EXERCISE 4
Determination of brightness temperature of the Moon and detection of weak radio sources

Before the exercise:

1. Choose from some catalogue of radio sources few objects with the highest radio fluxes, visible at the time of the exercise. Determine coordinates these sources (Right Ascension, Declination, Hour Angle) on the epoch of observations. Take into account propositions given below:

Name	RA(1950) h ms	DEC(1950) °	Flux (810MHz) [Jy]
3C273	12 26 33.0	2 19 48.0	67
CTB9	2 23 42.0	61 43 00.0	400
CTB59	18 44 42.0	-2 06 00.0	345
CTB73	19 20 42.0	14 04 00.0	370
CTB79	19 46 00.0	9 30 00.0	320
CTB91	20 21 00.0	40 00 00.0	800
CTB96	20 37 30.0	41 55 00.0	800
CTB100	20 52 30.0	44 09 00.0	350
ROSETTE	6 29 24.0	4 53 00.0	342
M42	5 32 49.0	-5 25 00.0	360

2. Determine coordinates of the Moon on the epoch of observations (Right Ascension, Declination, Hour Angle).

At the time of exercise – weak radio sources:

1. Perform calibration of the receiver.

2. Set the antenna on the chosen source and scan it many times. Record your data.

Data reduction - weak radio sources:

1. Subtract the base level of the signal (with the OOD).

2. Average the scans (obtain e.g. one scan as an average of all available scans).

3. Harnessing the calibration determine increment of the antenna temperature ΔT because of the source.

4. Taking into account an effective area of the antenna A_{eff} (from the exercise 2A) determine flux of the observed radio source, or use for this observations of *CasA.*

5. With using catalogues find (single-handedly) flux of the observed radio source at 1420MHz (e.g. in the Bonn survey) and at 408MHz (the Haslam survey). Do not use the approximate data available in the above table.

6. Compare observed flux with the flux at 1420MHz from point 4.

7. From two values of fluxes, first at frequency from point 4 and second for which you have found catalogue radio flux compute a spectral index α. Exploit the definition of the power spectrum:

$$F_\nu \propto \nu^{-\alpha}$$

which physical process (mechanism of radiation) is responsible for the observed slope of spectrum?

At the time of exercise – the Moon

1. Perform calibration of the receiver.

2. Set the antenna on the Moon and scan it in the Hour Angle.

Data reduction – the Moon:

1. Subtract the base level of the signal (with the OOD).

2. Harnessing the calibration determine increment of the antenna temperature ΔT because of the source.

3. Determine the brightness temperature of the Moon T_K in agreement with the formula:

$$T_K = \frac{\Omega_A}{\Omega_K} T_A$$

taking into account solid angle of the antenna obtained on the previous exercises.

4. Compare computed temperature with the one obtained from the formula relating brightness temperature with the Moon phase (the paper of Marina Battagli).

5. What cause the observed radiation from the Moon? Find the answer in literature.

Note:
Report (coverage) should contain plots of the original scans (depending on the time or the number of the alternate scan) and plots from last steps of data analysis. Additionally, you should attach Haslam maps of the observed radio sources.