

Exercise 3

MEASUREMENT OF THE SOLAR FLUX AND DETERMINATION OF RADIO SPECTRUM OF THE SUN

Before the exercise:

Prepare ephemeris of the Sun and CasA on the day and epoch of observations.

Observations on RT15 radio telescope:

1. Perform the calibration of the radiometer
2. Turn on the additional attenuation of 20dB. Scan the Sun along hour angle axis and register the signal.
3. Turn off the additional attenuation and register the signal for CasA by the same way as for the Sun.
4. Perform the calibration of the radiometer

Observations on RT8 radio telescope:

1. Perform the calibration of the radiometer
2. Do observations of the Sun at all available frequencies (four frequencies: 480 MHz, 820 MHz , 1580 MHz , 2800 MHz).

Report (coverage)

RT15 radio telescope:

1. Using OOD (or another) software subtract the base of the signal.
2. Determine the flux of the Sun at 1420 MHz (S_{Sun}) expressed in solar units SU (solar unit: $1\text{SU}=10000\text{Jy}$) using observations of CasA as a calibrator of known flux on the epoch of your observations (S_{Cas}):

$$S_{\text{Sun}} = \frac{S_{\text{Cas}} \cdot S_{\text{Sun}} [\text{ADU}]}{S_{\text{Cas}} [\text{ADU}]}$$

RT8 radio telescope:

1. Determine the mean values for the five-minutes measurements of the solar, calibration and background signals.
2. By determination of factor w_v , which define flux in conventional units, calibrate the signal from the Sun (S) for each frequency using measurements of the background signal (B) and two calibration signals (Cal1, Cal2).

$$w_v = \frac{S - B}{\text{Cal1} - \text{Cal2}}$$

3. For each frequency determine conversion rate which allow to change the solar flux expressed in conventional units to solar flux expressed in SU. To do this – use radio observations carried out at the same day by another observatory (e.g. Learmonth Observatory, find them by yourself). Determine the uncertainties of obtained conversion rates.

The solar radio spectrum

1. Determine the solar brightness B for each of five frequencies (RT15, RT8). Use approximate formula for the observed flux F (we assume that the Sun have a small angular size in comparison with the beam of the antenna and it's brightness is constant over the Sun's disc):

$$F = B \Omega_s$$

where Ω_s is a solid angle of the Sun (determined on the observation date).

2. Using Rayleigh-Jeans approximation determine the Sun temperature. Draw the figure: Sun's brightness temperature as a function of frequency.

3. What means that we observe changes of solar brightness temperature with frequency? Interpret the obtained result (see Kraus).