Radioastronomy I Syllabus

17.01.2011

1. Discovery of radio emission, the history of radio astronomy: Karl Jansky, Grote Reber, predictions of stellar radio emission of the Milky Way, ”parallel universe”. Radar and the Sun. The beginning of radio astronomy in Poland.
2. Brightness and flux density, units, antenna pattern, spatial resolution, parameters describing antenna properties. Planck’s radiation law, the Rayleigh-Jeans approximation, brightness temperature, antenna temperature.
3. Spectral power, observed flux density for sources of different spatial extent. Effective aperture and the antenna beam area. Determination of the antenna beam area.
4. The main ways of conducting observations with radio telescopes. Techniques of removing scanning effects.
5. Prawa emisji i absorpcji. The equation of transfer, source function, optical depth, sources optically thin and thick. TE, LTE, thermal sources. Observed brightness from a source and an additional background source.
6. Radio window. Influence of Earth’s atmosphere on receiving radio waves. The spillover.
7. Polarization of EM waves. The polarization ellipse, the Poincare sphere, the Stokes parameters. Linearly polarized emission, polarization angle, degree of polarization (linear, circular and total).
8. Wire antenna, spiral and aperture antenna. Types of reflectors. Antenna mounting types. The world’s largest antennas.
9. The antenna theory: radiation of a dipol. Determination of the the antenna pattern from the aperture electric field distribution.
10. Total power receiver (superheterodyne), function of the receiver elements.
11. Sensitivity of the receiver (the radiometer equation), the receiver of 15m radio telescope in OAUJ.
12. Noise system of the receiver. Noise temperature and noise figure of the receiver. The importance of the first element in the receiver.
13. Sensitivity reduction due to receiver gain instability. Dicke receiver, Graham’s receiver, correlation receiver. The simples spectrometer.
14. Calibration of the signal from the antenna, measurements of the noise temperature of receivers.
15. Optical interferometer, two dipol interferometer, the angular pattern of the adding, phase switched and correlation interferometer. The spatial resolution of interferometer.
16. The N-element interferometer.
17. Generalization of the interferometer theory to two dimentions, the UV plane, complex visibility function and its connection with the brightness distribution.
18. Aperture synthesis. Supersynthesis.
19. Gaps in the UV coverage. Reconstruction of sky brightness from interferometric measurements: dirty map, dirty beam, the weight function, the map cleaning method (the CLEAN procedure).
20. The most important interferometric systems in the world. The puzzle of quasars – the case of 3C273.
21. VLBI technics. The primary subetworks of the VLBI.
22. The future of radio astronomy instrumentation.

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