ASTR 121 Honors Astronomy Laboratory

Introduction to Observational Stellar Astronomy

Course Description

The student will plan and execute sessions in the Ball State University Observatory and analyze and interpret astronomical data related to the determination of the properties of stars.

Prerequisite: Permission of the instructor. (1 credit hour)

Prerequisite or parallel: ASTR 120.

Course Objectives

Star Charts & Constellations:

recognize the classes of celestial objects from their names and provide additional information I implied by their designations

use various star charts to find objects in the sky or in the planetarium

use TheSky software to find objects and their designations in the sky

Celestial Coordinates:

describe the definitions of and use celestial coordinates to find objects in the sky or the

planetarium

define the following terms: celestial equator, celestial pole, ecliptic, solstice, right ascension,

declination and precession

use computer software to update coordinates by correcting for precession

Magnitudes and Time Systems:

use magnitudes to determine brightness ratios and distinguish between the different magnitude systems in terms of color

define the following terms: transit, circumpolar, apparent solar time, mean solar time, local

time, zone time, sidereal time, universal time

Properties of Telescopes:

identify the basic parts of a telescope

describe quantitatively the effect of focal length and aperture on the image size, light gathering power, resolving power, magnification plate scale and field of view of a telescope

use telescopes to observe and to obtain CCD images

IBM-PC Fundamentals and CCD Cameras:

Define the following terms related to IBM personal computers: bit, byte, Mb, Kb, memory, floppy disk, hard drive. Use of Windows95 and a variety of astronomical software

CCD Camera Operation:

define the following terms related to CCD cameras: pixel, ADU, dark frame, bias frame, image

or light frame, flat field, readout time, blooming

define the following terms related to astronomical imaging: sensitivity, spectral response,

reciprocity failure, and linear detector

acquire CCD images of laboratory and astronomical objects

Astronomical Applications Overview:

list the basic applications of CCD images and provide examples of each

Image File Formats & Conversions:

describe the three possible components of an image file and discuss how the size is related to

the A/D converter and the array size

list the number of bytes required to store 1) an ASCII character code, an integer and a

decimal

or floating point number in a computer or on a disk

list the basic file formats used for CCD images and identify appropriate file extensions

CCD Image Calibrations & Reduction:

Explain what bias is and how one can obtain a measure of bias. Describe how and when bias

frames are obtained, how they are processed and explain why

Explain what dark counts are and how one can obtain a measure of dark count rates.

Describe how and when dark frames are obtained, how they are processed and explain why

Explain what a flat is and how one can obtain a measure of a flat field.

Describe how and when flat frames are obtained, how they are processed and explain why

list the sources of noise present in a typical CCD image

Image Acquisition (Asteroid Search) and Image Alignment and Combination:

determine proper time intervals between images used to search for asteroids

describe the steps taken to ensure image alignment between images taken to detect asteroids

discuss the limitations on exposure times used for asteroid searches

combine calibration images and use them to remove bias levels, dark signal and sensitivity variations

determine offsets between two images and blink them to identify potential asteroids or cosmic rays

Astronomical Photometry & Photometry of M67:

Extract instrumental magnitudes from CCD images and convert to standard magnitude

Course Rationale

This course is designed to give Introductory Astronomy students a formalized lab experience in stellar observational astronomy. Students who are enrolled in ASTRO 120 are encouraged to take this course in conjunction with the lecture section.

Course content, format, and bibliography

Format

This course utilizes lectures, computer labs, quizzes, and many hands-on activities.

Content

Tour of Facilities

Star Charts & Constellations

Celestial Coordinates

Magnitudes & Time Systems

Properties of Telescopes

IBM-PC Computer Fundamentals

CCD Camera Operation

Astronomical Applications Overview

Image File Formats & Conversions

CCD Image Calibrations & Reduction

Image Acquisition (Asteroid Search) & Image Alignment and Combination

Astronomical Photometry

Photometry of M67

Bibliography

Foundations of Astronomy, 7th Edition, Michael A. Seeds, Thomson Learning, 2003.

Stars and Planets, 4th Edition, by Jay M. Pasachoff, Peterson Field Guides, Houghton Mifflin Company, 2000.