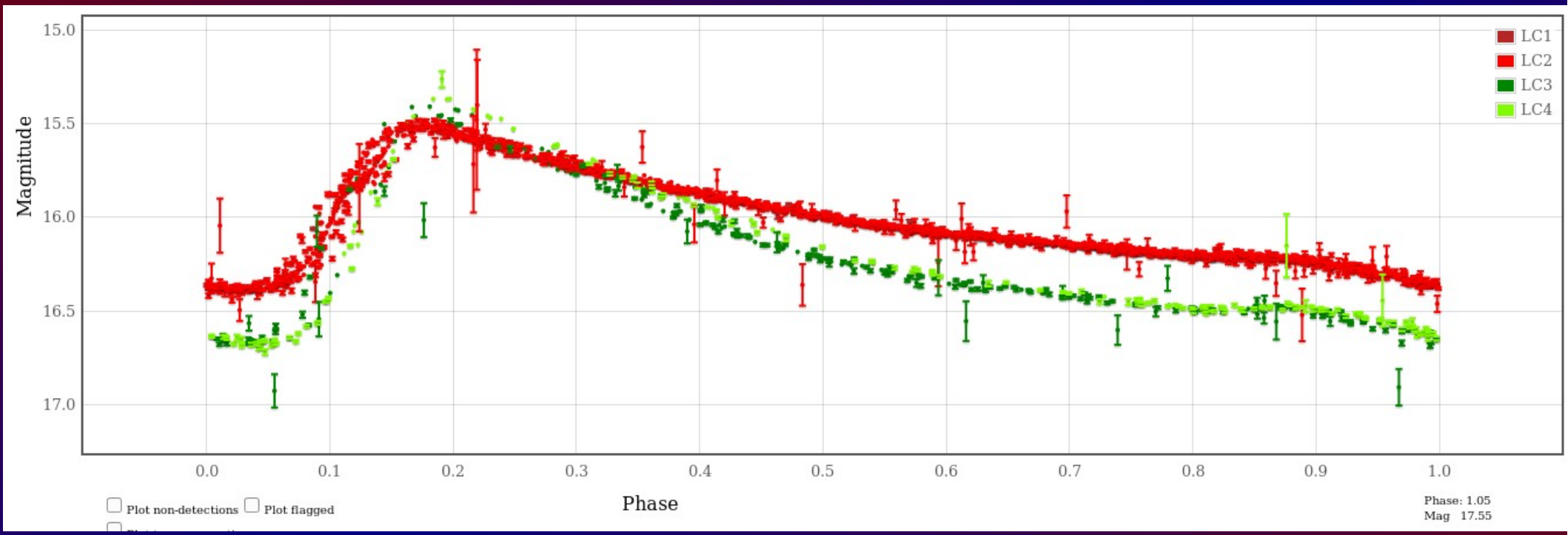
Using PTF Variable Marshal in Astronomy Major Course



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Talk Outline

- Course Overview
- Course Organization and Structure
- First Course Project
- PTF Variable Marshal Project
- Challenges

Course Overview: Student Population

- ASTR 310: Observational Astronomy is usually taken by majors in the fall of their sophomore year.
- Typically have 2 semesters of calculus, 1 semester of physics.

- ~25 students
- 16-week semester

- Two 75-min lecture periods per week
- One 2-hr daytime lab period per week (2 sections)
- Some nighttime observing at UMD Observatory

Course Learning Goals

- Students will be able understand and contribute effectively to all parts of a “research project”.
- Students will be able to explain how typical optical telescopes and CCDs work.
- Students will be able to compare capabilities of different optical telescopic/CCD systems.
- Students will be able to understand and be able to utilize the fundamentals of modern observational photometry, astronometry, and spectroscopy.
- Students will be able to understand the limitations of observational data and the data reduction process.

Relevant Course Learning Goals

- Students will be able to utilize large data sets to formulate a question that can be answered using the data set and manipulate/search the data set to answer that question.
- Students will be able to communicate research results effectively, in scientific papers and talks.
- Students will be able to collaborate with other researchers productively.

Course Structure and Organization

The course will be taught in a “flipped” format. The daily structure for the students will be as follows:

- Read assignment from textbook before lecture
- Take brief quiz on reading, before lecture
- In lecture, do active-learning activities (usually in groups) to explore, reinforce, and test understanding.
- At the end of each lecture, write a 1-paragraph essay answering a problem related to the day's topic. Usually done individually, with critiquing and revision.

Course Structure and Organization

Daytime labs have multiple purposes:

- At beginning of course, students will do activities to learn tools and techniques
- Transition to students working on data analysis for projects while TA is available for help.
- Throughout semester, used to organize teamwork.

Course Structure and Organization

- Primary focus of the course will be two projects.
- Course will present topics as needed to provide students with tools and information required for the projects.
- Course topics will be mostly procedural (i.e., related to data taking and analysis) or instrumental (understanding telescopes and CCDs), since the general background science of astronomical objects has been presented in prior courses.

First Course Project

Each student team:

- Chooses a nebula or galaxy to observe at UMD Observatory.
- Writes a proposal describing target selection and choice of two filters to use.
- Prior to observations, predicts through which filter the object will appear biggest and brightest.
- Writes analysis plan describing planned analysis procedure, reduces images and uses plan to measure brightness and size.
- Writes up results in paper.
- Participates in oral exam on project.
- Gives talk to class on project and results.

PTF Variable Marshal Project

- Same project structure, but using PTF Variable Marshal database as data source instead of telescope.
- Student teams will develop scientific question that can be addressed using database.
- The marshal's tools for lightcurves, period-finding, and viewing follow-up spectra will be extremely useful.
- Teams will write up results, participate in oral exam, and give talk on their results.

PTF Variable Marshal Project: Preparation

Specific course topics and activities will prepare the students for this project. Special topics include:

- Information on variable stars, cause of variability, and their lightcurves.
- History of astronomical surveys and their uses.
- Description of typical data processing pipelines.
- Information on iPTF program.

PTF Variable Marshal Project: Preparation

Specific activities will prepare the students for this project:

- Activities to learn how to use PTF Variable Marshal interface.
- Activities to explore content of database: what types of variables, how many, how many have spectra, etc.
- In-class activity and discussion about how to generate scientifically-interesting hypotheses.
- In-class discussion of reasonable sample sizes and data selection.

Challenges

Student understanding of database contents:

- Interpreting *r* and *g* photometry – correlation and offsets
- Interpreting spectra – understanding which spectral lines should be present for which object types
- Recognizing bad data – accidental bogus photometry or spectra

Challenges

Student organization and data management:

- Keeping track of which objects and data they are using.
- Organizing the data to be able to plot them.
- Recording their analysis procedures and reasoning.
- Presenting their lists of target objects appropriately in their papers.

Summary

- While this project will be very challenging for the students, I believe they will be excited to be working with real data on a research project of their own origin.

- With the era of big surveys, exposing the students to the use of large data sets will be helpful for them in their future careers.