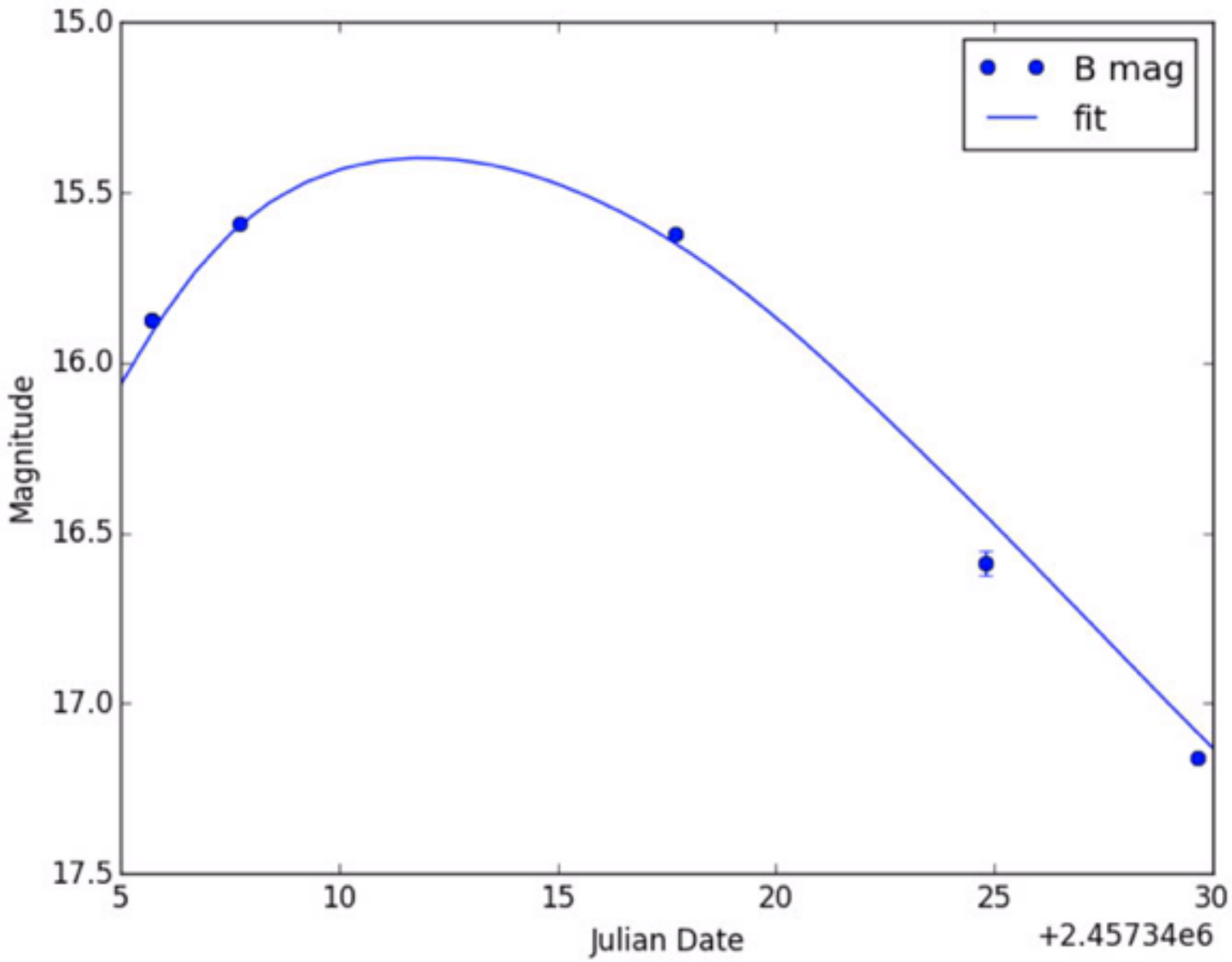
Master's Course in Observational Techniques

Robert Quimby

SAN DIEGO STATE UNIVERSITY

End Product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SDSU Graduate Courses

UPPER DIVISION COURSES

ASTR 510. Exoplanets (3)
Prerequisites: Astronomy 350 and 440, or Physics 350 and 354 with minimum grade of B-, and consent of instructor.
Extrasolar planet detection; mass and radius determination; transits and eclipses; orbital dynamics and transit timing variations; internal and atmospheric characteristics; the exoplanet population and formation scenarios.

ASTR 596. Advanced Topics in Astronomy (2-3)
Prerequisite: Consent of instructor.
Selected topics in astronomy or astrophysics. May be repeated with new content upon approval of instructor. See *Class Schedule* for specific content. Limit of nine units of any combination of 296, 496, 596 courses applicable to a bachelor's degree. Maximum credit of six units of 596 applicable to a bachelor's degree. Credit for 596 and 696 applicable to a master's degree with approval of the graduate adviser.

GRADUATE COURSES

ASTR 610. Binary Stars (3)
Prerequisite: Astronomy 450.
Visual, spectroscopic, and eclipsing binary stars. Review of observational techniques. Methods of orbital analysis with applications emphasizing determination of fundamental stellar properties, such as mass, radius, temperature, and luminosity. Implications for stellar evolution.

ASTR 620. Galactic Structure (3)
Prerequisite: Astronomy 450.
Survey of basic observational data for determining structure of Milky Way Galaxy. Includes luminosity functions, stellar distributions, solar motion, stellar populations, kinematics and dynamics of general and peculiar stellar motions.

ASTR 630. Stellar Atmospheres and Interiors (3)
Prerequisites: Astronomy 440 and Mathematics 342A.
Gas thermodynamics and equations of state. Production of stellar continuum radiation and spectral lines. Theories of radiative and convective energy transport. Interior structure and evolution of stars.

ASTR 640. Accretion Power and Radiation Processes (3)
Prerequisites: Astronomy 450 and Mathematics 342A.
Accretion processes in astrophysics; compact objects, spherical and disc accretion, interacting binary stars and active galactic nuclei. High energy radiation processes: bremsstrahlung, Compton and inverse Compton scattering and synchrotron emission.

ASTR 660. Galaxies and Cosmology (3)
Prerequisite: Astronomy 450.
Morphology, photometric, and spectroscopic properties, dynamics, and evolution of normal galaxies. Current interpretations of peculiar galaxies and QSO's. The extragalactic distance scale. Observational cosmology.

ASTR 680. Astronomical Techniques (3)
Prerequisites: Astronomy 350 and 450.
Basic methods of data acquisition and analysis. Emphasis is given to CCD direct imaging, spectroscopy, and photometry. Direct experience with telescopes and instruments at Mount Laguna Observatory, as well as with the department computing and image processing facility.

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Astro 680

- Introduce students to astronomy
- Introduce students to research
- Introduce new graduate students to the Department

Class Philosophy

- Get students to put their skills to work on “real world” tasks
- Students should walk away from the class with general purpose tools for research
- Tie astronomical research (and real data) into as many aspects of the course as possible

- Avoid black boxes
- Don’t create zombie researchers

Lecture Format

- review prior lecture
- introduce new concept
- give students a problem related to the new concept
- have students discuss a solution to the problem themselves (in groups)
- have students present their solutions
- ask students to implement their solutions
- discuss final results
- homework related to new concept

Class Days Include

- lecture/labs
- talks from SDSU faculty
- student presentations (journal club)

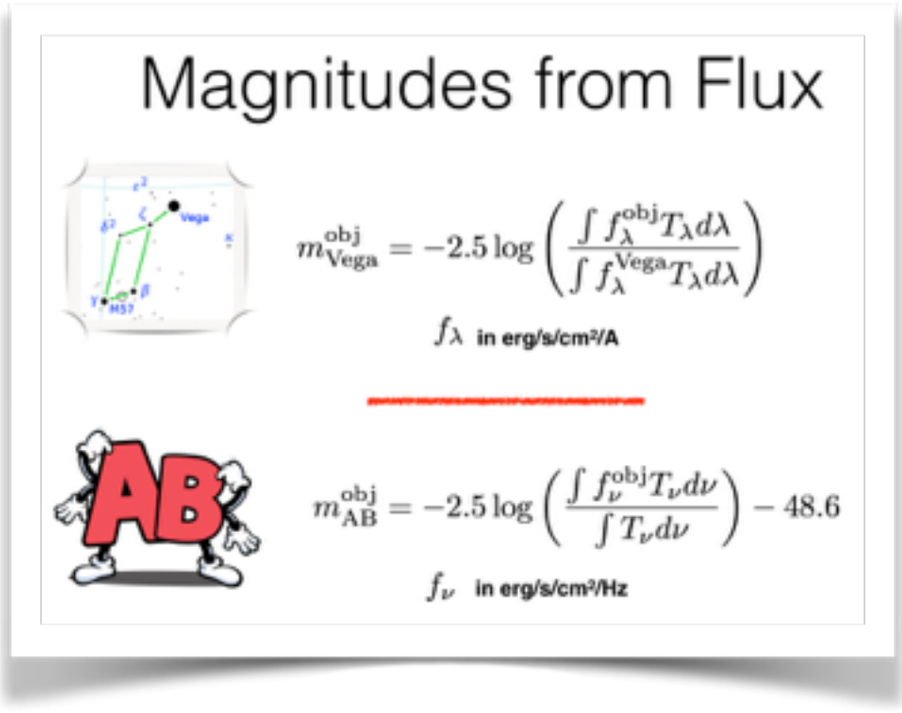
Startup

- Introduce students to Linux
- Have students install linux on their laptops (if necessary)
- Give students access to a linux server (with VNC)

- Get students familiar with python
- Install standard tools (AstroConda?)

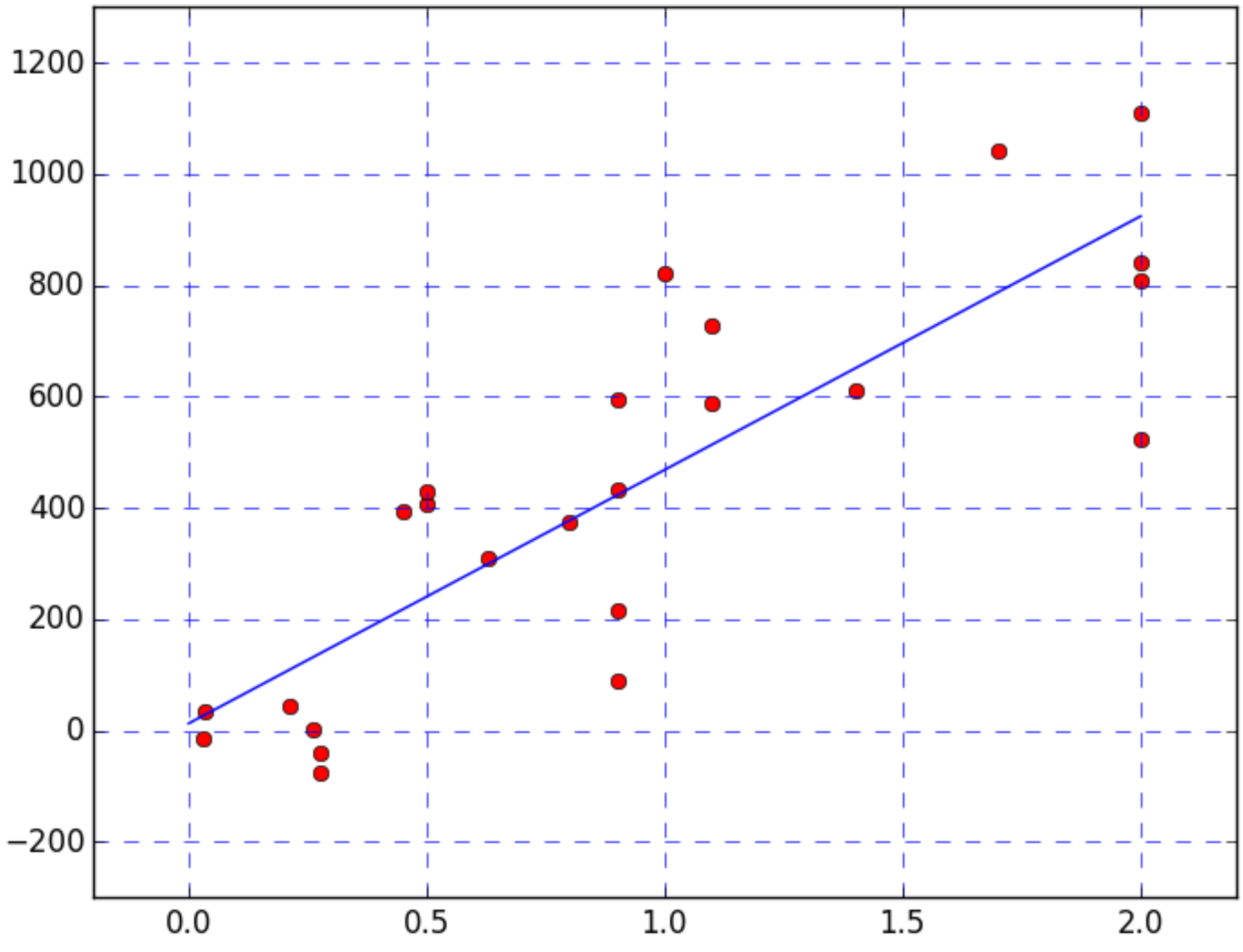
Lecture Topics

- basic astronomy
- alt/az, HA/Dec, RA/Dec
- telescopes
- magnitudes (AB, Vega)
- Poisson distribution
- CCDs
- FITS format (+DS9)
- photometry (optical)
- fitting models to data (least-square fits and MCMC)



- spectroscopy (if time)
- IR photometry (if time)

Lesson Example: fitting a line to data



Final Project

Demonstrate mastery of the major concepts covered in the course:

- Take new data with the telescope (of a supernova)
- Fully process the data with original python code
- Extract photometry and produce a light curve
- Fit the light curve with a model
- Make a measurement (with error bars) of the peak magnitude and date of maximum light
- Write up a report using Latex

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Results from Student Report