UvA MSc Radio Astronomy 2013

Lecture Synopsis (date, title, lecturer)

Course Outline

April 2, 2013 - The History of Radio Astronomy: Past to Present - Jason

Lecture 1

- Introduction to the course: lecture structures, practica, etc.
- Maxwell, Hertz, Marconi
- Karl Jansky
- Grote Reber
- Technological developments during WWII
- The post-war dawn of radio astronomy
- Great discoveries in the first half century of radio astronomy
- Radio astronomy in the context of multi-wavelength astronomy
- The radio telescope as IT instrument

April 4, 2013 - The Science of Radio Astronomy: Extragalactic - Michael

Lecture 2

- Radio Astronomy for Extragalactic Science
- Nearby Galaxies, Mapping HI, Dynamics, Magnetic Fields
- Nearby Galaxies, Astrometry, SNR, GRBs, Mapping HI, Dynamics,
- Star Formation, FIR-Radio Correlation, Lensing
- Radio Galaxies, AGN, Jets, Quasars, Gas Flows, and Radio Source Evolution
- Galaxy Groups and Clusters, Feedback, Black Hole Growth, Relics, Halos, and Shocks
- Cosmic Microwave Background, S-Z Effect, EoR, Cosmology and Large-scale Structure

April 8, 2013 - The Science of Radio Astronomy: Galactic and Solar System - Joeri

Lecture 3

- The Milky Way
- Clouds of gas, supernovae, pulsars
- The Sun
- The Giant planets
- Radar imaging of the planets, moon, and near-Earth asteroids

April 11, 2013 - Emission Mechanisms in Radio Astronomy - Jason

Lecture 4

- Thermal vs. non-thermal observing windows on the Universe
- Synchrotron radiation

April 15, 2013 - The Radio Telescope - Joeri

Lecture 5

- Antenna response: resolution and beam shapes
- Reflector types, collecting area
- The signal chain: antenna, receivers, amplifiers, and mixers
- Sensitivity: the radiometer equation

April 18, 2013 - The Techniques of Radio Interferometry I: The Basics - Jason

Lecture 6

- Motivation for radio interferometry
- Two-element interferometer
- Basic interferometer equations
- Confusion limit
- Beam shape
- Understanding the UV-plane

April 22, 2013 - The Techniques of Radio Interferometry II: Calibration - Michael

Lecture 7

- Definition of Calibration
- Visibilities, uv Coverage, Gains, Phases
- Real Data, Data Examination, Data Editing
- Formalism, Ideal vs. Real Measurements
- Calibration Strategies and Effectiveness

April 25, 2013 - The Techniques of Radio Interferometry III: Imaging - Michael

Lecture 8

- Imaging and Deconvolution
- Image Quality, Noise, Dynamic Range
- Wide-band imaging, Multi-frequency Synthesis

- Wide-field imaging, Facet Imaging, W-Projection
- Mosaicing

May 2, 2013 - Field Trip to LOFAR and Westerbork - Michael + Joeri + Jason

May 6, 2013 - The Techniques of Time-Domain Radio Astronomy I: Single-dish techniques - Joeri

Lecture 9

- Main differences between imaging and single-dish time domain astronomy
- High-time resolution recording
- Pulsar properties
- Pulsar timing

May 13, 2013 - The Techniques of Time-Domain Radio Astronomy II: High time resolution with interferometers - Jason

Lecture 10

- Comparison with single-dish observations.
- Incoherent vs. coherent summation.
- Fly's Eye observations.
- Fast imaging.
- Advanced techniques.

May 16, 2013 - NAC 2013

- No lecture because of NAC conference.

May 21, 2013 - The Future of Radio Astronomy - Michael

- New Radio Telescopes, MeerKAT, ASKAP, SKA
- New Non-radio Telescopes, JWST, ELT, LSST
- Computational and Algorithmic Challenges
- Networks, Storage, Computing, Databases, Software
- Data Intensive Astronomy, Large-scale Data Management, Visualization and Analysis
- The Rise of Data Centers, Archives, and the Virtual Observatory
- Beyond the SKA

May 23, 2013 - Project Presentations - All

May 24, 2013 - Deadline for written observing proposals and data analysis

project

May 28, 2013 - Final Exam (13-16h) - All

Lab Notes

Instructions on installing software to work on the LOFAR Cluster

Proposal Writing

The proposal is 3 page scientific justification, 1 page technical justification, and 1 page references maximum. Final deliverable is a PDF. You can write it as Latex, Word, or otherwise. Templates: PDF | Latex

A few suggestions on writing good observing proposals:

- http://www.aoc.nrao.edu/events/xraydio/meetingcont/6.3_fomalont.pdf: First read 5.1, then all of 5, then skip the rest.
- http://pulsar.sternwarte.uni-erlangen.de/black-hole/1stschool/coursematerial/proposals.pdf After page 22, “Tips and Tricks”
- http://summerschool2011.oa-cagliari.inaf.it/SSS2011/lectures/110916_01_Casu.pdf First page 21 and following, then rest.

References

Links to other classes

- NRAO Essential Radio Astronomy (Condon & Ransom): http://www.cv.nrao.edu/course/astr534/ERA.shtml
- NJIT Radio Astronomy Course (Gary): http://web.njit.edu/~gary/728/
- Leiden Radio Astronomy Course (Garrett): http://www.astron.nl/~mag/dokuwiki/doku.php?id=radio_astronomy_course_description
- Leiden Radio Astronomy Course (Schilizzi): http://home.strw.leidenuniv.nl/~intema/ra2006.htm
- Glasgow Radio Astronomy Course (Woan): http://radio.astro.gla.ac.uk/ralectures/
- UvA Interferometry (Jaffe): http://home.strw.leidenuniv.nl/~jaffe/interferometry/AMS2/
- UvA Radio Astronomy (Strom): http://www.astron.nl/~leeuwen/course/RadioAstronomy_2013/Strom/
- NRAO Synthesis Imaging Summer School: http://www.aoc.nrao.edu/events/synthesis/2012/lectures.shtml
- U. Calgary radio telescope project: http://www.ras.ucalgary.ca/radiotel/

Reference books

- An introdution to Radio Astronomy
- Radio Astronomy
- High Energy Astrophysics
- Tools of Radio Astronomy
- Antennas
- Interferometry and Synthesis in Radio Astronomy

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