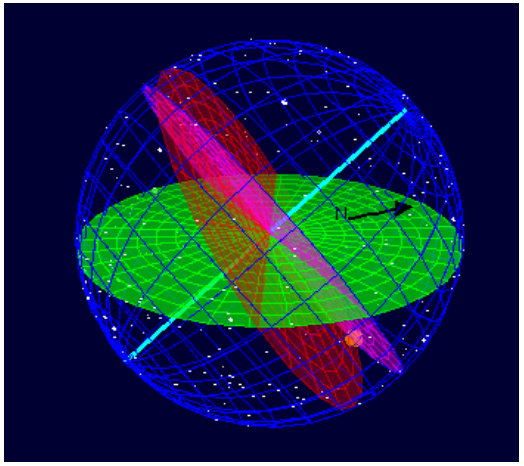
Physlets, Easy Java Simulations, and Open Source Physics

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 grant s 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.

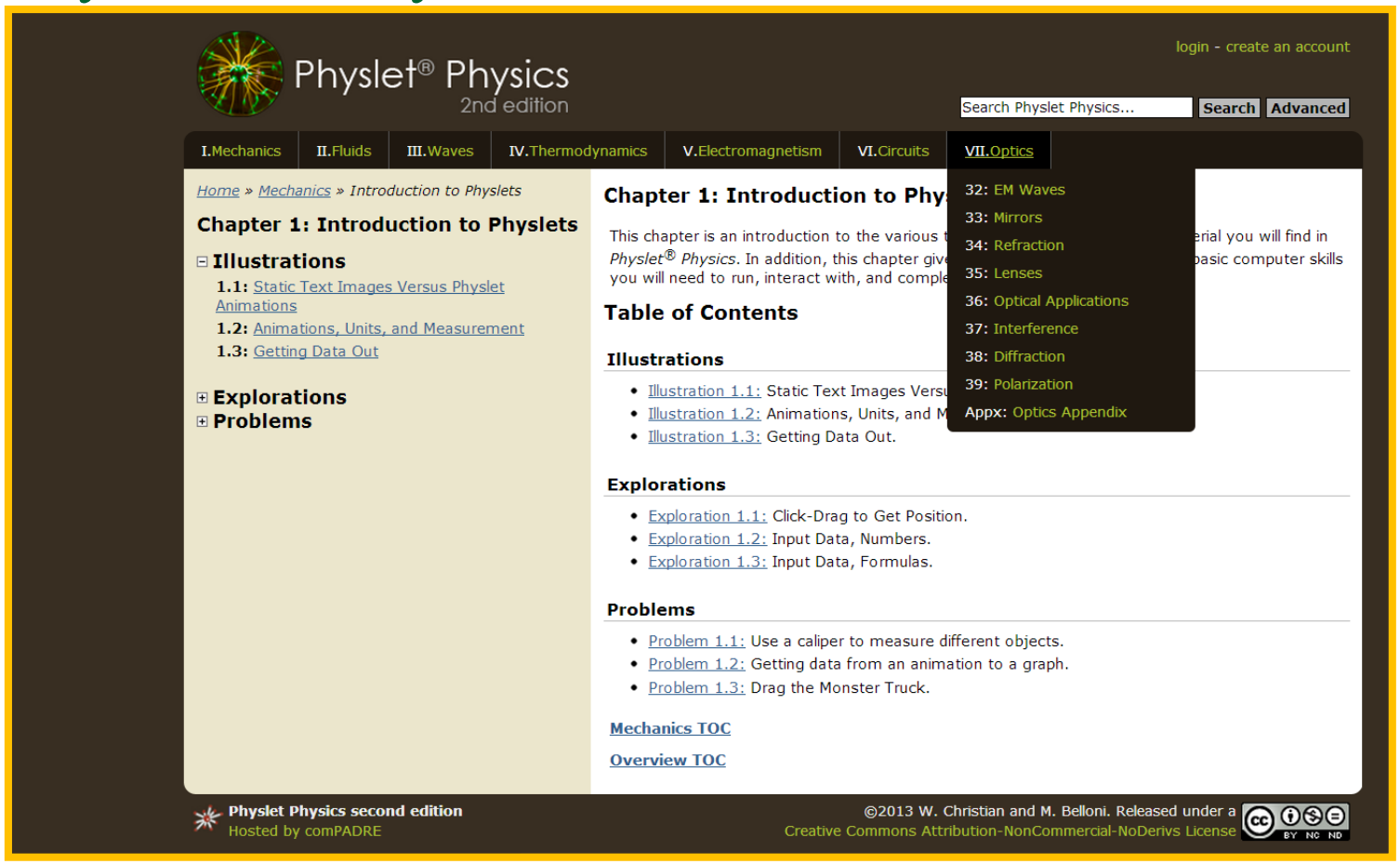
- Physlets are small interactive Java applets that are designed for the teaching physics in a web-based environment. **Physlet Physics** contains a collection of over 800 items spanning the introductory physics sequence.

- **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.

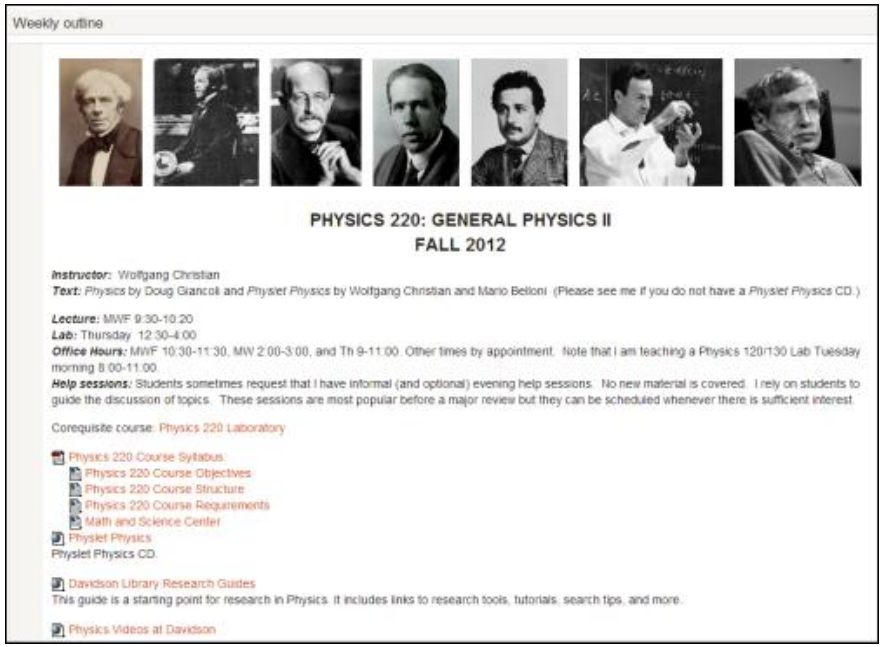
Physlet Physics on ComPADRE

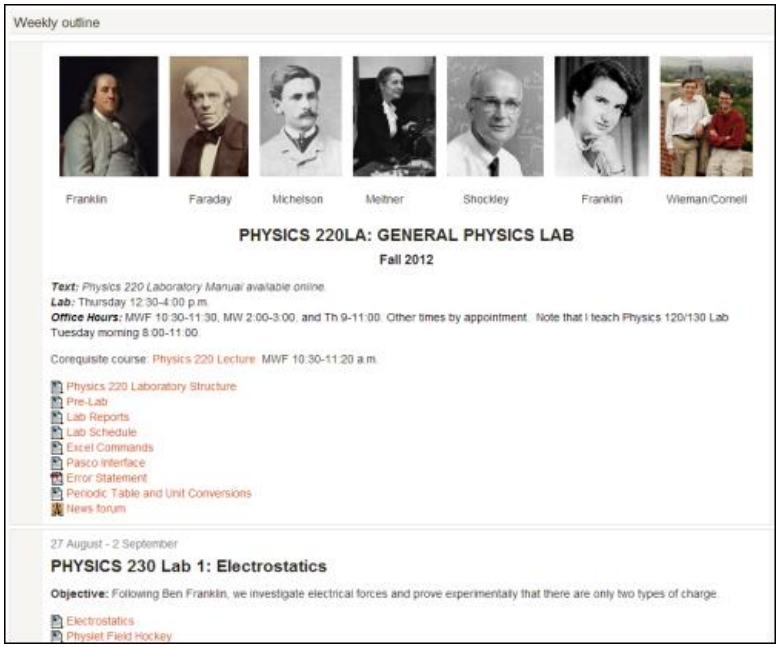


Activity: Do the following problem: Draw the schematic diagram.

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.

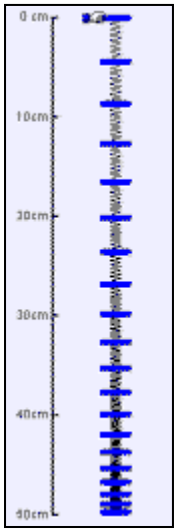




The Moodle course management system allows instructors to organize materials from multiple sources and reassemble them into a personalized course.

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.

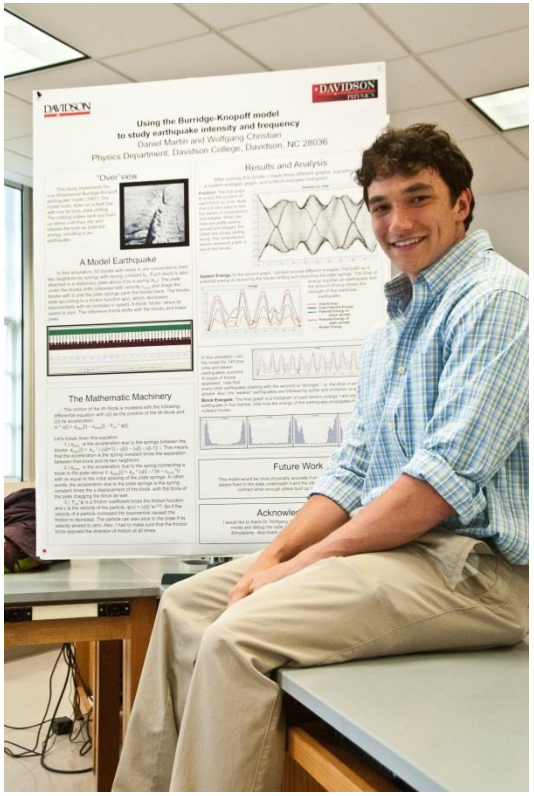
Time for an EJS Demo.

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….

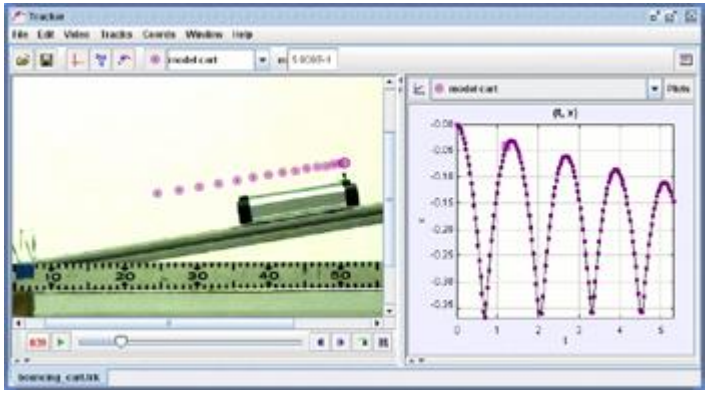
…that we reward students for knowing the answers….

….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

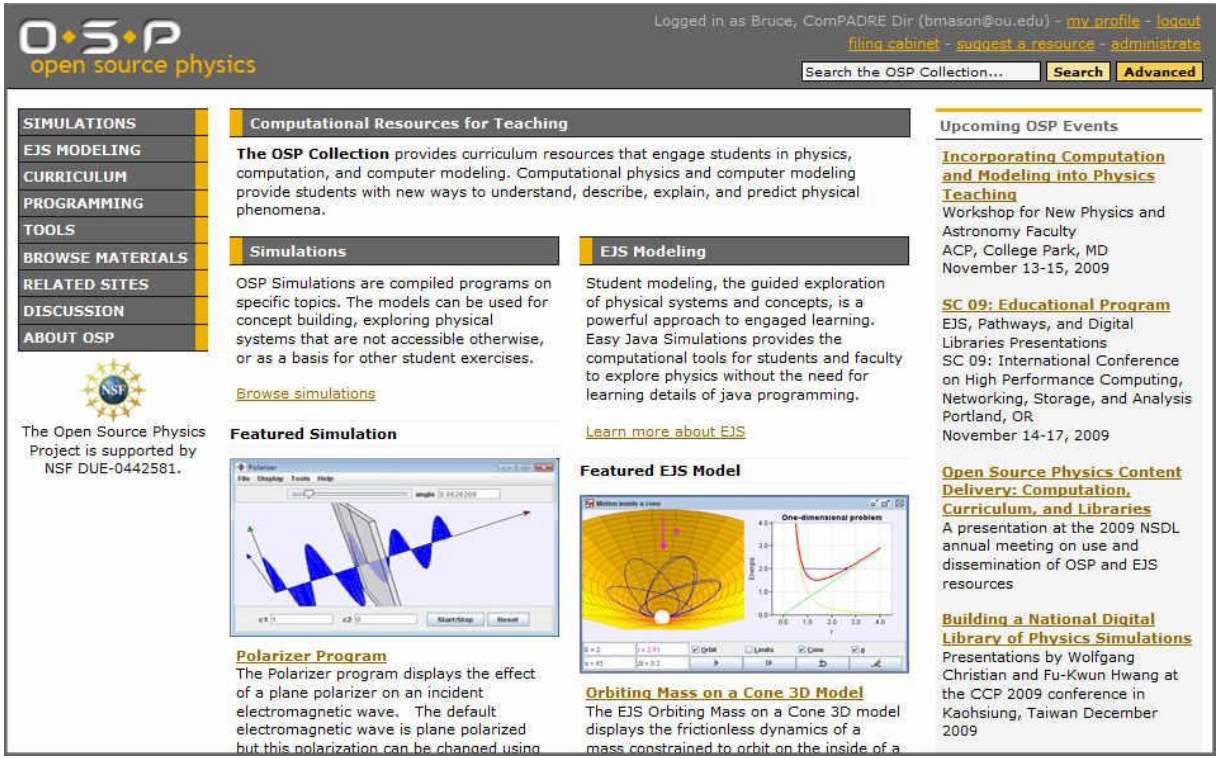
Standard and Custom Library and Web Services

Connections to Users and NSDL

>500 OSP Items

>10,000+ visitors/month

>5,000 simulation downloads/month



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 - Astronomy Education = Curricula - Fundamentals = Lunar Phases - Solar System = The Moon	- Lower Undergraduate - Middle School - High School	- Instructional Material = Curriculum support = Interactive Simulation - Audio/Visual = Image/Image Set

Intended Users	Formats	Ratings
- Learners - Educators - General Publics	- application/java	Rated **5.0 stars** by 9 people Want to rate this material? Login here!

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Is Based On
Easy Java Simulations Modeling and Authoring Tool
Is the Basis For
www.phy.ntnu.edu.t...
See details...

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Personalization

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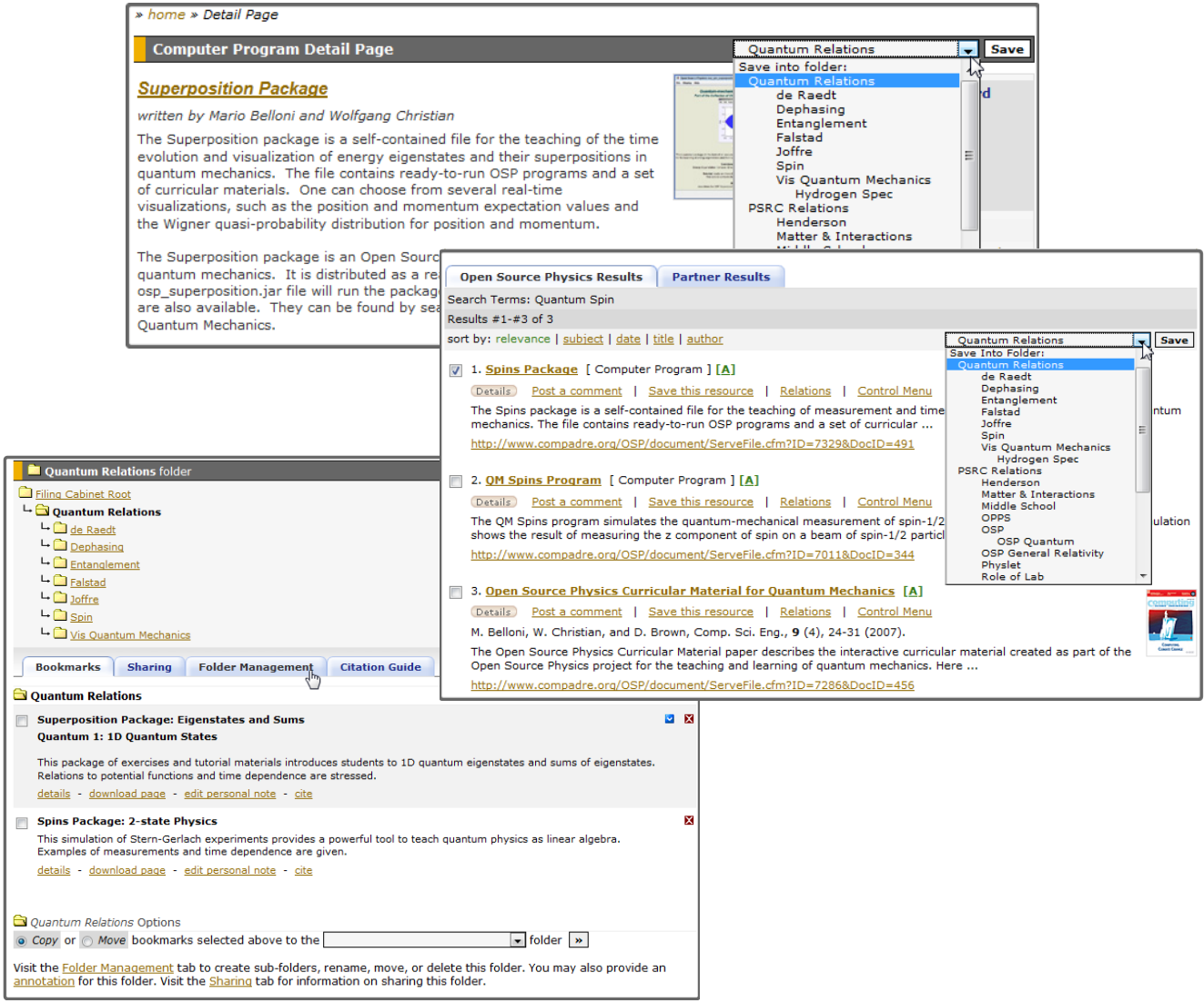

OSP Collection Team

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  - Lyle Barbato- AAPT
  - Matt Riggsbee- AAPT
  - Caroline Hall- AAPT

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.

Science
Education Prizes

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