



Astronomy Education In USA

Kaike Pan
Apache Point Observatory

July, 2010, Guiyang

Overview

- Astronomy Education as a science, many research articles/year. Association, journals.
- Undergraduate
 - Non-science major: developing the scientific literacy of future citizen; training future teachers.
 - Science major: Stimulate interests of potential astronomy students, broaden students' background in astronomy.

● Graduate

Training astronomers and teachers

Undergraduate

- Non-science major, Astronomy 101 and 105
 - Astr101: introductory astronomy course, basic concepts of astronomy. Astr105: the Solar System.
 - Developing the scientific literacy of future citizen.
 - Who take: According to the newest survey, introductory astronomy courses are very popular,
 - ~300 K/year;
 - 10% takes introductory astronomy courses, some take more than one;
 - a representation of cross section of student body: gent, race, family income, GPA etc.
 - 25% are interested in the study of education. So the classes also training the future teachers of next generations.

7/23/10

Undergraduate (cont.)

● Non-science majors (cont.)

- What to teach? How sciences are done - scientific method, basic concepts, big picture of astronomy, outstanding questions. But very little calculations. Connections among stellar astrophysics, galactic astrophysics, and cosmology.

➤ Scientific method: observation-->theory --> predication --> observation (circle)

4 features: testable, continually be tested, simple, elegant.

No perfect theory: identifying a problem(s) (inconsistency) means a big progress.

Undergraduate (cont.)

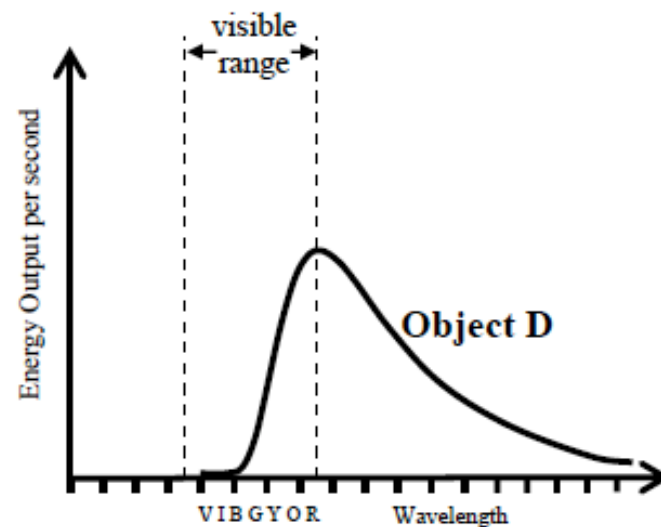
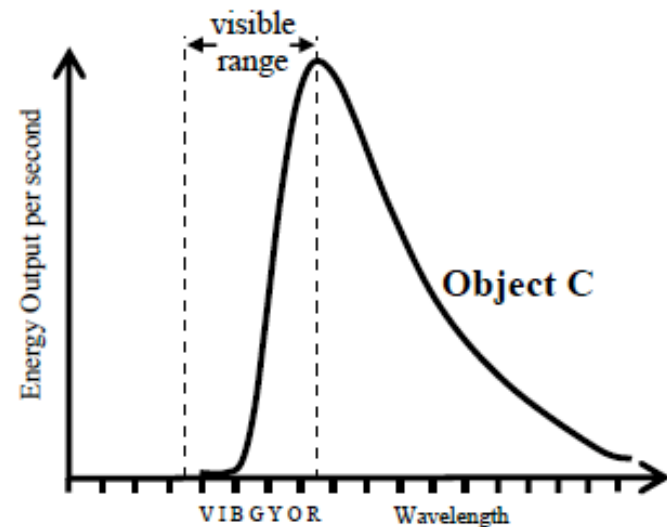
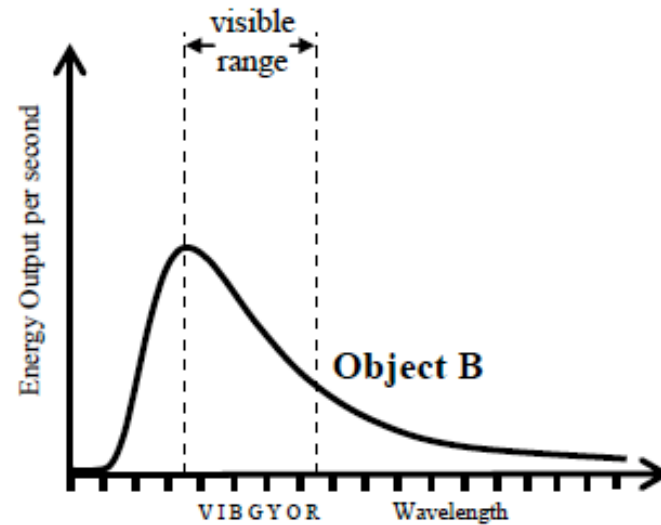
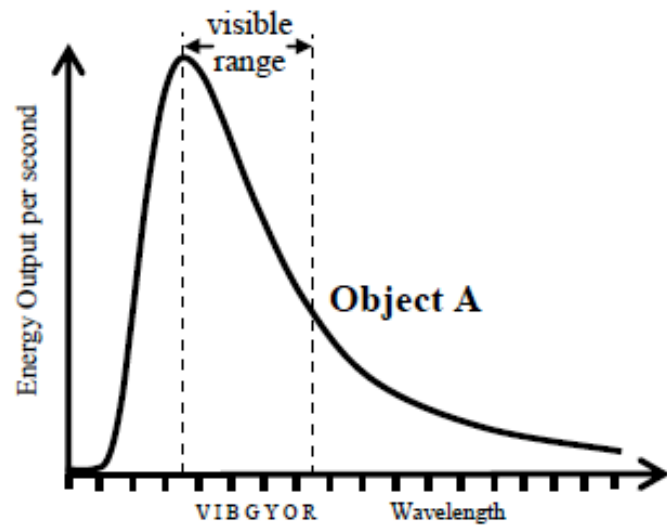
● Non-science majors (cont.)

- examples of basic concepts: What are most important concepts in astronomy:

Forces and Electromagnetic spectrum and the nature of light.

- ✓ Nature of spectrum: wavelength, frequency, energy, speed.
- ✓ Doppler shift, redshift
- ✓ Continuum shape
- ✓ Relationships of Luminosity, T , and surface area of blackbody radiator
- ✓ The connection between spectral features and underlying physical processes.

Use the spectral curves for objects A-D shown below to answer the next **three** questions. The scale is the same for all four graphs.



1) Which of the other objects has the same temperature as object B

- a) Object A, b) Object C, c) Object D
- d) They are all the same temperature
- e) There is insufficient info to answer this question

2) Which, if any, of the objects could be approximate the same size as object D

- a) Object A, b) Object B, c) Object C
- d) They could all be the same size
- e) None of the above

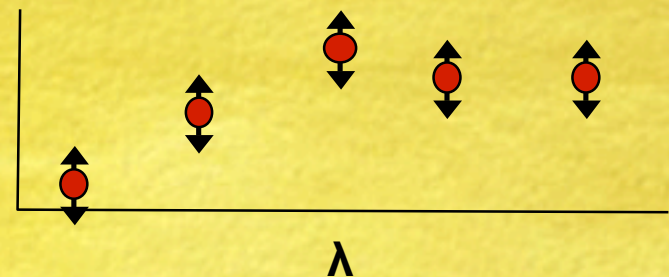
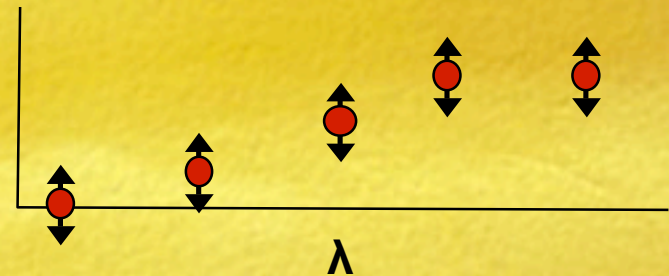
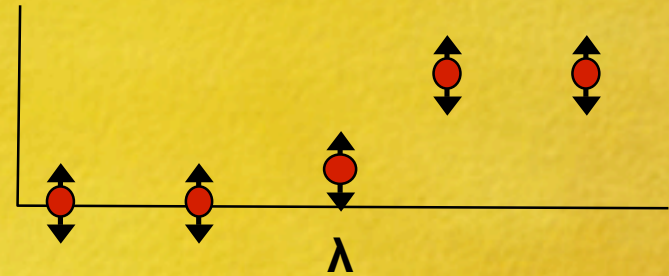
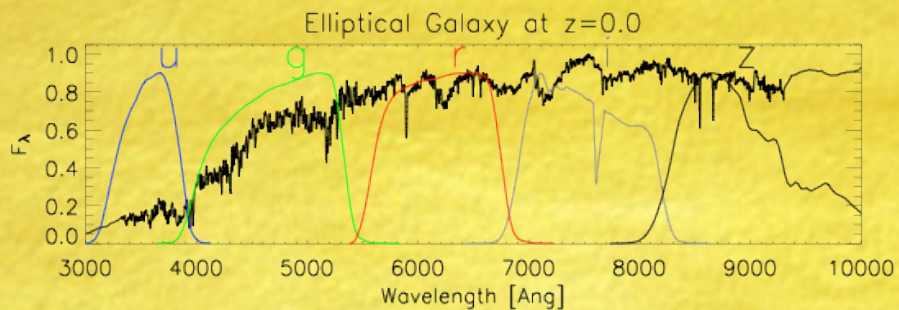
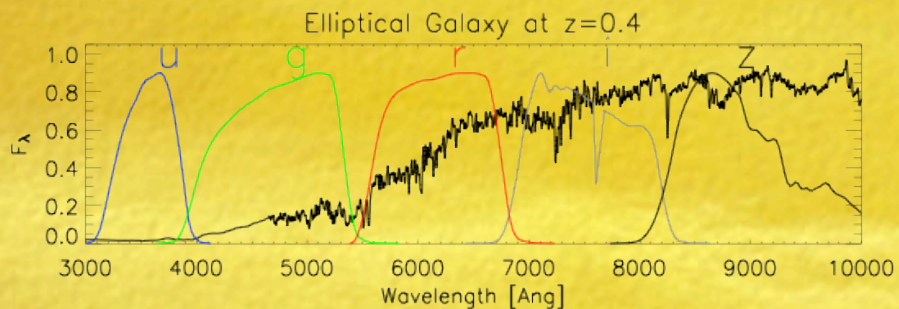
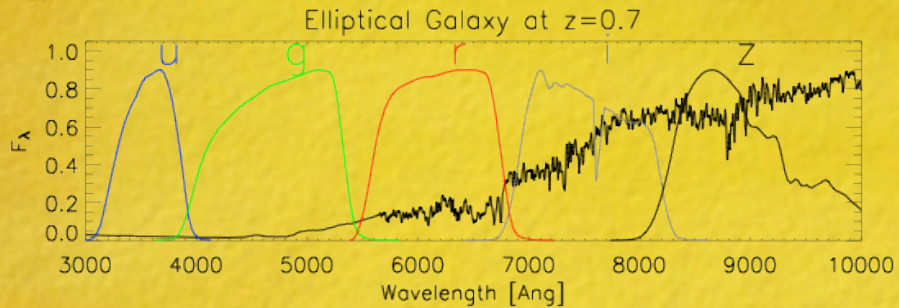
Wien's law: λ of peak emission $\propto 1/T$

Stefan-Boltzmann law: $F = \delta T^4$

Undergraduate (cont.)

- What information we can get from the spectrum of an object.
 - Peak (shape) of continuum --> T (Wien's law)
 - Lines (e + a) present (footprints), intensities--> Composition + T
 - Line width --> T, turbulence, rotation, density, magnetic field
 - Spectra line shifts --> Radial Velocity, redshifts

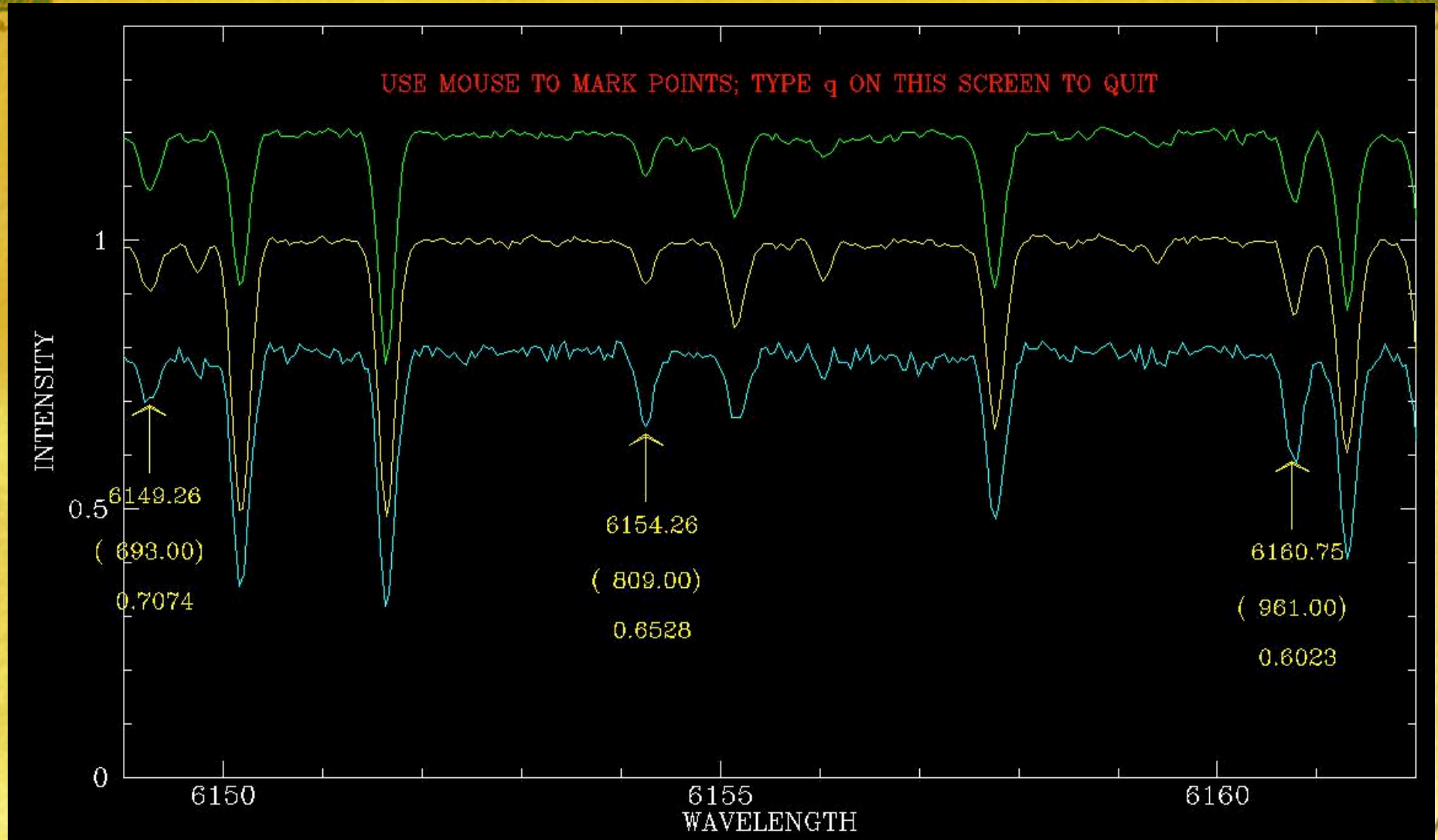
Photometry vs. Spectroscopy



== photometric measurements is A “spectrum”, but with a few points instead of ~thousands

7/23/10

High resolution spectra



Undergraduate (cont.)

● science majors

- Stimulate interests of potential astronomy students, broaden students' backgrounds (mostly in Physics, then astronomy: Observational astronomy a necessary course).

Lower Courses (little calculations)

- Introductory Astronomy,
- Astronomy Discovery Laboratory,
- Astronomical Observations, Galaxies,
- Quasars, and the Universe,
- The Milky Way Galaxy.

Undergraduate (cont.)

● science majors (cont.)

Upper (more likely astronomy major):

- Origins: The Universe, Stars, Planets, and Life
- History and Philosophy of Astronomy
- Methods of Astronomy
- Astronomical Instrumentation
- Stellar Astronomy
- Astrophysics
- Galaxies and the Universe
- Solar System Astronomy
- Positional, Dynamical, and Kinematical Astronomy
- Current Problems in Astronomy

Graduate

- Training astronomers and teachers: broad backgrounds, not necessary details in specific subfields, but outstanding problems.
- Methods to broaden backgrounds
 - Qualifying tests (Physics + Astronomy)
 - Seminars/week
 - Colloquia/week
 - Research group meeting /week (may not related to work topic)
 - Discussion with advisor /week (work topic, thesis)

Key Points

- Big pictures: See the forest, not only trees. Know basic concepts in other subfields.
- Know outstanding problems of your field.