 2900 3000
16:42
16:41
16:40
16:39
2.785233 kHz, -65.37dB

Results


Spectrum Lab V2.72 b06
File
Start/Stop
Options
Quick Settings
View/Windows
Help
Freq
Time
RDF
Min
2667.74
Hz
Max
2993.26
Hz
Offs
0.0
Hz
Cursor [N]
2.786196 kHz
-53.158 dB
16:39:05.1
Color Palette
B
C
-100 dB
-50
0
Default settings
Capture now
Time: 16:48:03.1
peak at 1734.63 Hz
Pause
Continue
Button #6
-20.0 dB
-40.0 dB
-60.0 dB
-80.0 dB
-100 dB
2700 Hz
2750
2800
2850
2900
2950
16:42
16:41
16:40
16:39
6
5
4
3
2
1
2.786346 kHz, -54.62dB

Going Forward

- Different Buzzer
  - Louder
  - Single frequency peak
- Completion of Lab
  - Setup
  - Write-up

III. Applets

By Bennett Lessard

My Goals

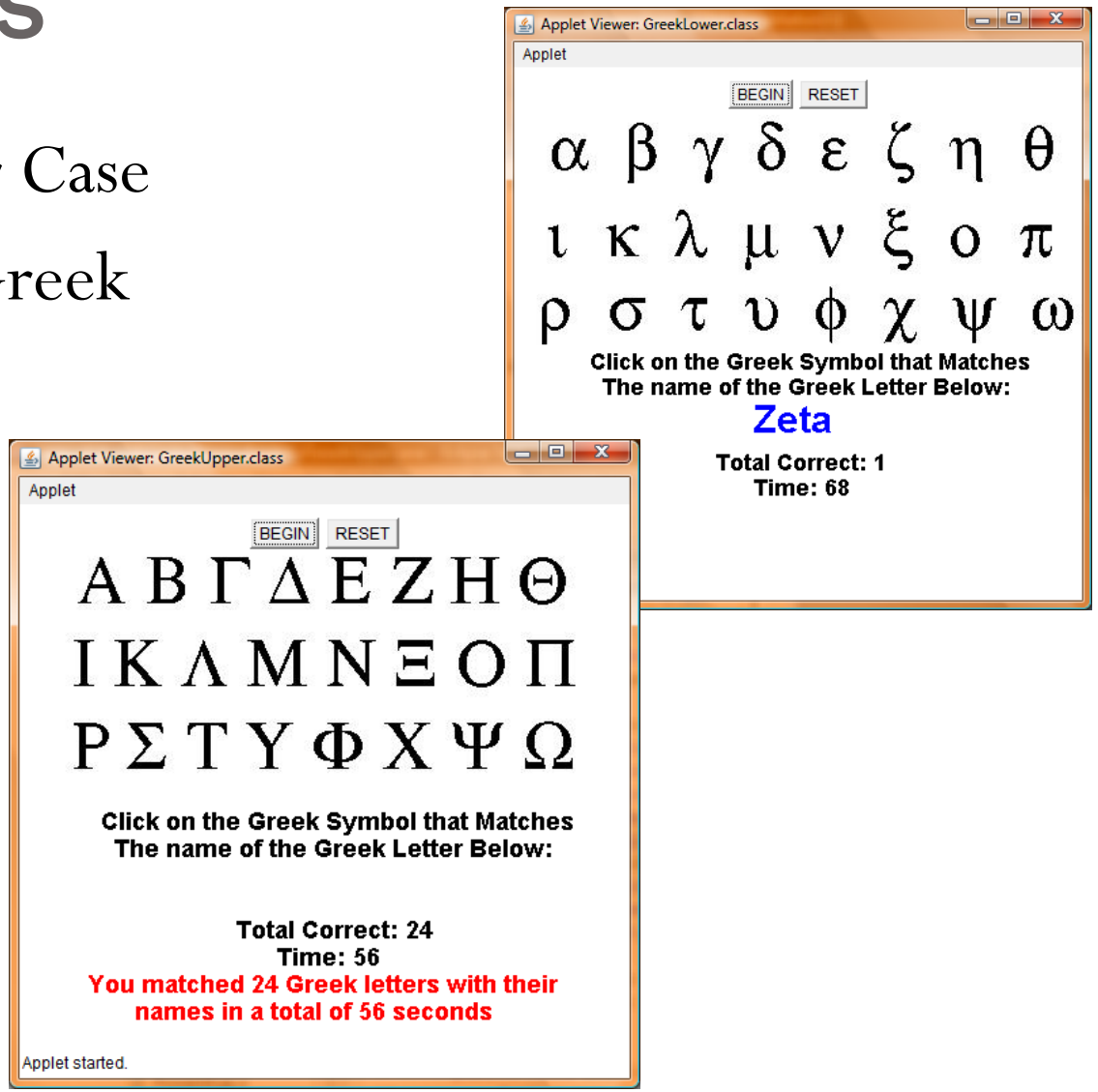
- Advance Java Knowledge
- Produce Applets For Web
  - Assisting Applets
  - Simulation Applets
- Explanatory Text Surrounding Applets
- Why Use Applets?
  - One Applet Can Be Applied To Many Areas

Applets Created

- Assisting Applets
  - Greek Letters
    - Upper Case and Lower Case
  - Powers of Ten
    - 3 Different Applets
  - Statistical Analysis Tool
- Simulation Applets
  - Projectile Motion
  - Collisions
  - Hooke's Law

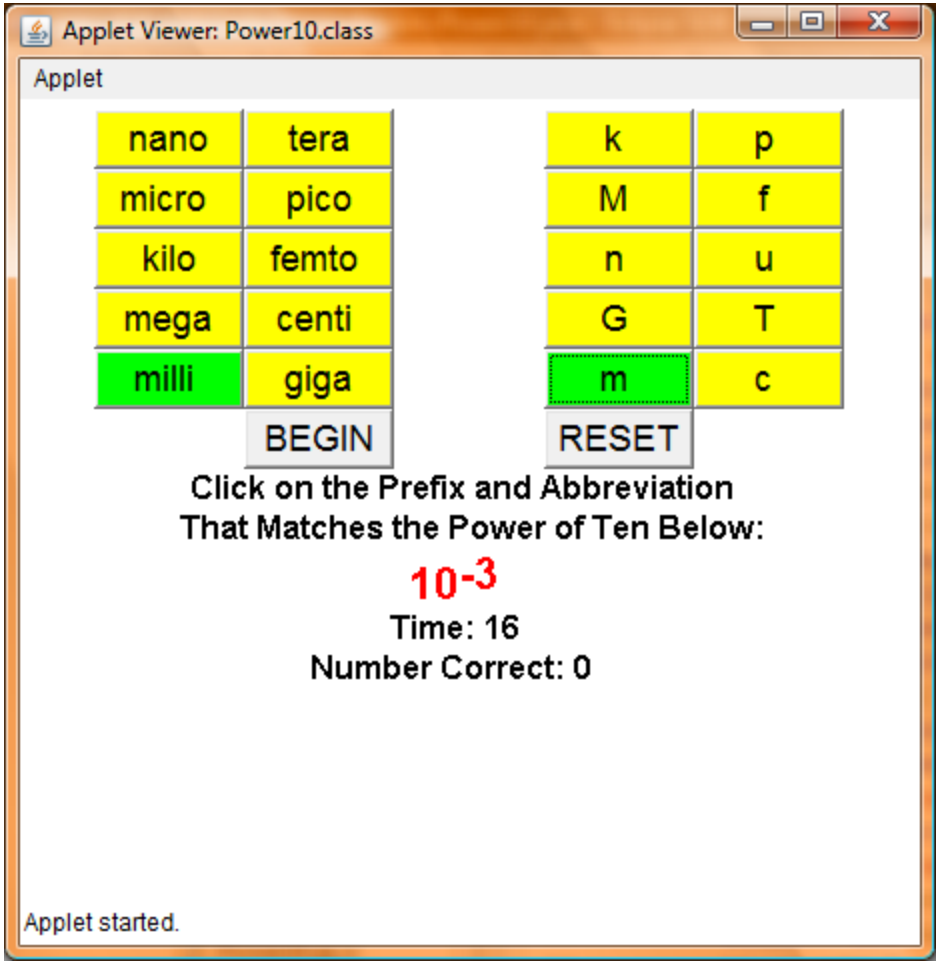
Greek Letters

- Upper and Lower Case
- Various Uses of Greek Letters



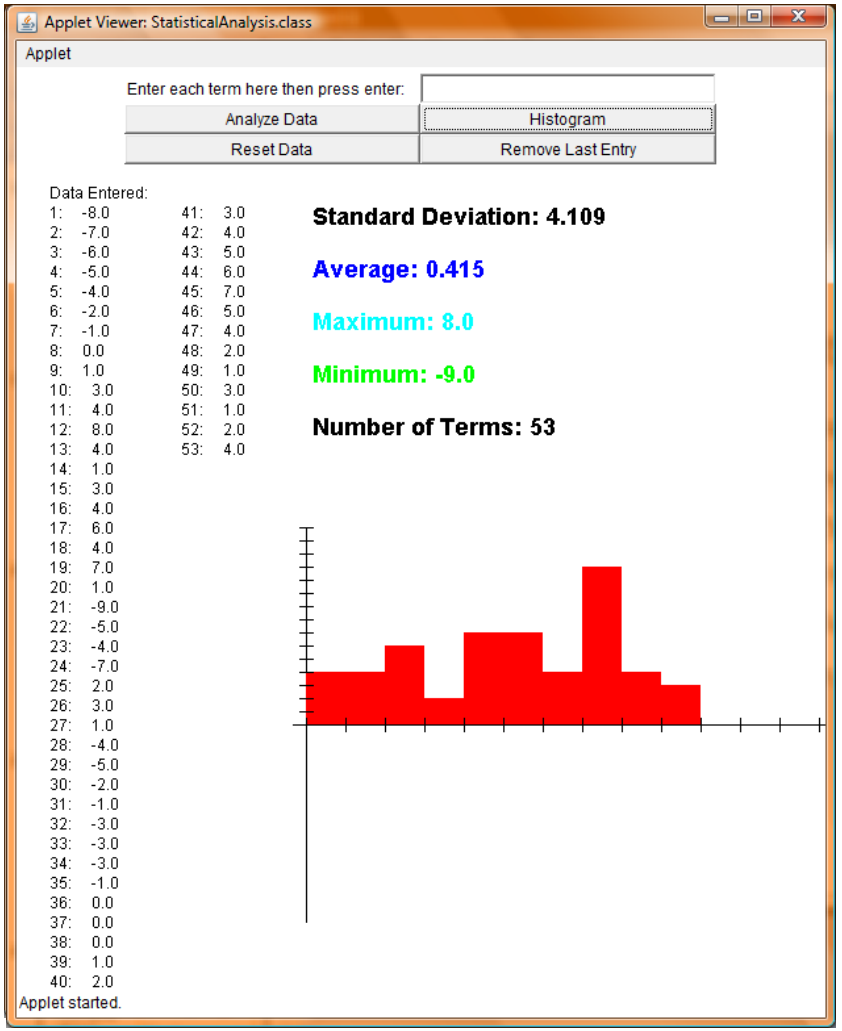
Powers of 10

- 3 Versions
- Kilograms to Microfarads



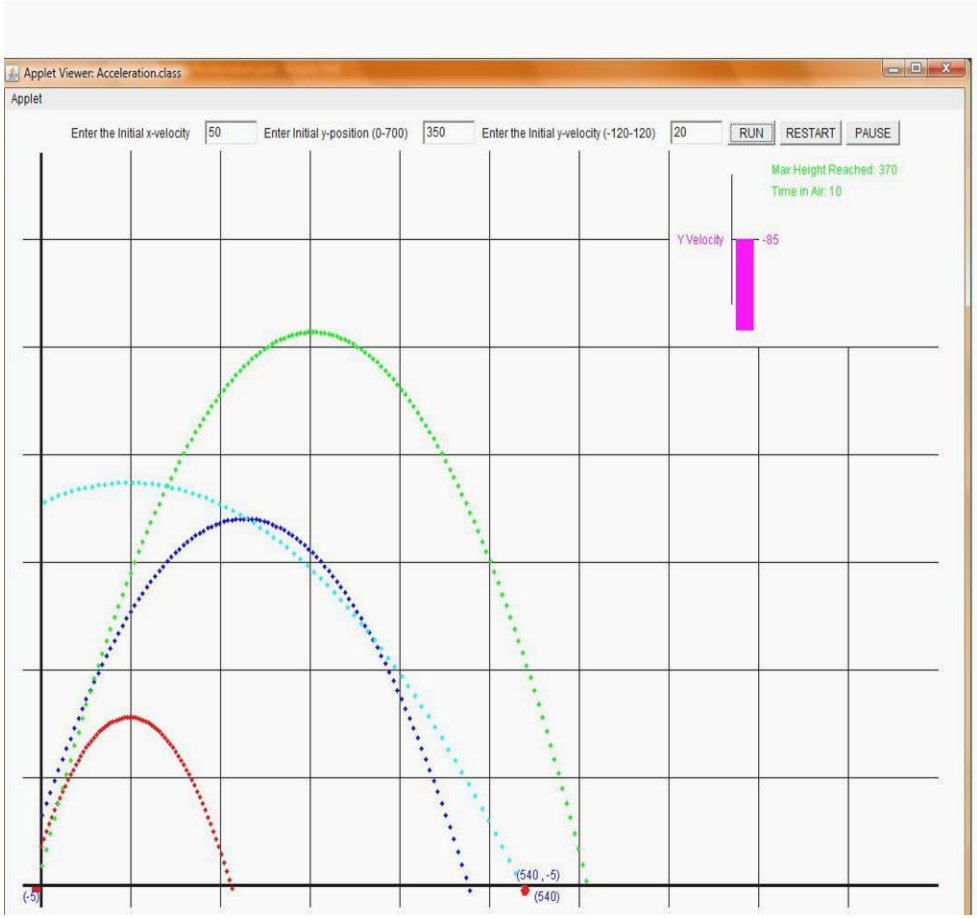
Statistical Analysis Tool

- User Enters Data
- Standard Deviation
- Mean, Max, Min, Number of Terms
- Plots Data, Auto Scaling
- Histogram Capabilities



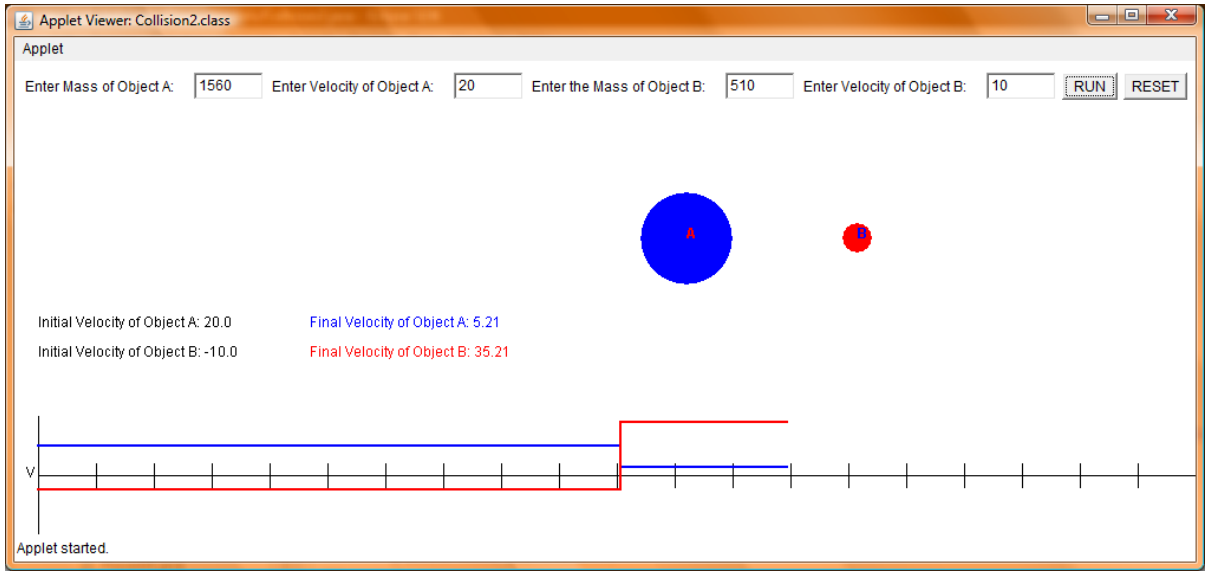
Projectile Motion

- Simulates Projectile Motion
- User Enters Velocities and Height
- Max Height
- Time in Air
- Position Readings



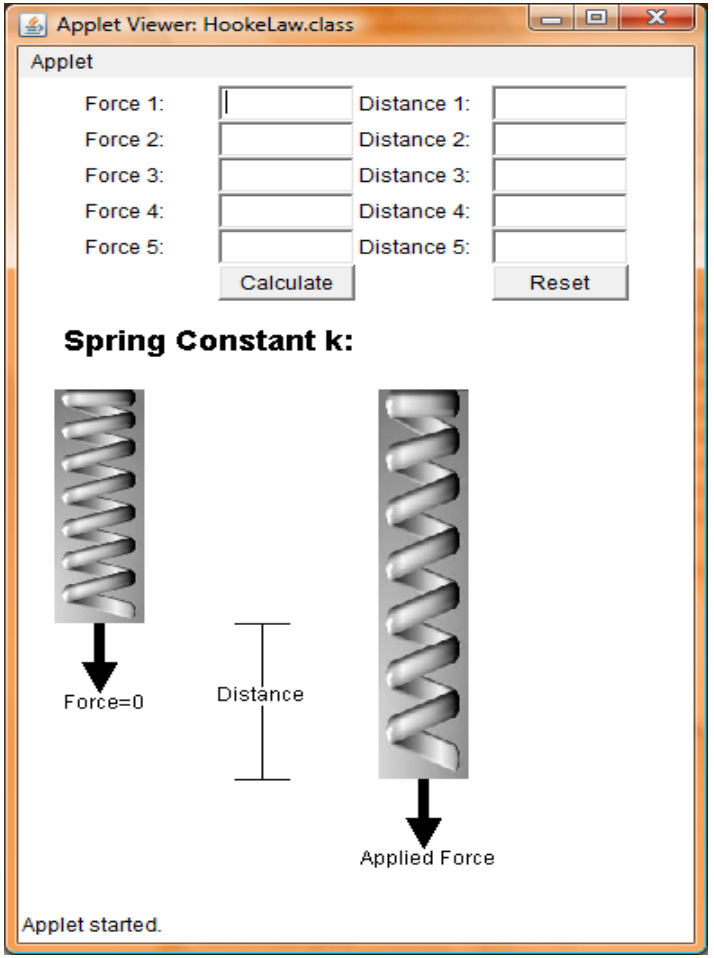
Collision

- Elastic Collisions
- Physics Equations
- Objects size
- Velocity Graph



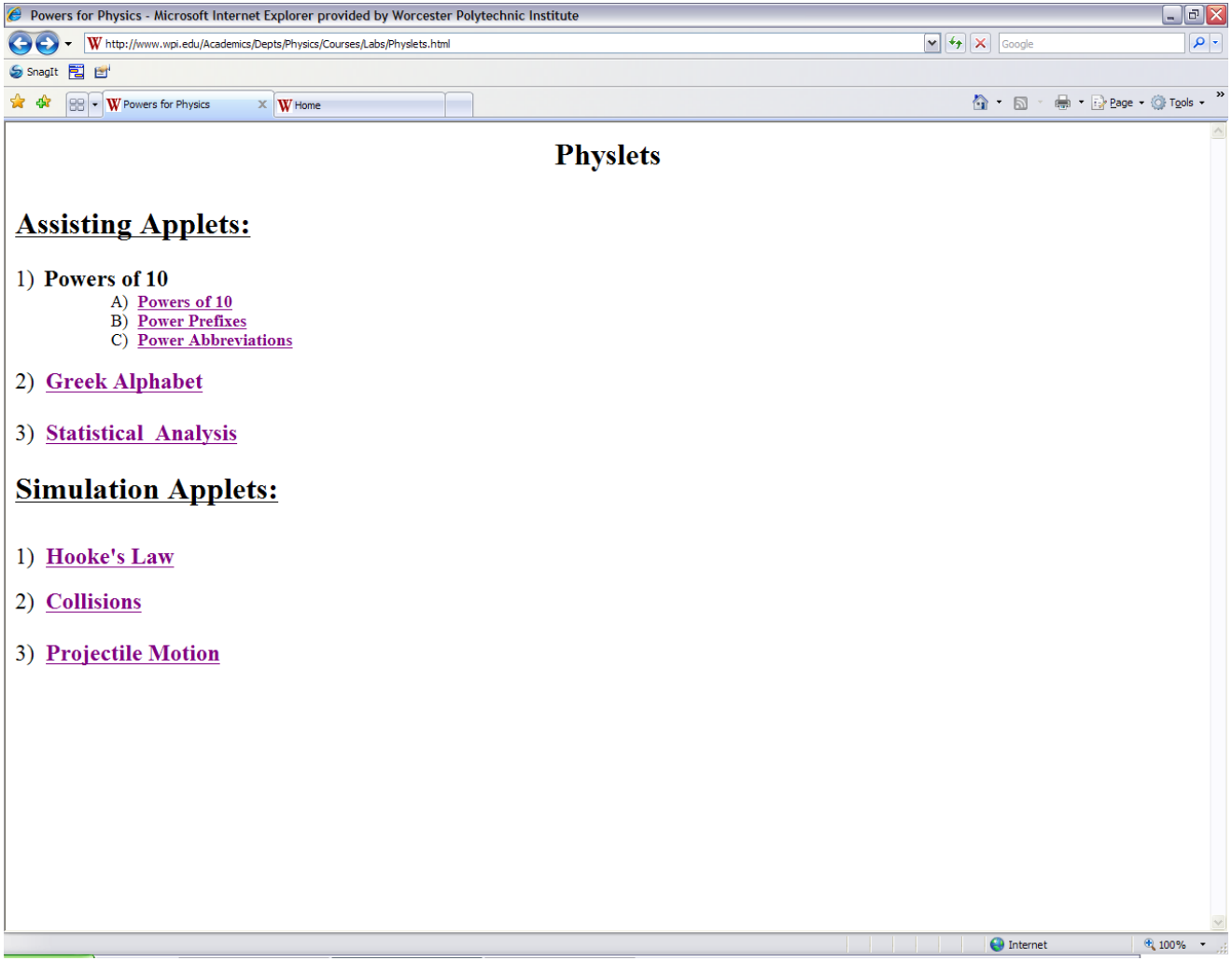
Hooke's Law

- Calculates Spring Constant



Available Online At…

http://www.wpi.edu/Academics/Depts/Physics/Courses/Labs/Physlets.html



Going Forward

- Specific to created applets
  - Projectile Motion
  - Collision
  - Statistical Analysis Tool
- Other Applet Ideas
  - Significant Digits
  - Unit Conversion
  - Physics Topics
- Web Development

IV. Energy Lab

Konrad Perry

My Goals

- Portray energy in a new light
- Excite Incoming Freshman
- Involve students
- Complement classroom learning

Hot Wheels Energy Lab

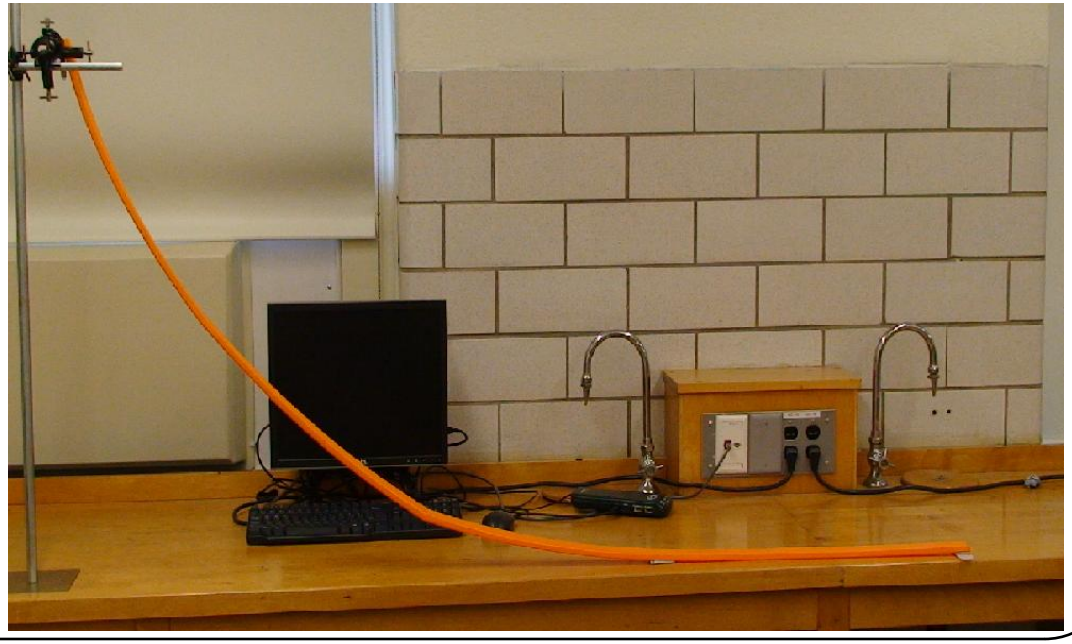
- Attempted Experiments
  - Photogates
  - Collision -- X
  - Force Sensor
  - Launch/Jump -- X
- Chosen Experiments
  - Photogates
  - Force Sensor

Photogate Experiment

Force Sensor Experiment

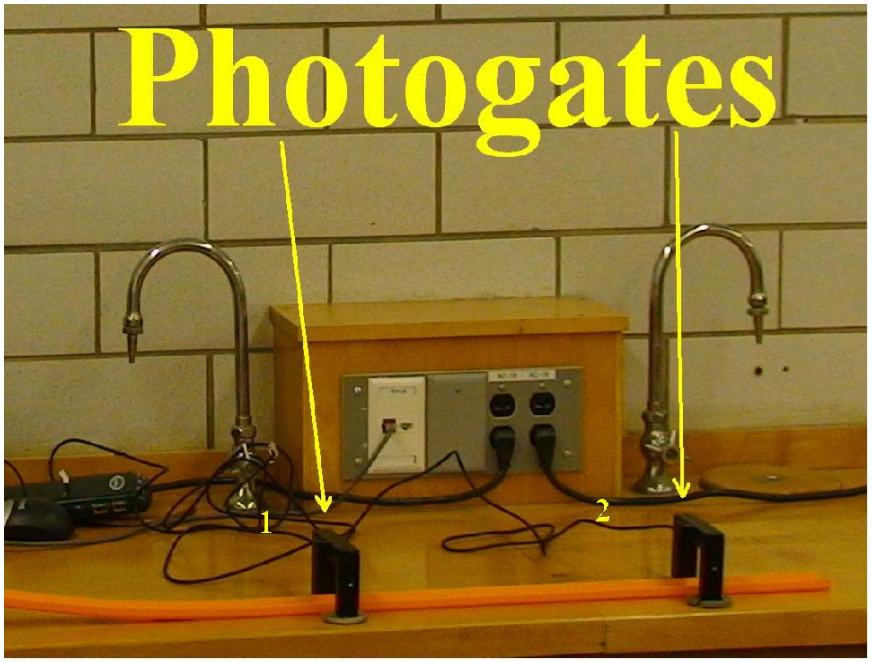
Lab Procedure

- Setup
- Photogate Experiment
- Force Sensor Experiment
- Data Sheet
- Lab Worksheet



Lab Procedure

- Setup
- Photogate Experiment →
- Force Sensor Experiment
- Data Sheet
- Lab Worksheet



Lab Procedure

- Setup
- Photogate Experiment
- Force Sensor Experiment
- Data Sheet
- Lab Worksheet

Data: Photogate

1st Height: 35 cm — Expected Velocity (m/s): 2.619

Photogate	Trial 1 Velocity (m/s)	Trial 2 Velocity (m/s)	Trial 3 Velocity (m/s)	Average Velocity (m/s)
1	2.544	2.532	2.524	2.533
2	2.500	2.469	2.483	2.485

2nd Height: 45 cm — Expected Velocity (m/s): 2.968

Photogate	Trial 1 Velocity (m/s)	Trial 2 Velocity (m/s)	Trial 3 Velocity (m/s)	Average Velocity (m/s)
1	2.788	2.845	2.816	2.816
2	2.751	2.796	2.686	2.744

3rd Height: 55 cm — Expected Velocity (m/s): 3.283

Photogate	Trial 1 Velocity (m/s)	Trial 2 Velocity (m/s)	Trial 3 Velocity (m/s)	Average Velocity (m/s)
1	3.172	3.168	3.162	3.167
2	3.106	3.100	3.095	3.100

Relationship

Height (m)	V (m/s)	$\sqrt{Y} * 4.427$ (m/s)	% Dev. (Theory)	% Dev. (Friction)
.35	2.533	2.619	-3.28%	-1.89%
.45	2.816	2.969	-5.15%	-2.56%
.55	3.167	3.283	-3.53%	-2.12%

Data: Force Sensor

Mass of Car (kg): .0343 Length of Car: .075m

1st Height

	Trial 1	Trial 2	Trial 3	Average
Max Force (N)	12.40	12.36	12.73	12.50
Impulse ($N*s$)	.0925	.0924	.0929	.0926

Expected Impulse ($N*s$): .0898

2nd Height

	Trial 1	Trial 2	Trial 3	Average
Max Force (N)	15.43	16.16	15.67	15.75
Impulse ($N*s$)	.1043	.1074	.1053	.1056

Expected Impulse ($N*s$): .1019

3rd Height

	Trial 1	Trial 2	Trial 3	Average
Max Force (N)	20.98	20.56	20.19	20.58
Impulse ($N*s$)	.1199	.1187	.1209	.1198

Expected Impulse ($N*s$): .1126

Difficulties in Experimentation

- Force Sensor Issues
- Data Sampling Rates
- Time Constraints
- Equations

Going Forward

- Lessons Learned
- For the Future

V. Energy Video

By John McGinley

Physics IQP

My Goals

- Provide an additional tool for learning
- Excite students
- Helpful demonstration of labs

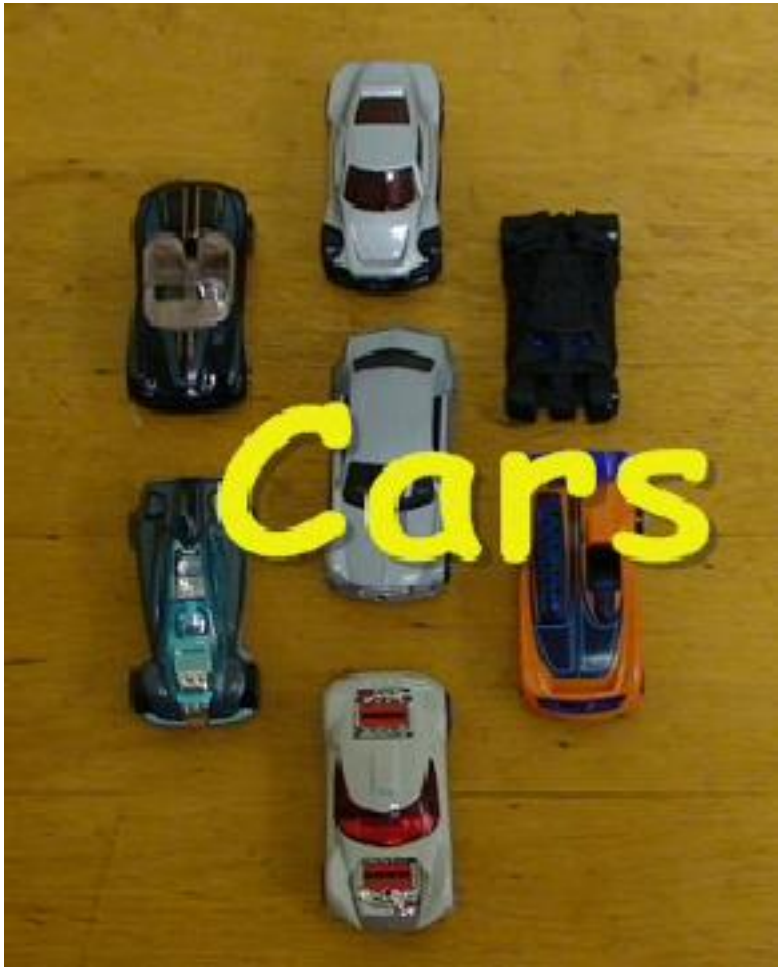
The Video

Part 1 (Introduction)

- Attention Grabbing

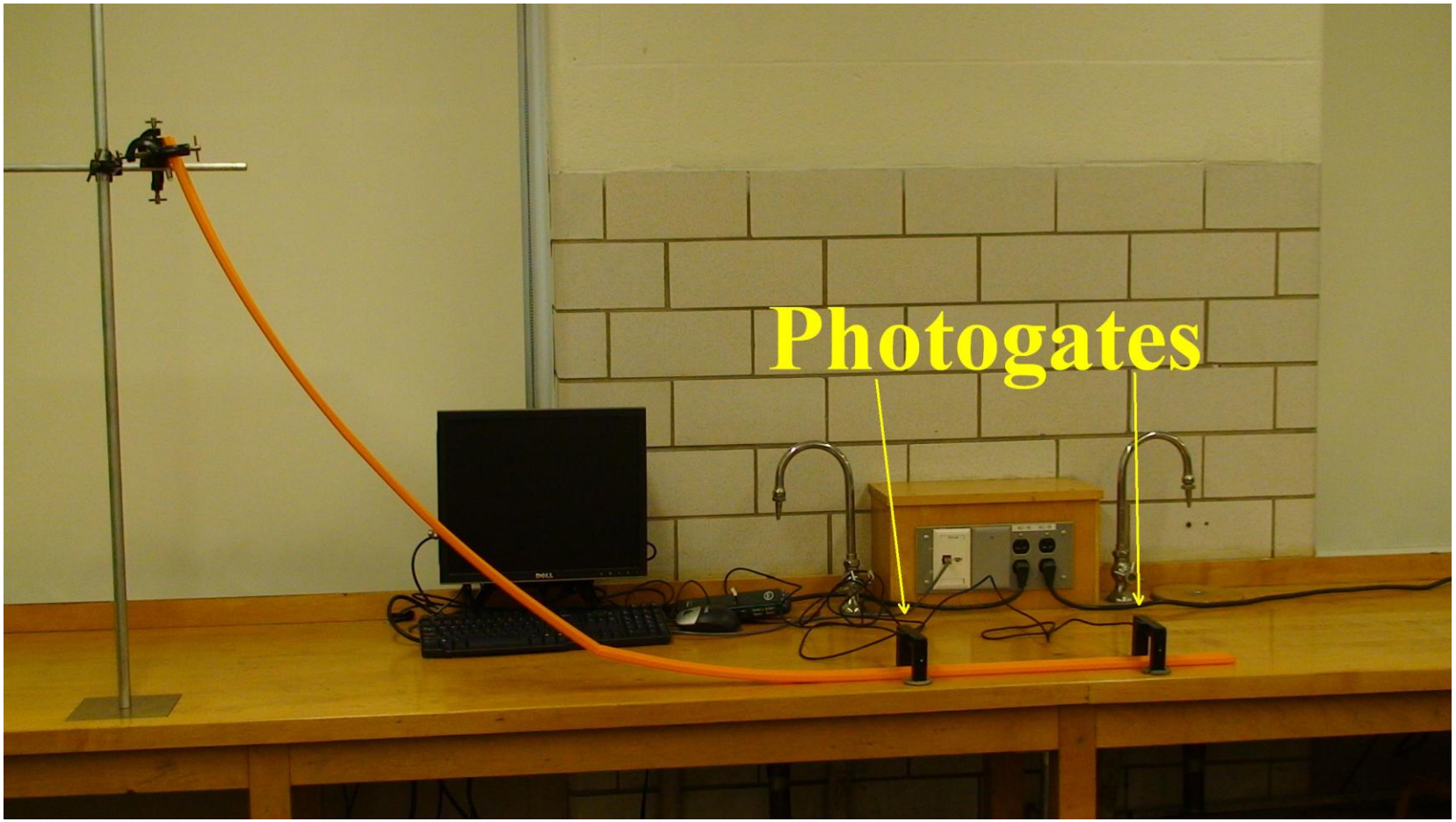
Part 2 (Materials)

- Show materials used



Part 3 (Photogate)

- Provide a visual aid of the final Photogate setup



Part 4 (Force Sensor)

- Provide a visual aid of the final force sensor setup

Part 5 (Conclusion)

- Leave the students interested

Going Forward

- Lessons learned
- Present material in several ways
- Create videos for other lab experiments

VI. Overall Conclusion

By Bennie Jones

My Part

- Organizational team-manager
- Head critique
- Unbiased experiment and applet evaluator
- Editor and moderator

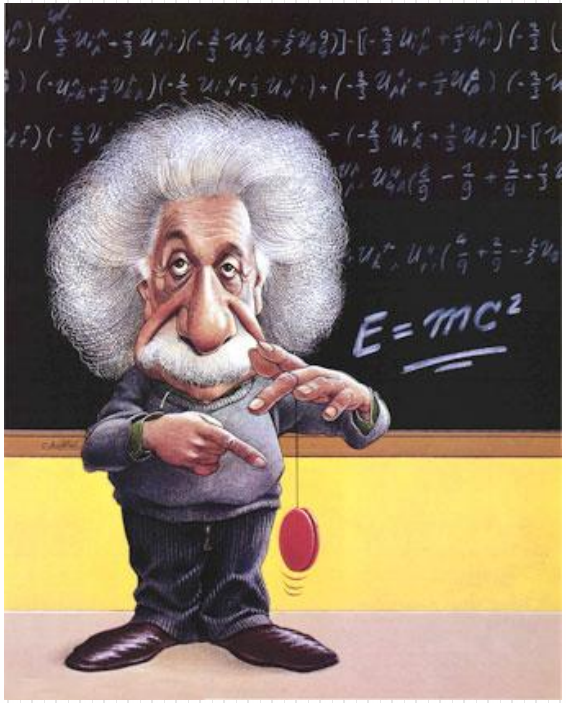
Conclusions

- Beginning feelings about Physics labs
- Ran through trials several times
  - Reworked, reworded, sharpened and shined
- Ending feelings about Physics lab

Going Forward

- Sample crowd
- Conduct surveys
- Implementation in classroom

Questions?



http://www.tuition.com.hk/pics/Physics-GCSE.jpg