Observational Astrophysics 2

Introduction to the Course

Christoph U. Keller

Outline

Observational Astrophysics 2: NS-AP433M

Goal (7.5 ECTS)

Understand how to use
astronomical telescopes and instruments
to learn more about the universe

People

- Christoph Keller (UU, Chair of Experimental Astrophysics)
- Peter Jonker (SRON Staff Member)
- Tim van Werkhoven (UU, PhD student in Experimental Astrophysics)

Communication

- everybody: through Blackboard
- C.U.Keller@uu.nl, P.Jonker@sron.nl, T.I.M.vanWerkhoven@uu.nl

Course Web Page

Course URL

www.astro.uu.nl/~keller/Teaching/ObsAstro2_2010

Contents

- contact information
- course schedule, subscribe to iCal link
- lecture presentations, exercises, exercise materials
- presentation topics and assignments including links to papers (only from UU computers)

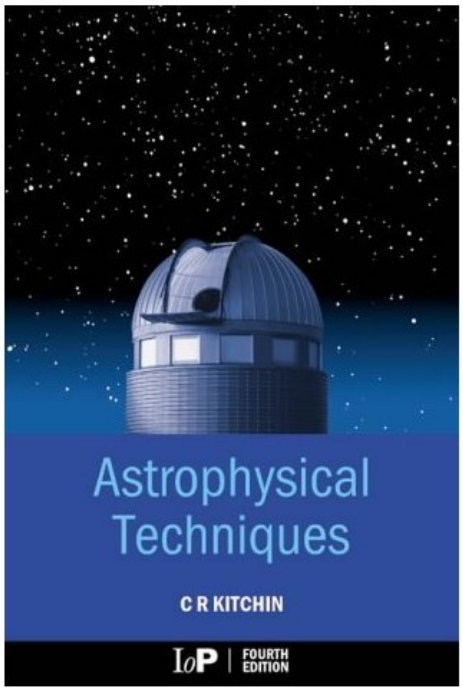
OSIRIS

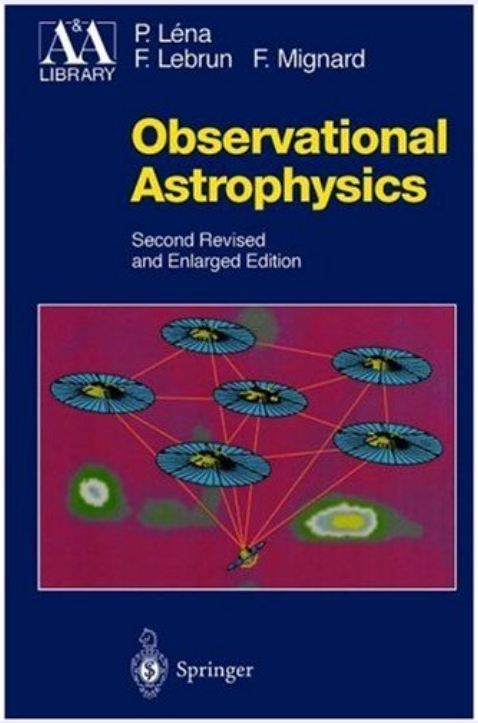
The course web page takes precedence over OSIRIS.

Lecture Notes and Books

Lecture Notes

- written by Johan Bleeker and Frank Verbunt for previous years
- updates as needed





Course Schedule and Requirements

Weekly Schedule

Day	Time	Location	Topic
Monday	13:15 – 15:00	BBL 412	Lectures
Tuesday	13:15 – 17:00	BBL 112	Computer Exercises
Thursday	9:00 – 10:45	BBL 412	Lectures
Thursday	11:00 – 12:45	BBL 412	Exercises/Presentations

Exercises

- exercises are integral part of course
- computer exercises and paper exercises (at home)
- home work has to be submitted by deadline
- will be checked, returned, and discussed
- solutions will not be made available in writing

Presentations

- select one original paper and present it to peers
- 20-minute presentation in English
- public and private discussion of presentation
- grade is for level of understanding of paper

Lectures

Title	Chapter	Instructor
Introduction to the Course		Keller
Radiation Fields 1	1	Jonker
Radiation Fields 2	1	Jonker
Optical Spectroscopy		Keller
Astronomical Measuring Process 1	2	Jonker
Astronomical Measuring Process 2	2	Jonker
Polarimetry 1		Keller
Polarimetry 2		Keller
Fitting Observed Data 1	5	Jonker
Fitting Observed Data 2	5	Jonker
Indirect Imaging	3	Keller
X-Ray Spectroscopy	5	Jonker
Imaging 1	4	Keller
Imaging 2	4	Keller
Observational Astrophysics at SRON		Jonker
Variability and Periodicity	6	Keller
Observational Astrophysics at SIU		Keller

Radiation Fields

- Astronomical measurements
- Stochastic processes
- Distribution functions
- Correlations and auto-correlations
- Convolution
- Fourier transforms
- Sampling and Nyquist theorem
- Filtering

Optical Spectroscopy

- Astrophysical Spectroscopy
- Broadband Filters
- Fabry-Perot Filters
- Interference Filters
- Prism Spectrograph
- Grating Spectrograph
- Fourier Transform Spectrometer

Astronomical Measuring Process

- Power spectra
- Optimal filtering
- Discrete Convolution
- Noise removal
- Applications of filtering
- Moments of a stochastic process
- Stochastic description of radiation fields
- Fluctuations of radiation fields
- Thermal and quantum noise
- Poisson distribution
- Error propagation

Polarimetry

- Polarized Light in the Universe
- Fundamentals of Polarized Light
- Descriptions of Polarized Light
- Polarizers and Retarders
- Polarimeters
- Scattering Polarization
- Zeeman Effect

Fitting Observed Data

- Comparing data with a model
- Least squares fitting
- Maximum likelihood method
- Gaussian data
- Poissonian data
- Monte Carlo simulations

Indirect Imaging

- Interference
- Coherence
- Two-Element Interferometer
- Van Cittert-Zernike Theorem
- Aperture Synthesis Imaging

Imaging

- Overview
- Photoconductive Detection
- Charge Coupled Devices
- CMOS and CMOS Hybrid Devices
- Array Detector Properties
- Array Detector Data Reduction
- Array Detector Problems

Variability and Periodicity

- Finding periodicities in data
- Comparing two distributions

Exams and Grades

Exams

- content
  - lectures
  - corresponding sections of lecture notes
  - exercises (computer and home work)
  - paper presentations and questions
- written exam after course ends
- oral exams after that
- mock exam before end of lectures

Grades

- 20% presentation
- 20% exerciseses
- 60% exam

Papers for Presentations

Topic	Paper with Link to ADS	Student Name	Date
Nod and Shuffle Spectroscopy	Glazebrook & Bland-Hawthorn 2001		11.3.2010
CCD Spectroscopy	Horne 1986		11.3.2010
Sensitive Polarimetry	Semel et al. 1993		11.3.2010
Fringe Removal	Malumuth et al. 2003		25.3.2010
Doppler Imaging	Vogt et al. 1987		25.3.2010
Rotating Modulation Imaging	Hurford et al. 2002		25.3.2010
Lucky Imaging	Law et al. 2006		1.4.2010
Fourier Filtering	Brault and White 1971		1.4.2010
Crowded-field Photometry	Stetson 1987		1.4.2010
Radio Image CLEANing	Hogbom 1974		8.4.2010
Asteroseismology	Bruntt et al. 2007		8.4.2010
Image Deconvolution	Lucy 1974		8.4.2010