# EXERCISE 1A
# Measurement of noise fluctuations and determination of the sensitivity of the antenna–radiometer system

**Theoretical basis:**
Electrical resistance in the temperature ***T*** emits EM radiation in an agreement with the Planck's formulae. This radiation possesses a nature of the stochastic noise. Radio telescope is composed with an antenna and a receiver (radiometer), i.e. system of circuits which power of the noise is determined by the noise temperature $W = kT_{SYS}$, where $T_{SYS} = T_A + T_R$, $T_A$ is the noise power detached in the antenna, $T_R$ – is the noise power detached in radiometer circuits.

Minimal detectable variation of the total power system noise temperature is given by:

$$\Delta T_{SYS} = \frac{T_{SYS}}{\sqrt{B[Hz]\,\tau[s]\,n}}$$

**Tasks:**

a) Set the antenna on the zenith (this is needed because of exercise 1B). Set the time sampling constant of the receiver $\tau$. Perform the measurement of fluctuations of the noise of the radiometer $W \sim T_{SYS}$. At the beginning and at the end of measurement perform the calibration ($T_{CAL,1}$ and $T_{CAL}$) - turn on the noise source, setting up additional attenuation of 10dB besides of attenuation of the interface which is 20dB. The temperature of the noise source is T = 8670 K. Remember to do measurement of the level of the reference background before and after the calibration.
b) Perform the measurement of the noise for active calibrator source but this time without the attenuation (the change of the attenuation involves the change of the offset of the AD converter). Do the measurement of the level of the reference background before and after the calibration.

**Report (coverage):**

1) Compute, in units of the Analog – Digital converter (ADU), the mean value and standard deviation ($\Delta T_{SYS}$, $\Delta T_{CAL}$(rms)) for measurements from points a) and b).
2) Divide measurements from point a) inro 4 independent "blocks" (do not take into account measurements when noise source was turned on). Then repeat your computations of mean and standard deviation values for each of these 4 blocks. Check the agreement of the obtained results with formulae given in the theoretical basis part. Make analogical calculations after dividing the measurement into 2 independent blocks.
3) From the measurements of $T_{CAL,1}$, $T_{CAL,2}$ and reference background determine scaler from the scale of AD converter to the scale of the temperature in kelvins. Recalculate results obtained in point 1 and 2 and express them in the Kelvin scale.
4) In base on formulae given above determine the system temperature for measurements composed from 4 blocks, taken together and separately. Do the same for measurements where noise source had turned on additional attenuation. In these calculations assume that bandwidth and the time sampling constant are known. Bandwidth is 12.6MHz.
5) Determine in the analogical way (but this time without dividing measurements on the blocks) the system temperature for point b). Compare the results with these obtained in point 4).
6) Discus obtained results.