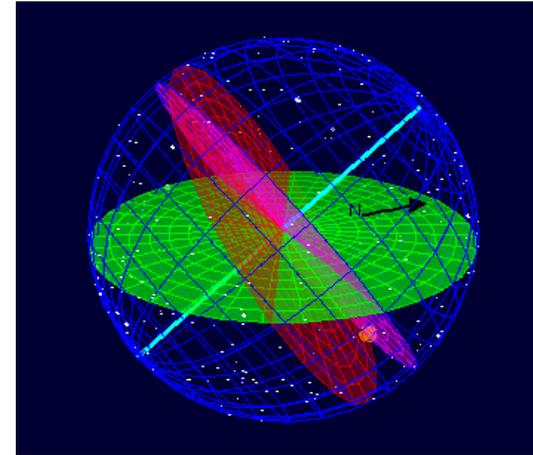

Physlets, Easy Java Simulations, and Open Source Physics

New Faculty Workshop

June 17-20, 2013

American Center for Physics, College Park, MD



Celestial sphere model.

Wolfgang Christian Davidson College, USA

Partial funding for OSP was obtained through NSF grants DUE-0442581 and DUE-0937836. Opinions expressed here are not those of the NSF.



Online Open Source Physics Resources

Open Source Physics (OSP) provides curriculum resources and tools that engage students in physics, computation, and computer modeling. Computational physics and computer modeling provide students with new ways to understand, describe, explain, and predict physical phenomena. This workshop explores the ComPADRE OSP Collection.

- Physlets are small interactive Java applets that are designed for the teaching physics in a web-based environment. [Physlet Physics](#) contains a collection of over 800 items spanning the introductory physics sequence.
- [Easy Java Simulations](#) encourages modeling and authoring with basic programming. EJS removes many of the complicated tasks involved in integrating computation into the classroom allowing students and teachers to focus on the science. The EJS environment allows learners to explore new physics and to test the limitations of the models being used.
- [Tracker](#) video analysis and modeling tool analyzes video clips. Students can both analyze the motion of objects and overlay simple dynamical models on the video and see how well the model matches the real-world.

The [OSP Collection](#) is a ComPADRE repository where EJS models and OSP-based curricular materials can be organized and shared.

Physlet Physics on ComPADRE

The screenshot shows the Physlet Physics website interface. At the top left is the Physlet Physics logo and the text "Physlet® Physics 2nd edition". To the right is a search bar with the text "Search Physlet Physics..." and buttons for "Search" and "Advanced". Below the search bar are navigation tabs for various physics topics: I. Mechanics, II. Fluids, III. Waves, IV. Thermodynamics, V. Electromagnetism, VI. Circuits, and VII. Optics. The VII. Optics tab is currently selected. The main content area displays "Chapter 1: Introduction to Physics" with a description: "This chapter is an introduction to the various topics covered in Physlet® Physics. In addition, this chapter gives you the basic computer skills you will need to run, interact with, and complete the Physlets." Below the description is a "Table of Contents" section with sub-sections for "Illustrations", "Explorations", and "Problems". Each sub-section contains a list of links to specific resources. At the bottom of the page, there is a footer with the text "Physlet Physics second edition Hosted by comPADRE" and "©2013 W. Christian and M. Belloni. Released under a Creative Commons Attribution-NonCommercial-NoDerivs License" along with the CC BY-NC-ND license logo.

Activity: Do the following problem: Draw the schematic diagram.

Introductory Physics

The Davidson College Physics Department has adopted the open source Moodle platform as its preferred course management system. Not only does this platform provide well organized course content for students, it encourages collaboration and provides an opportunity for outreach.

Weekly outline



PHYSICS 220: GENERAL PHYSICS II
FALL 2012

Instructor: Wolfgang Christian
Text: *Physics* by Doug Giancoli and *Physlet Physics* by Wolfgang Christian and Mario Belloni. (Please see me if you do not have a Physlet Physics CD.)

Lecture: MWF 9:30-10:20
Lab: Thursday 12:30-4:00
Office Hours: MWF 10:30-11:30, MW 2:00-3:00, and Th 9-11:00. Other times by appointment. Note that I am teaching a Physics 120/130 Lab Tuesday morning 8:00-11:00.
Help sessions: Students sometimes request that I have informal (and optional) evening help sessions. No new material is covered. I rely on students to guide the discussion of topics. These sessions are most popular before a major review but they can be scheduled whenever there is sufficient interest.

Corequisite course: [Physics 220 Laboratory](#)

- [Physics 220 Course Syllabus](#)
- [Physics 220 Course Objectives](#)
- [Physics 220 Course Structure](#)
- [Physics 220 Course Requirements](#)
- [Math and Science Center](#)
- [Physlet Physics](#)
- [Physlet Physics CD](#)
- [Davidson Library Research Guides](#)
This guide is a starting point for research in Physics. It includes links to research tools, tutorials, search tips, and more.
- [Physics Videos at Davidson](#)

Weekly outline



PHYSICS 220LA: GENERAL PHYSICS LAB
Fall 2012

Text: *Physics 220 Laboratory Manual* available online.
Lab: Thursday 12:30-4:00 p.m.
Office Hours: MWF 10:30-11:30, MW 2:00-3:00, and Th 9-11:00. Other times by appointment. Note that I teach Physics 120/130 Lab Tuesday morning 8:00-11:00.

Corequisite course: [Physics 220 Lecture](#) MWF 10:30-11:20 a.m.

- [Physics 220 Laboratory Structure](#)
- [Pre-Lab](#)
- [Lab Reports](#)
- [Lab Schedule](#)
- [Excel Commands](#)
- [Pasco Interface](#)
- [Error Statement](#)
- [Periodic Table and Unit Conversions](#)
- [News forum](#)

27 August - 2 September

PHYSICS 230 Lab 1: Electrostatics

Objective: Following Ben Franklin, we investigate electrical forces and prove experimentally that there are only two types of charge.

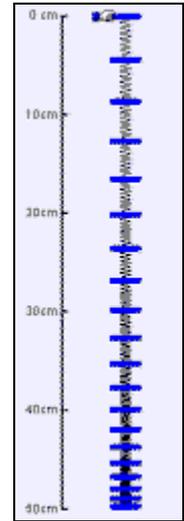
- [Electrostatics](#)
- [Physlet Field Hockey](#)

The Moodle course management system allows instructors to organize materials from multiple sources and reassemble them into a personalized course.

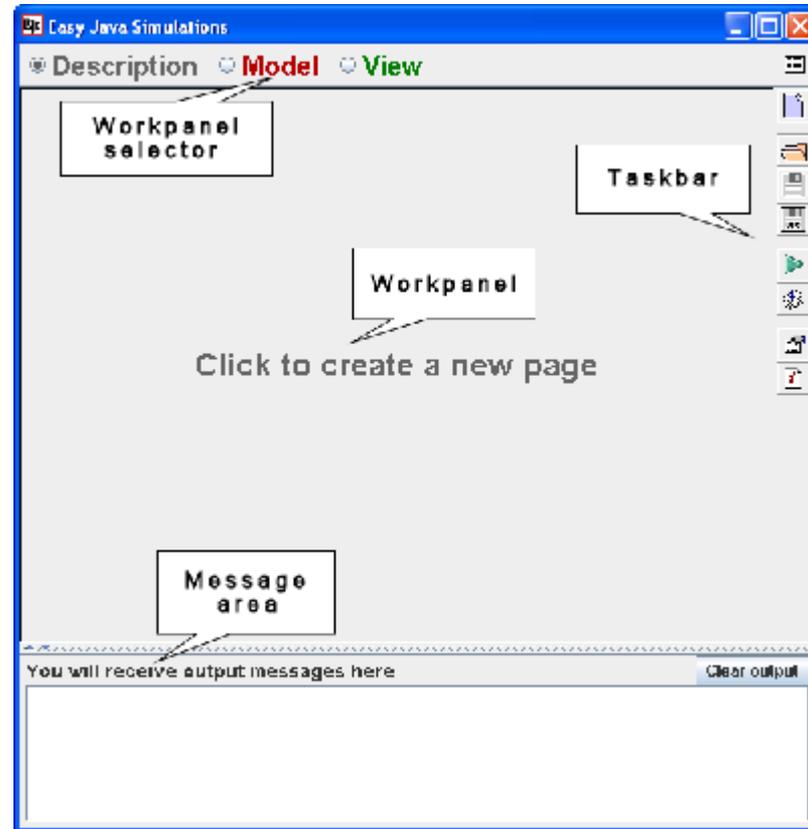
Computer Modeling

Workshop Activity: Go to the [OSP](#) site and find a simulation that you can use in your classroom. Explain how you would it.

- The [Falling Cup and Ball](#) model.
- The [Falling Slinky](#) model approximates a slinky using twenty masses connected with light springs. The slinky is suspended from one end and released. Two actions will occur simultaneously when it is released hanging at rest from its equilibrium position - it will fall and it will collapse. What happens to the bottom when it begins its fall?
 - The bottom end will move up initially.
 - The bottom end will move down initially.
 - The bottom end will remain at the same point for a short time before it begins to move.
- The [Colliding Galaxy](#) model.
- The [Lennard-Jones](#) molecular dynamics model.



Time for an EJS Demo.

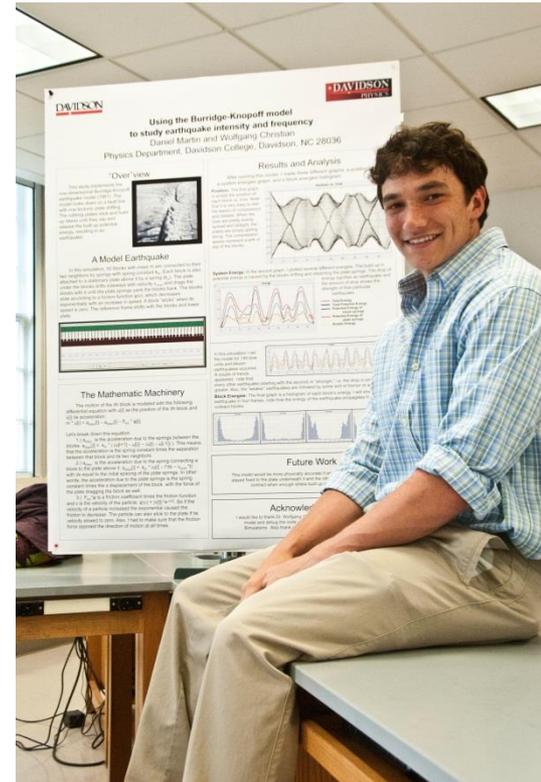


Start EJS and demonstrate how to load, modify, and save a model.
[Chain Model]

Teaching

Teaching should reflect current research and professional practice. Every undergraduate physics major should know about computational physics, including essential algorithms, some level of programming experience, and computational ways of thinking.

- Differential equations and ODE numerical algorithms: oscillators, Newtonian orbits, and few-body problems.
- PDEs and boundary value problems: Laplace and Poisson equations.
- Stochastic models and Monte Carlo algorithms: Random walks and the Ising model.
- Chaos theory: Logistic map and driven pendulum.
- **Final project of the student's choice.**



[See shared filing cabinet.](#)

Interactive Engagement



The problem with our system of education is....

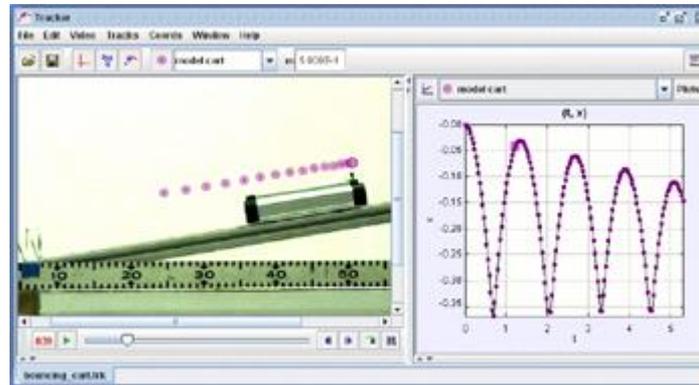
...that we reward students for knowing the answers....

....to questions they have never asked.

Video Modeling with Tracker

Three easy steps:

- Load Video
- Set scale and origin
- Shift-click to take motion data



Time for a demo!

Modeling Cycle

- The goal of modeling is to teach in a student-centered environment where students do **not** solve problems in a formula-centered way.
- Modeling Instruction attempts to enhance student achievement through a process called the **Modeling Cycle**, (following Robert Karplus' Learning Cycle).
- Throughout the Modeling Cycle we rely on student engagement and explanation as the dynamic of learning.
- The start of the modeling cycle is the development phase:
 - Qualitative description
 - Identification of variables
 - Planning an experiment
 - Performing the experiment
 - Analysis of experiment
 - Presentation of results
 - Generalization

Although the Modeling Cycle can be used without computers, it is well suited for computer modeling if we replace the word “experiment” with “simulation” in the development phase.

After the development phase, the model is deployed in a variety of new physical situations in a variety of different ways.

Need for Digital Libraries

A Google search for “***pendulum***” returns 11,600,000 pages; while “***pendulum simulation***” returns 2,490 pages (The search for ***pendulum simulation*** without the quotes returns 449,000 pages).

- Most of the simulations (or animations that “fake” the physics) are inappropriate for teaching.
- There is usually no instructional material, no support materials for teachers, and no information about how these materials are correlated to state or national science standards.
- Most of these simulations also support a passive (viewing) pedagogy versus an active (interacting) pedagogy.

In order to be effective for instruction, simulations need to be easy to find, simple, adoptable, adaptable, and coupled with support content for students and teachers.

ComPADRE

“But in my view, the most important implication of choosing a web-based technology is the way it facilitates sharing.” Joe Redish 2001

Standard and Custom
Library and Web
Services

Connections to Users
and NSDL

>500 OSP Items

>10,000+ visitors/month

>5,000 simulation
downloads/month

OSP open source physics

Logged in as Bruce, ComPADRE Dir (bmason@ou.edu) - [my profile](#) - [logout](#)
[filing cabinet](#) - [suggest a resource](#) - [administrate](#)

Search the OSP Collection...

SIMULATIONS
EJS MODELING
CURRICULUM
PROGRAMMING
TOOLS
BROWSE MATERIALS
RELATED SITES
DISCUSSION
ABOUT OSP

Computational Resources for Teaching

The OSP Collection provides curriculum resources that engage students in physics, computation, and computer modeling. Computational physics and computer modeling provide students with new ways to understand, describe, explain, and predict physical phenomena.

Simulations

OSP Simulations are compiled programs on specific topics. The models can be used for concept building, exploring physical systems that are not accessible otherwise, or as a basis for other student exercises.

[Browse simulations](#)

EJS Modeling

Student modeling, the guided exploration of physical systems and concepts, is a powerful approach to engaged learning. Easy Java Simulations provides the computational tools for students and faculty to explore physics without the need for learning details of java programming.

[Learn more about EJS](#)

Featured Simulation

Polarizer Program
The Polarizer program displays the effect of a plane polarizer on an incident electromagnetic wave. The default electromagnetic wave is plane polarized but this polarization can be changed using

Featured EJS Model

Orbiting Mass on a Cone 3D Model
The EJS Orbiting Mass on a Cone 3D model displays the frictionless dynamics of a mass constrained to orbit on the inside of a

Upcoming OSP Events

[Incorporating Computation and Modeling into Physics Teaching](#)
Workshop for New Physics and Astronomy Faculty
ACP, College Park, MD
November 13-15, 2009

[SC 09: Educational Program](#)
EJS, Pathways, and Digital Libraries Presentations
SC 09: International Conference on High Performance Computing, Networking, Storage, and Analysis
Portland, OR
November 14-17, 2009

[Open Source Physics Content Delivery: Computation, Curriculum, and Libraries](#)
A presentation at the 2009 NSDL annual meeting on use and dissemination of OSP and EJS resources

[Building a National Digital Library of Physics Simulations](#)
Presentations by Wolfgang Christian and Fu-Kwun Hwang at the CCP 2009 conference in Kaohsiung, Taiwan December 2009

The Open Source Physics Project is supported by NSF DUE-0442581.

Library Information

Phases of Moon Model
written by Todd Timberlake

The EJS Phases of Moon model displays the appearance of Moon and how it changes depending on the position of Moon relative to Earth and Sun. The main window shows Earth (at the center) and Moon, as well as a circle tracing out Moon's orbit. Sun is far to the right in this picture and therefore the right side of Earth and Moon are bright while the left sides are dark. By using the Options Menu the Moon View window shows the appearance of Moon as seen from Earth when Moon is in the position shown in the main window. You can modify this simulation if you have Ejs installed by right-clicking within the plot and selecting "Open Ejs Model" from the pop-up menu item.



The EJS Phases of Moon model includes three supplemental documents (see below) that include a middle school lesson plan, a college level worksheet, and the student version of the program.

EJS Phases of Moon model was created using the Easy Java Simulations (Ejs) modeling tool. It is distributed as a ready-to-run (compiled) Java archive. Double clicking the `ejs_astronomy_MoonPhases.jar` file will run the program if Java is installed. Ejs is a part of the Open Source Physics Project and is designed to make it easier to access, modify, and generate computer models. Additional Ejs models for astronomy are available. They can be found by searching ComPADRE for Open Source Physics, OSP, or Ejs.

Please note that this resource requires at least version 1.5 of Java (JRE).

 [download 923kb .jar](#)
 Last Modified: April 14, 2010
[previous versions](#)

View the supplemental documents attached to this resource (3)

View the source code document attached to this resource

Subjects	Levels	Resource Types
Astronomy <ul style="list-style-type: none"> - Astronomy Education <ul style="list-style-type: none"> = Curricula - Fundamentals <ul style="list-style-type: none"> = Lunar Phases - Solar System <ul style="list-style-type: none"> = The Moon 	<ul style="list-style-type: none"> - Lower Undergraduate - Middle School - High School 	<ul style="list-style-type: none"> - Instructional Material <ul style="list-style-type: none"> = Curriculum support = Interactive Simulation - Audio/Visual <ul style="list-style-type: none"> = Image/Image Set

Intended Users	Formats	Ratings
<ul style="list-style-type: none"> - Learners - Educators - General Publics 	<ul style="list-style-type: none"> - application/java 	 Rated 5.0 stars by 9 people Want to rate this material? Login here!

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Related Materials

Is Based On

- [Easy Java Simulations Modeling and Authoring Tool](#)

Is the Basis For

- www.phy.ntnu.edu.t...

[See details...](#)

Similar Materials

- [Phases of Venus Model](#)
- [Solar and Lunar Eclipse Model](#)
- [Superior Ptolemaic Model](#)

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Personalization

Content ...

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Computer Program Detail Page

Superposition Package

written by Mario Belloni and Wolfgang Christian

The Superposition package is a self-contained file for the teaching of the time evolution and visualization of energy eigenstates and their superpositions in quantum mechanics. The file contains ready-to-run OSP programs and a set of curricular materials. One can choose from several real-time visualizations, such as the position and momentum expectation values and the Wigner quasi-probability distribution for position and momentum.

The Superposition package is an Open Source quantum mechanics. It is distributed as a resp_superposition.jar file will run the package are also available. They can be found by searching Quantum Mechanics.

Save into folder: Quantum Relations

- Quantum Relations
- de Raedt
- Dephasing
- Entanglement
- Falstad
- Joffre
- Spin
- Vis Quantum Mechanics
- Hydrogen Spec
- PSRC Relations
- Henderson
- Matter & Interactions

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Open Source Physics Results Partner Results

Search Terms: Quantum Spin

Results #1-#3 of 3

sort by: relevance | subject | date | title | author

- 1. Spins Package [Computer Program] [A]**
[Details](#) [Post a comment](#) [Save this resource](#) [Relations](#) [Control Menu](#)
The Spins package is a self-contained file for the teaching of measurement and time mechanics. The file contains ready-to-run OSP programs and a set of curricular ...
<http://www.compadre.org/OSP/document/ServeFile.cfm?ID=7329&DocID=491>
- 2. QM Spins Program [Computer Program] [A]**
[Details](#) [Post a comment](#) [Save this resource](#) [Relations](#) [Control Menu](#)
The QM Spins program simulates the quantum-mechanical measurement of spin-1/2 shows the result of measuring the z component of spin on a beam of spin-1/2 particles.
<http://www.compadre.org/OSP/document/ServeFile.cfm?ID=7011&DocID=344>
- 3. Open Source Physics Curricular Material for Quantum Mechanics [A]**
[Details](#) [Post a comment](#) [Save this resource](#) [Relations](#) [Control Menu](#)
M. Belloni, W. Christian, and D. Brown, Comp. Sci. Eng., 9 (4), 24-31 (2007).
The Open Source Physics Curricular Material paper describes the interactive curricular material created as part of the Open Source Physics project for the teaching and learning of quantum mechanics. Here ...
<http://www.compadre.org/OSP/document/ServeFile.cfm?ID=7286&DocID=456>

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- OSP Quantum
- OSP General Relativity
- Physlet
- Role of Lab

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 - Entanglement
 - Falstad
 - Joffre
 - Spin
 - Vis Quantum Mechanics

Bookmarks | Sharing | Folder Management | Citation Guide

Quantum Relations

- Superposition Package: Eigenstates and Sums**
Quantum 1: 1D Quantum States
This package of exercises and tutorial materials introduces students to 1D quantum eigenstates and sums of eigenstates. Relations to potential functions and time dependence are stressed.
[details](#) - [download page](#) - [edit personal note](#) - [cite](#)
- Spins Package: 2-state Physics**
This simulation of Stern-Gerlach experiments provides a powerful tool to teach quantum physics as linear algebra. Examples of measurements and time dependence are given.
[details](#) - [download page](#) - [edit personal note](#) - [cite](#)

Quantum Relations Options

Copy or Move bookmarks selected above to the [] folder »

Visit the [Folder Management](#) tab to create sub-folders, rename, move, or delete this folder. You may also provide an [annotation](#) for this folder. Visit the [Sharing](#) tab for information on sharing this folder.

OSP Collection Team

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 - Matt Riggsbee- AAPT
 - Caroline Hall- AAPT



AMERICAN INSTITUTE OF PHYSICS



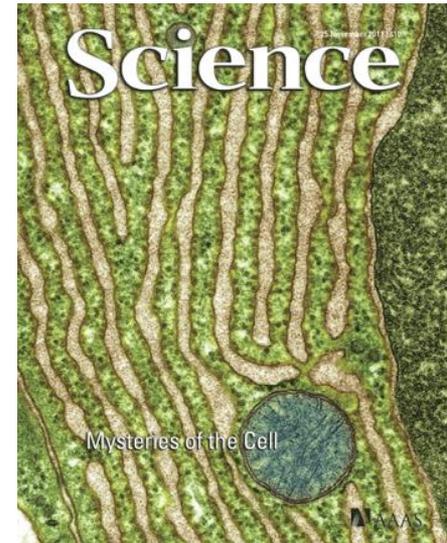
American Physical Society

Summary

The **OSP ComPADRE Collection** removes many of the complicated tasks involved in integrating computation into the classroom allowing teachers to focus on the science.

- OSP provides many computational tools, including a computational physics textbook, for our project.
- OSP allows learners to engage in computational physics modeling.
- OSP encourages the sharing of curricular materials by allowing instructors to adapt existing EJS models to their particular needs.
- ComPADRE supports distribution and collaboration by providing an internet portal and a web service of models that are directly downloadable into the EJS and Tracker modeling tools.

The OSP Collection in ComPADRE is a repository where programs, models, and curricular materials can be organized and shared by developers and instructors around the world.



Open Source Physics

In 2012, the OSP Collection had 500,000 page views and 22,000 visits from visitors returning six or more times. More importantly, there were 50,000 simulations downloaded from the Collection and many additional source code downloads from within EJS into users' workspaces. Physlets and the OSP Collection are recognized by over 50% and 22%, respectively, of United States physics faculty as a research-based instructional strategy they are familiar with or have used.

www.compadre.org/osp