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for observing twice a week. For courses involving solar astronomy, we use a 12-inch heliostat (also on the roof), and a solar lab inside the building. We use the heliostat to study sunspots, the solar rotation, the Fraunhofer spectrum, and the chromosphere (with an Hα filter and video camera). Our main observing facility is the Blue Mountain Observatory, which houses a 16 inch Cassegrain reflector. We have optional field trips to the Observatory for students in the elementary courses (as well as the general public). We have recently acquired a stellar photometer and CCD camera system so that we will be able to use the Observatory to teach an advanced course on observational astronomy.

32.02

Visualization and Geometrical Transformation in Elementary Astronomy: 2500 Years of Computer-Aided Instruction.

D.N. Brown (U. Wash) and J.Evans (U. Puget Sound)

The intellectual content of an introductory astronomy course, even one emphasizing modern observations and their astrophysical implications, depends heavily upon geometrical reasoning and is communicated substantially through geometrical representations. Typical undergraduate students, however, possess relatively undeveloped capacities for geometrical visualization and manipulation, especially in three dimensions. Thus, the effectiveness of our introductory astronomy teaching depends significantly upon our success in cultivating and enhancing the geometrical skills of our students.

We have successfully employed an ancient computing and pedagogical tool, the armillary sphere, as a vehicle for developing students' understanding of descriptive naked-eye astronomy and expanding their capacity for visualization. We argue that this device, essentially a 4th century B.C. analog computer, can be an invaluable complement to microcomputer planetarium programs. Unlike the screen of a computer monitor, it preserves the geometry of the sky and provides a concrete model of the relationship between the earth and the celestial sphere. Unlike a celestial globe, it incorporates only those geometrical elements essential for fundamental computations.

We discuss the complementary strengths of these ancient and modern instructional tools and present example sets of exercises developed for "survey-style" and "history-style" introductory astronomy courses. Each example set employs both the armillary sphere and the widely used *Voyager* planetarium program for the Macintosh.

32.03

Interactive Videotape with HyperCard

J.W. Allen (Boise State U.)

Single concept sequences, found in science programming from public television and NASA, can enhance introductory college astronomy courses. Examples include the Doppler effect, blackbody radiation, short period comets, and gravitational lenses. With little of this material on videodisc, computer controlled videotape has been chosen. In particular, the use of HyperCard software on a Macintosh computer allows a tape sequence to be found, introduced, supplemented during play, and summarized, with key segments replayed as needed. The random access of a linear medium and other aspects of repurposing videotape are discussed and demonstrated.

Session 33: Active Galaxies
Oral Session, 10:00–11:30 am
Grand Ballroom III

33.01

The Near Infrared Continuum Emission Components in AGN

M.J. Ward (Oxford Univ) and J.K. Kotilainen (Cambridge Univ)

A longstanding problem in understanding the continuum emission from AGN has been the question of what fraction of the near-infrared emission is stellar in origin. Previous studies have yielded contradictory results, partly due to the different samples used, and partly due to ambiguities in the interpretation. We present the results of an IR imaging study (J,H,K) of a sample of hard X-ray selected AGN. The data were obtained using IR arrays on Kitt Peak, CTIO and UKIRT telescopes. The images are used to deconvolve the three spatial components, disc, bulge and nuclear. We compare the stellar/non-stellar fractions with results from CCD studies, and in general find good agreement, particularly for the I-band and J-band images which are close in wavelength. We also compare the fractions derived by a completely independent method, using the strength of the calcium triplet absorption lines around 8500 angstroms.
The results are used to investigate the suggested link between X-ray and near infrared continuum emission. Also, the colors of the nuclear stellar component are compared with standard colors of old and starburst populations.

33.02

Optical Variations in Blue Bump Quasars

O. Kuhn, A. Siemiginowska, M. Elvis, B. J. Wilkes (CfA), J. Mc-Dowell (NASA/MSFC)

Studies of optical variability in AGN have focussed on OVVs and BL Lacs; little has been written about the nature of continuum variability in blue bump quasars. In the course of compiling and examining a number of quasar energy distributions (Elvis, *et al.* 1991), we have found that the optical continua of two relatively nearby and bright quasars, 3C 206 (Q0837-120; $z = 0.198$; $m_V = 15.78$) and Mkn 205 (Q1219+755; $z = 0.07$; $m_V = 15.24$) have varied both in luminosity and in shape. Photometric and spectroscopic observations indicate that the 1μm to 3000Å flux of 3C 206 varied from May 1978 to April 1988. In the first 6 years, the continuum brightened by a factor of $\sim 2-2.5$; over the next 4 years, the flux dropped to an intermediate level. As noted by Cutri *et al.* (1985), changes in the flux at shorter wavelengths were greater than those at the longer wavelengths. From May 1972 to April 1980 the optical continuum of Mkn 205 brightened by a factor of ~ 1.5. Observations made in May 1986 show that the continuum subsequently dropped to a level roughly midway between its 1972 and 1980 values. During the 14 years for which we have data on this object, the shape of the 1μm to 3000Å continuum evolved from one which dipped to a minimum at 5600Å (rest frame) to one which peaked at about this same wavelength.

These variations in the continuum shape as well as in its strength might have interesting implications for both accretion disk and free-free emission models. In particular, models which treat thermal limit cycle behavior in accretion disks predict changes in the shape of the optical continuum over timescales of order 10 years (Clarke and Shields 1989). We attempt to describe the observed variations using such models.

Clarke, C. J. and Shields, G. A. 1989, *Ap. J.*, **338**, 32.
Cutri, R. M. *et al.* 1985, *Ap. J.*, **296**, 423.
Elvis, M. *et al.* 1991, in preparation.

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