Java Educational Applets For Photonics Engineering Education

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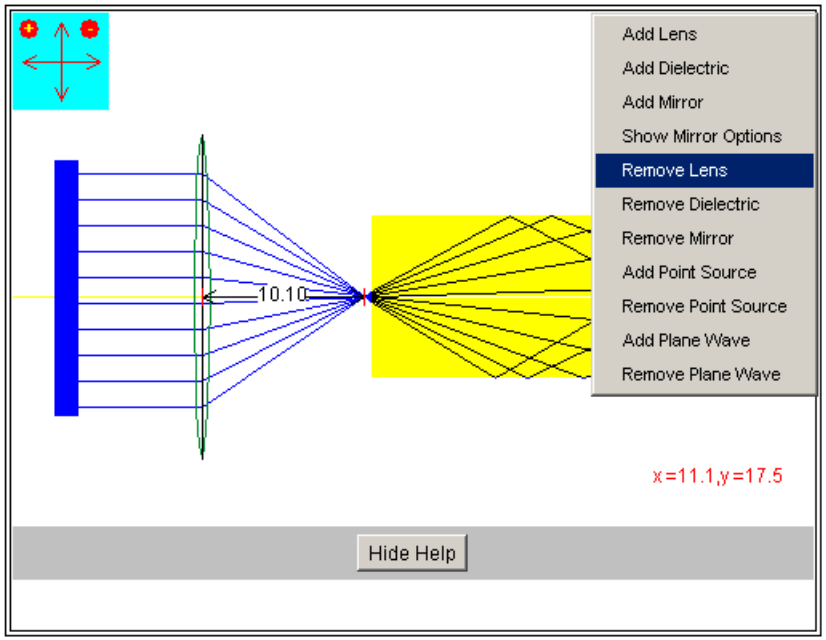
Motivation

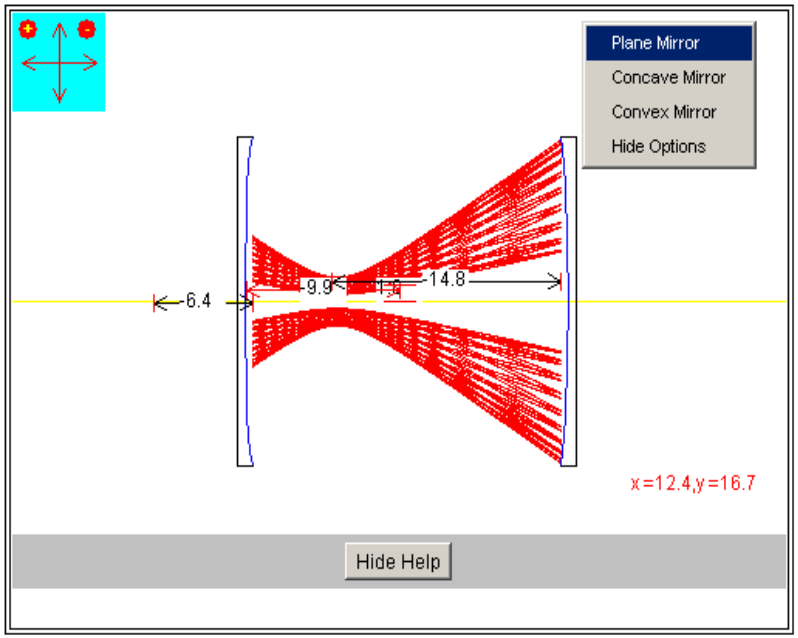
- Introducing Java Applets as supplementary instructional material
  - Extending the power of Java and the Internet to educational, simulation and design tools
  - Presenting information in a more visually appealing manner by creating a dynamic and stimulating learning environment through the inclusion of design tools and multimedia technologies
  - Address the various learning styles of the students
  - Address many of the guidelines pointed out by the *"Criteria for Accrediting Engineering programs"* set by *Accreditation Board for Engineering and Technology* (ABET)

Motivation

- Develop a software framework that
  - Helps in developing Information-rich virtual laboratories which are very cost-effective and consume less time to implement as compared to setting up a real laboratory
  - Provides guidelines and follows good software design for developing ideal instructional tools
  - Captures the experience of instructors and software developers
  - Helps instructors to effortlessly develop educational applications (Applets)
  - Can easily be disseminated to other faculty members.

Applets As Design And Simulation Tools





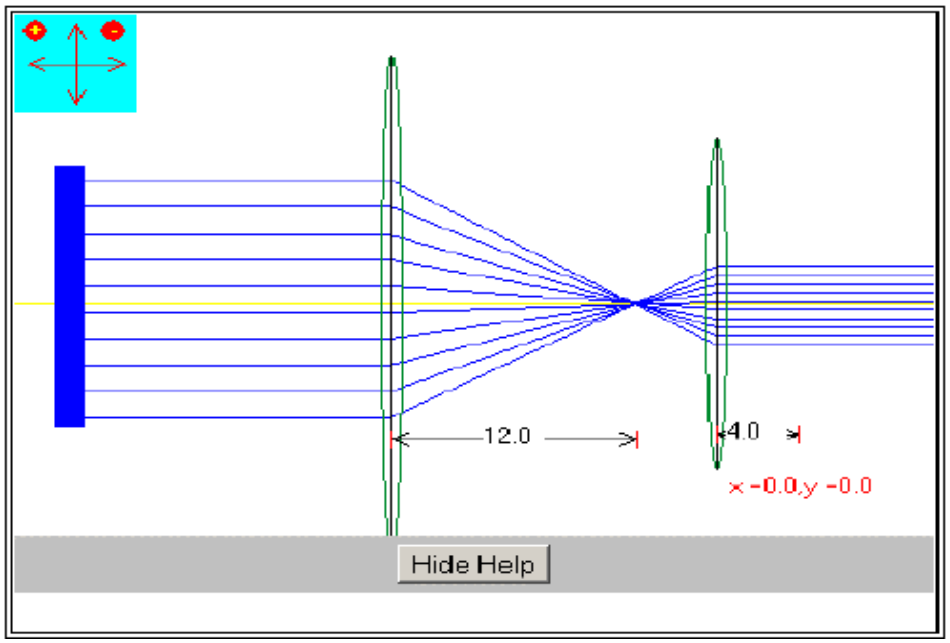
These Applets provide a design window on which the users can build their own optical systems by selecting the components provided in the list

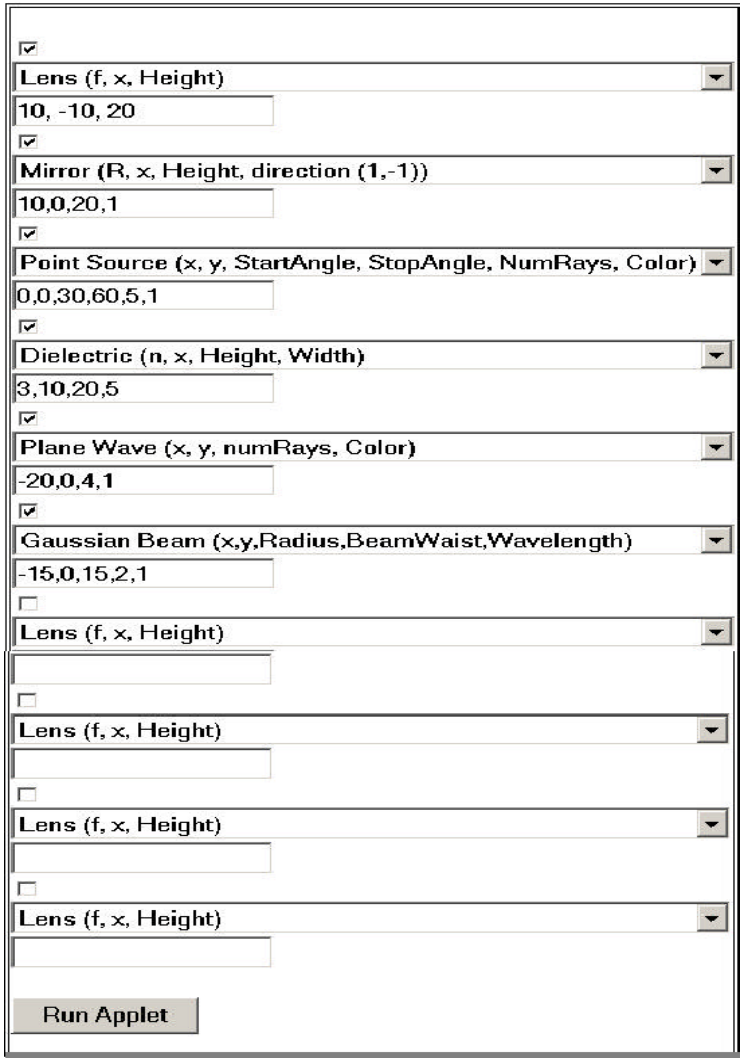
Assignments on Design Applets

"Use the Form Based Optical System Design v2.0 applet located at http://www.ee-eng.buffalo.edu/~anc/photonics/photonics/OpticalDesignVer2/dynamicForm.html to do the following problems. Submit a printout of the completed form along with a hand sketch of the optical system."

Problem 1

Construct and demonstrate a beam compressor which reduces the spread of an incident plane wave by a factor of 3.





Form Based Optical Design system and the final solution

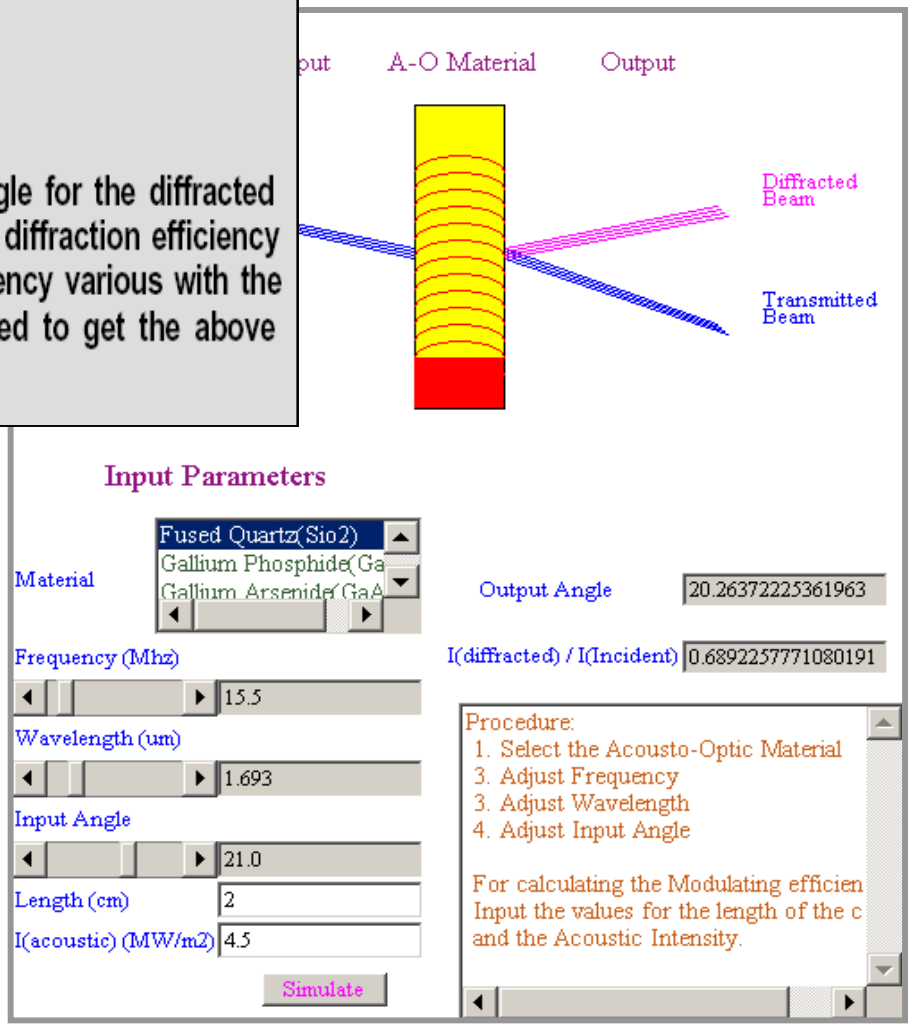
Assignments on Design Applets

"Use the Acousto-Optic modulator applet to do the following problem. Submit a printout of the completed solutions."

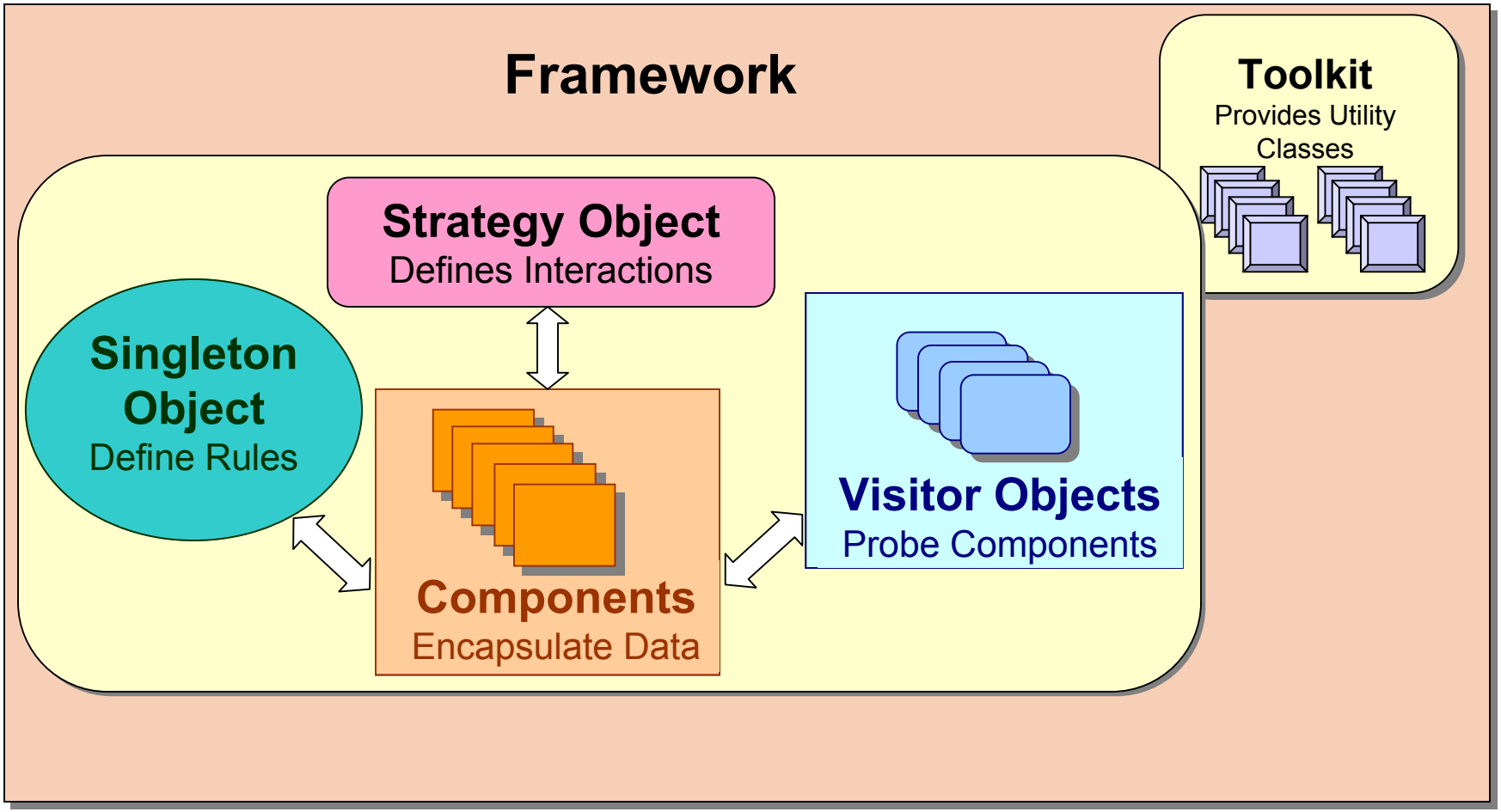
Problem:

Design an acousto-optic modulator to get an output angle for the diffracted beam between 20° and 21.3° and at the same time get a diffraction efficiency between 80% and 90%. Explain how the diffraction efficiency various with the wavelength. Give a list of the materials that can be used to get the above values.

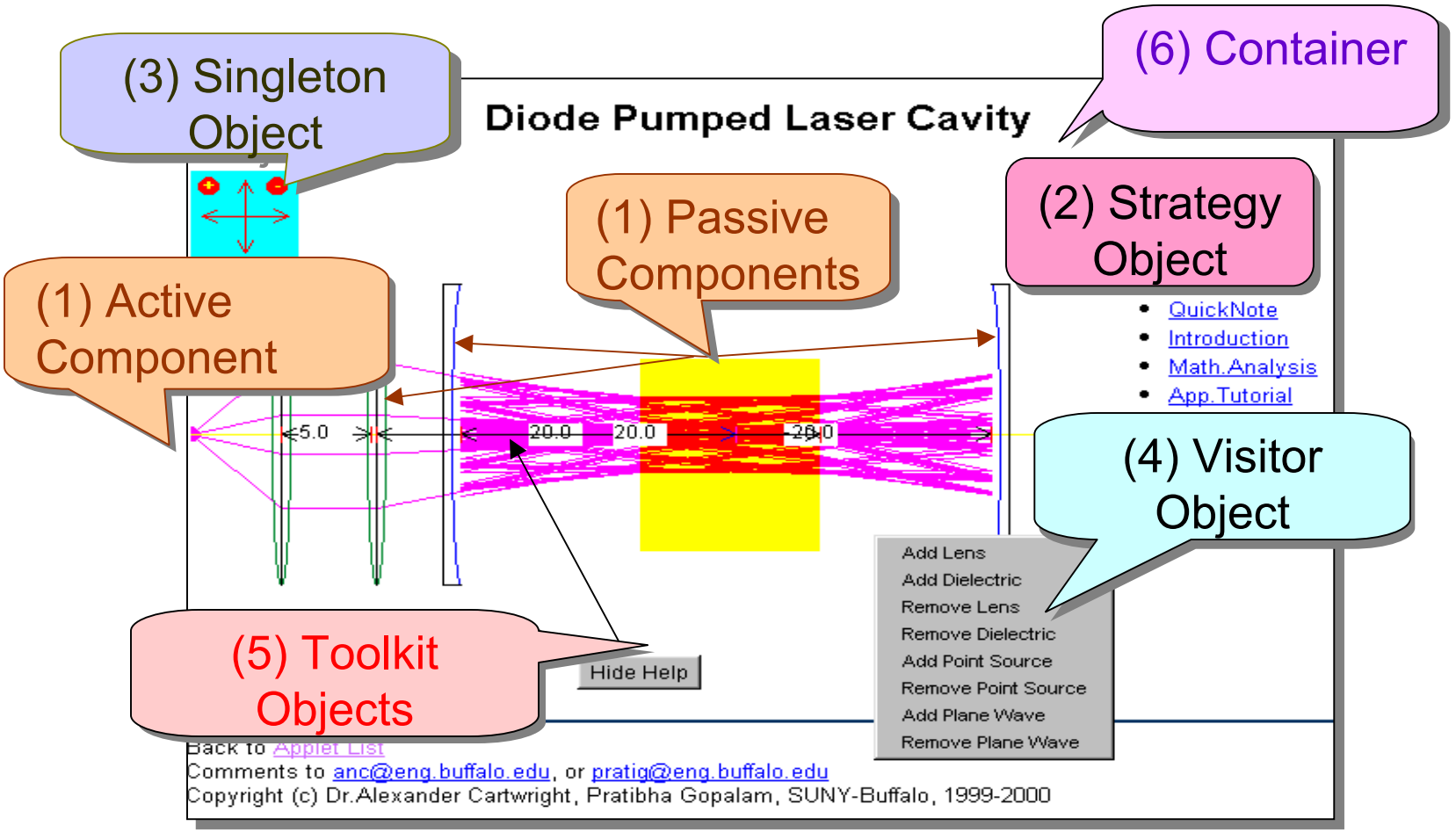
Acousto-Optic Modulator



Key Elements Of The Framework

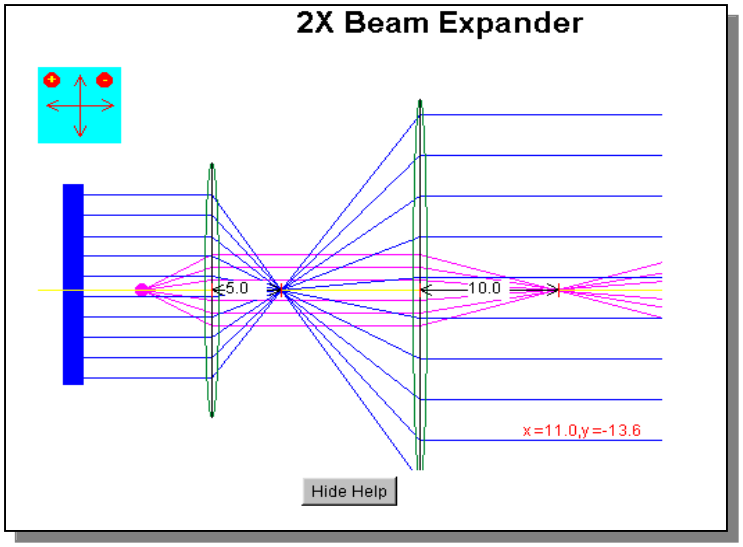


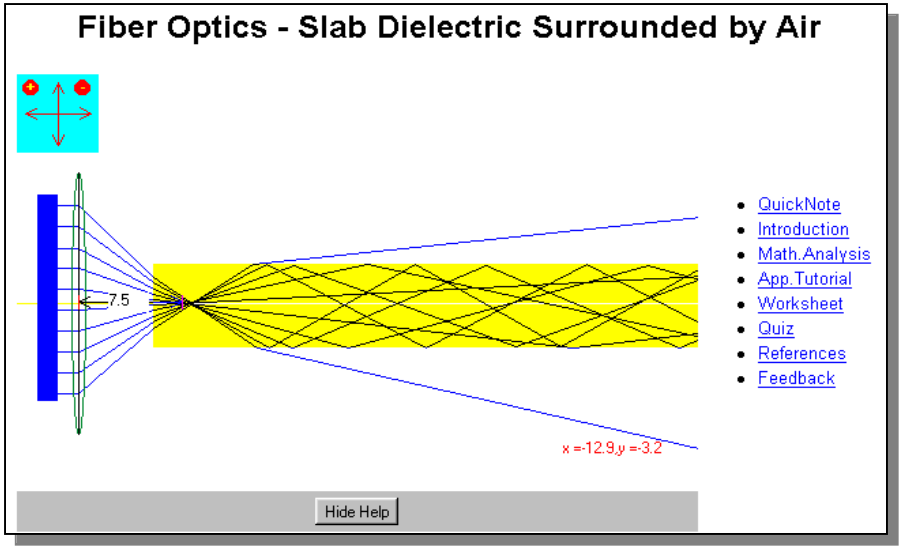
Example Implementation of the Framework

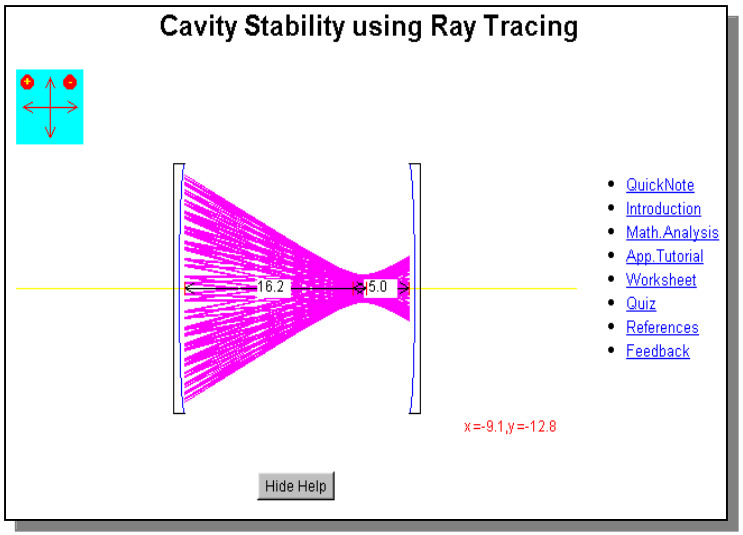


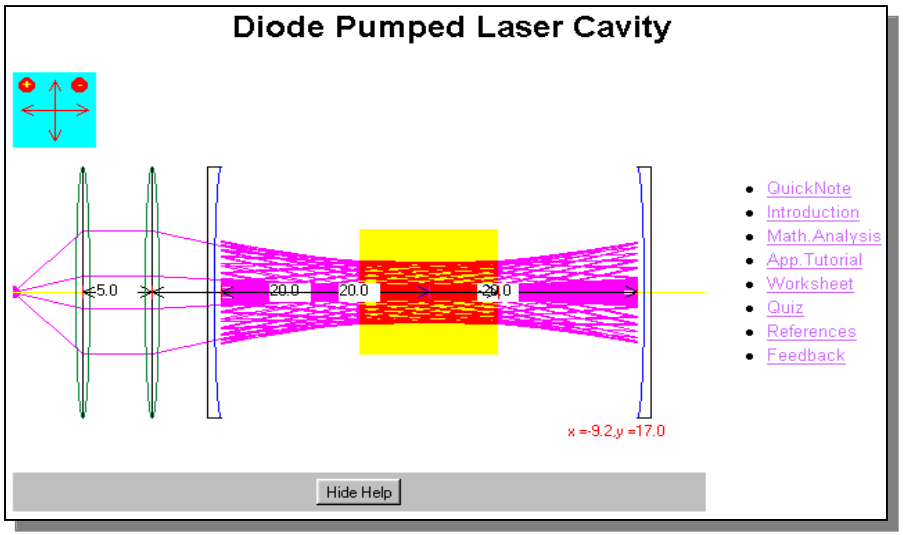
This Applet demonstrates a diode pumped laser system using ray tracing.

User Configurable Design Applets



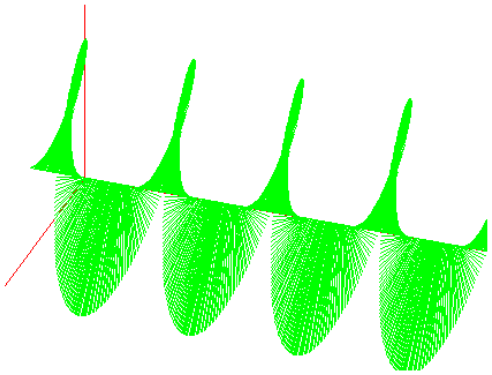




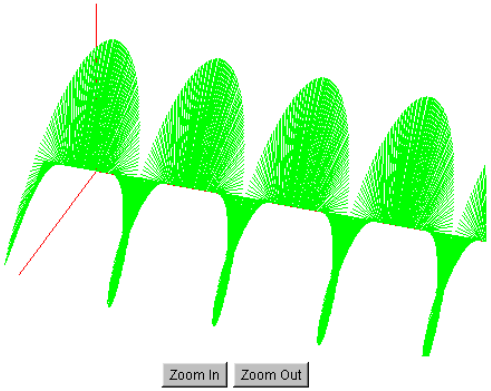


User Configurable Design Applets

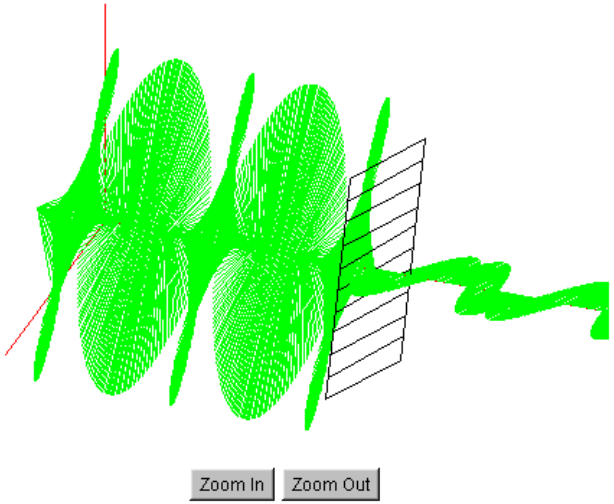
Right Hand Polarized Light



Left Hand Polarized Light

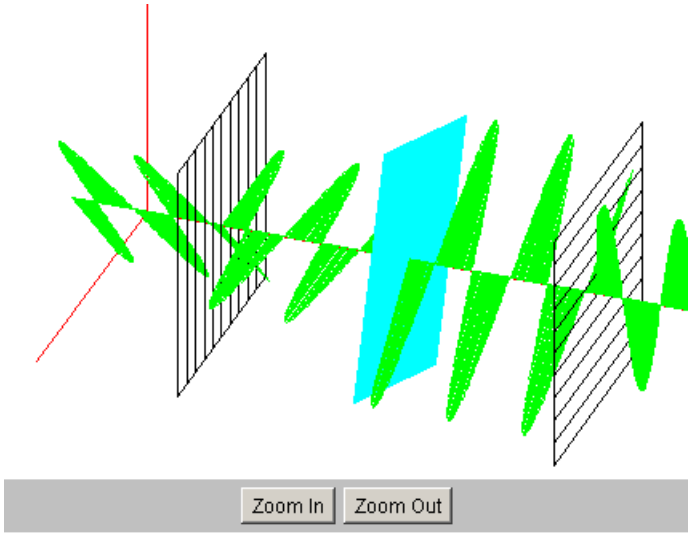


Right Hand and Left Hand Polarized Light
Filtered by Rotating Linear Polarizer

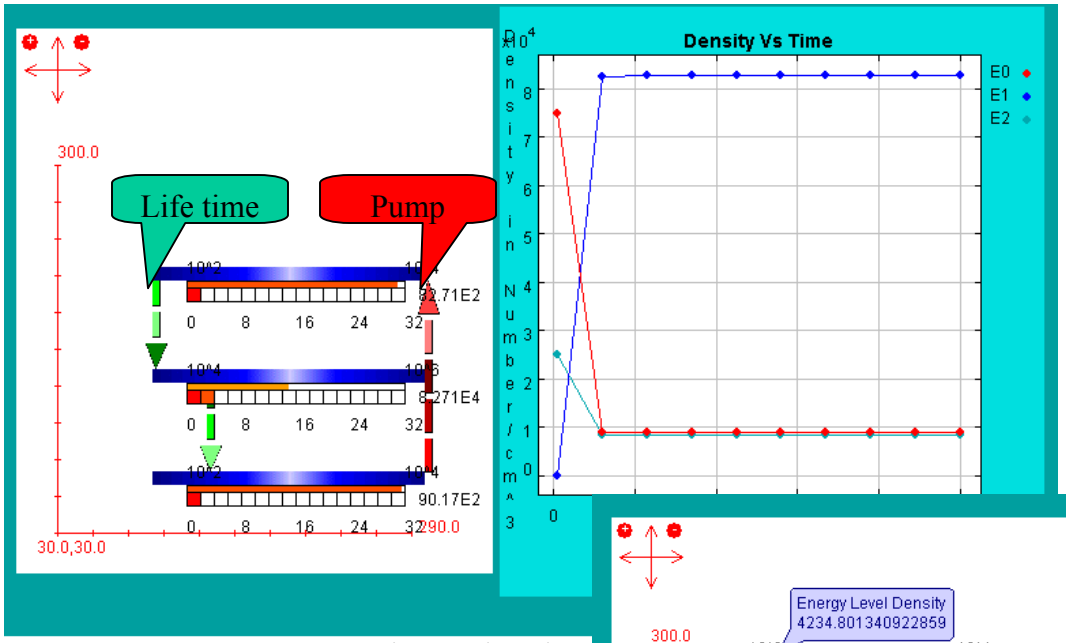


- QuickNote
- Introduction
- Math.Analysis
- App.Tutorial
- Worksheet
- Quiz
- References
- Feedback

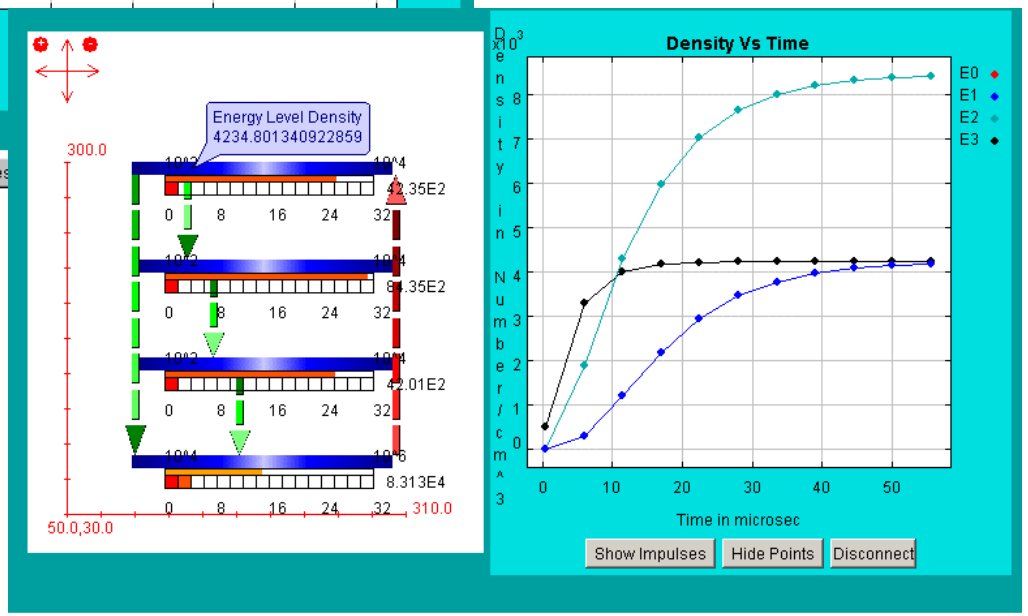
Polarization Modulator
(Halfwave Plate between Cross Polarizers)



User Configurable Design Applets



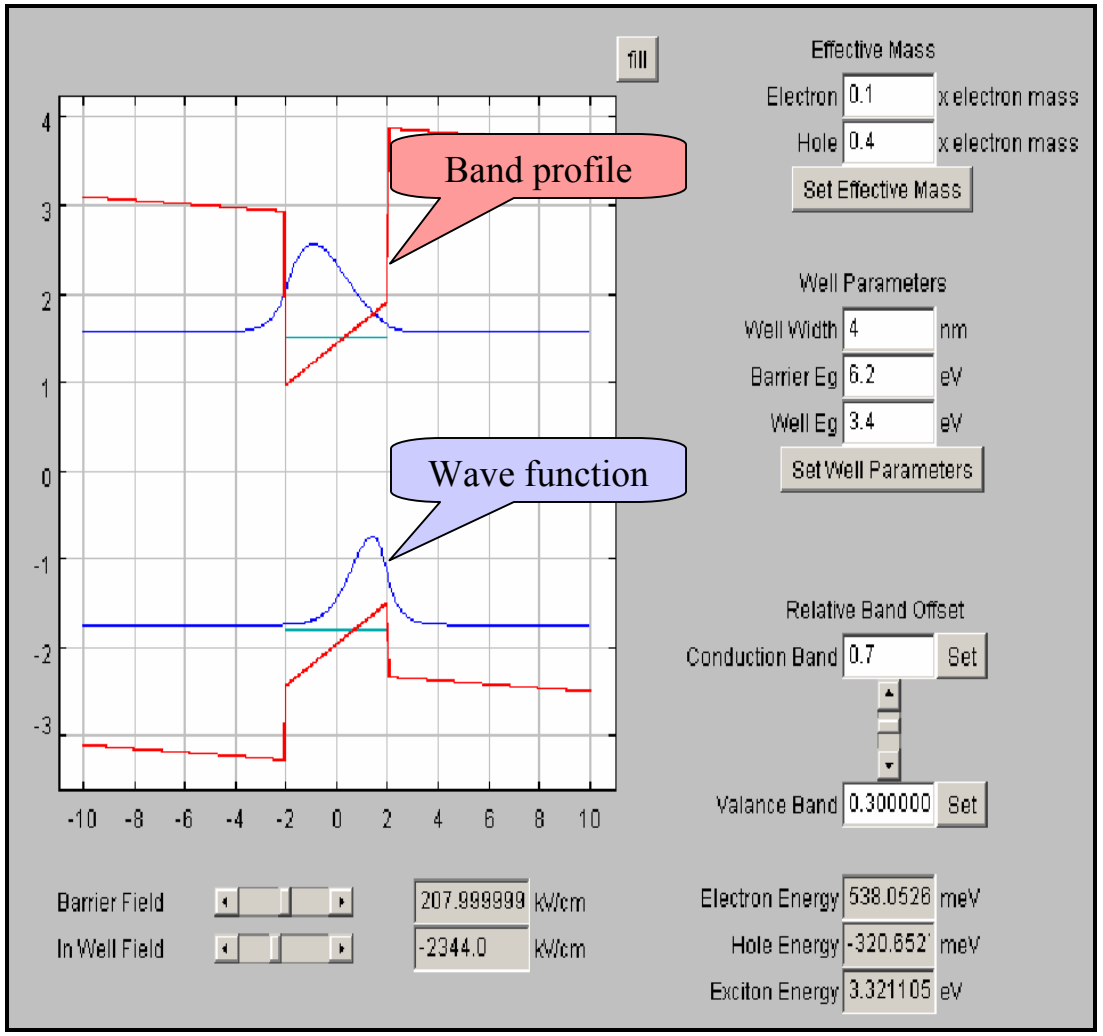
3 – Level Gain Medium



4 – Level Gain Medium

Design Applets As Research Tools

"Numerov Quantum well Calculator"

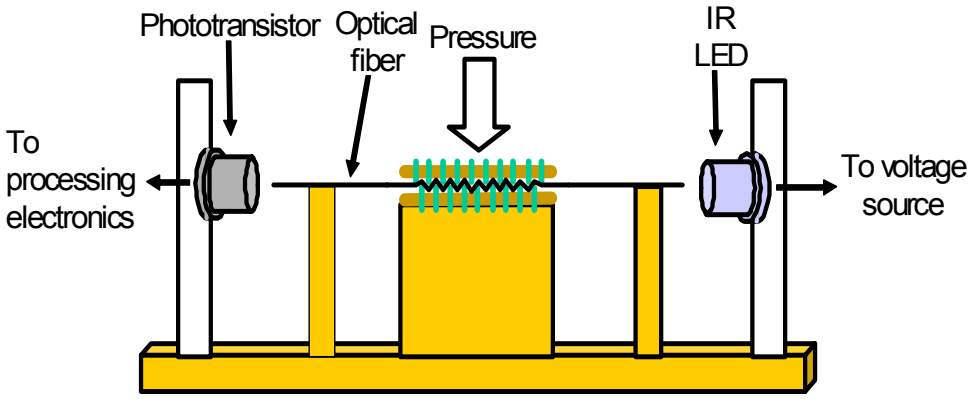


Used for calculating the recombination energy in various semiconductors with and Inwell and barrier field

Goals Achieved From This Methodology

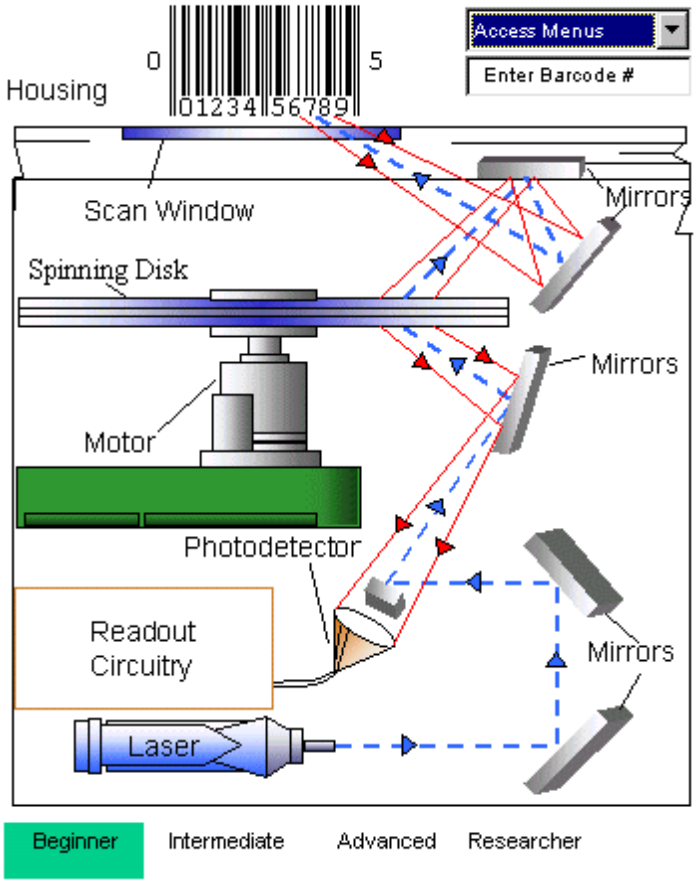
- An ability to design various photonic systems to meet the prescribed requirements as well as analyze and interpret the outcome
- An ability to understand and solve various open-ended problems underlying today's high tech photonic devices
- An ability to work in teams with members from different backgrounds
- An ability to use the World Wide Web and multimedia technologies to broaden the understanding and knowledge of the principles and fundamentals of photonic devices
- More interest to pursue a career in the area of photonics

Future Development In Optical Design Applets



Simple Fiber Based Sensor

- Promote the concept of Pre-Laboratory for K-12 and Undergraduate/graduate students
- Promote global understanding of large-scale systems using context based case studies
- Explain complex systems using vivid simulation schematics to favor visual learners



Bar Code Scanner

Pre-Laboratory Methodology

- The Pre-Laboratory consists of a group of Java Applets, which are specific to the type of the experiments done in the actual physical laboratory, to convey the general concepts about the actual experiments
- Reduction in the cost of performing experiments by the prior knowledge about the design of the experiment
- The Pre-Laboratory can be configured according to the level of the user from K-12 to undergraduate and graduate students
- University at Buffalo, California State University and many other universities used these Applets for similar purpose showed good results among students

Conclusions

- Developed a number of Educational Java Applets as learning aids in Photonics
  http://www.ee.buffalo.edu/faculty/cartwright/photonics/index.html
- Developed a generic, portable, set of objects for the proposed framework that can be effortlessly used by other educators
- Successfully used these Applet based simulation systems in undergraduate courses on “Lasers and Photonics” (EE 492) and “Consumer Optoelectronics” (EE494) and graduate courses “Optical Communications” (EE 566) and “Consumer Optoelectronics” (EE 594)

Acknowledgements

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