

Rochester Institute of Technology

College of Science

New Course Proposal

Title: 1051-217 Fundamentals of Astronomical Imaging

Date: 1/16/2002

Proposed by: Joel Kastner

Department: Imaging Science

Pre-requisite: 1051-215 (Imaging Sci Fundamentals) or consent of instructor

Co-requisite:

Department in which course will be taught: Imaging Science

Maximum number of students per section:

Lec	Rec	Lab
40	N/A	20

Quarter or Quarters when course will be offered: (list hours per week in appropriate columns)

Fall				Winter				Spring				Summer			
Lec	Rec	Lab	Cr	Lec	Rec	Lab	Cr	Lec	Rec	Lab	Cr	Lec	Rec	Lab	Cr
								4		(0)**					

Students required to take course: (dept. and year) Not required

Students who might elect course: (dept. and year) Non-science majors (any year)

Justification of new course: Provides a follow-up elective for non-science students who have taken SIMG 215 (Fundamentals of Imaging Science) and are in need of a second "lab science" course to fulfill their departmental requirements.

Special needs: (rooms, labs, equipment, etc.) Limited access to RIT Observatory (2-3 nights during the quarter); 3rd floor Imaging Science lab rooms (average 1-2 hours per week); classroom with smart podium

Comments: **Laboratories will likely consist of take-home assignments and/or observing projects, requiring e.g. 1-2 visits to RIT Observatory and web-based image processing and image database resources. Hence, no separate, regularly scheduled laboratory sessions are scheduled. Instead, 1 hour of lecture per week will be devoted to discussion and review of labs.

**Rochester Institute of Technology
College of Science
Center for Imaging Science**

Course Information Summary: SIMG 217

I. Course: Fundamentals of Astronomical Imaging

1.1 Four (4) credit hours

1.2 Two 1.5-hour lectures per week

One 1-hour lab recitation per week

Take-home laboratory assignments (average 3 hours per week)

1.3 Prerequisite:

SIMG 215 (Imaging Science Fundamentals) or consent of instructor

II. Course Catalog Description

Familiarizes students with the goals and techniques of astronomical imaging. The broad nature of astronomical sources will be outlined, in terms of requirements on astronomical imaging systems. These requirements are then investigated in the context of the astronomical imaging chain. Imaging chains in the optical, X-ray, and/or radio wavelength regimes will be studied in detail as time permits. Laboratory assignments will range from construction and characterization of a hand-held telescope to analysis of images collected at the RIT Observatory.

III. Course Objectives:

3.1 Understanding of scientific goals of contemporary astronomical imaging

3.2 Familiarity with and use of simple astronomical instrumentation (including computer manipulation of images)

3.3 Application of knowledge of the imaging chain to astronomical imaging systems

3.4 Basic knowledge of concepts and nomenclature required to critically read and parse astronomy articles in newspapers and popular science magazines

IV. Course Outline

4.1 A brief history of astronomical imaging: from Galileo to the HST

4.1.1 The telescope as a two-lens optical system

4.1.2 Detectors: from plates to CCDs

4.1.3 Astronomy in the computer age

4.2 Imaging requirements for multiwavelength astronomy

4.2.1 The relationship between temperature and wavelength regime

4.2.2 Chemical composition and spectroscopy: how can we determine the elements present in distant stars and gas clouds?

4.2.3 The universe in motion: understanding and exploiting the Doppler shift

4.3 Spatial (angular) resolution, field of view, and sensitivity

4.3.1 Distances, physical size scales, and luminosities of astronomical sources

4.3.2 Tradeoffs: field of view vs. resolution; dynamic range and sensitivity

4.4 The modern astronomical imaging chain: source, atmosphere, telescope, detector, computer

4.4.1 Limitations of atmosphere, telescopes, & detectors on wavelength coverage

4.4.2 Limitations placed on spatial resolution

4.4.3 Limitations placed on sensitivity

4.5 Examples of imaging chains in astronomy

4.5.1 Optical: reflecting telescopes, CCDs, basic image processing

4.5.2 Radio: radio telescopes, receivers, image (re)construction

4.5.3 X-ray: grazing incidence optics, X-ray CCDs, X-ray event processing

4.6 Methods of beating the limitations

4.6.1 Space-based observing platforms of the present and future

4.6.2 Interferometry

4.6.3 Image restoration techniques

Comment [JHK1]:

Comment [JHK2]:

V. Instructional Techniques

5.1 Lectures

5.2 Demonstrations

5.3 Laboratories and/or projects

VI. Suggested Methods of Evaluation

6.1 Laboratory Reports

6.2 One or two 50-minute exams

6.3 Final exam and/or final project report

VII. Suggested Bibliography

Web-based class notes; web-based astronomy education resources (e.g., Space Telescope Science Institute, Keck Observatory, Haystack Radio Observatory, Chandra X-ray Observatory web sites)