

Exercises for OT

Exercise 1

The observation of continuum emission is very important in all radio astronomy. In this example the user is asked to use OT to observe the source NGC 1333, a star formation region. The goal is to observe continuum emission with 4 GHz of bandwidth per sideband (2 GHz per baseband).

The central frequency is 222 GHz.

In this way the correlator will observe four basebands, covering the frequencies

213 - 217 GHz

227 - 232 GHz

With an angular resolution of $1.2''$, how much time is needed to reach a sensitivity of 0.1 mJy/beam?

Exercise 2

In the star formation field, the observation of several spectral lines gives information about the physical structure of the source. The user is asked to work on the spectral setup of the ALMA correlator to observe the next lines.

CO 3-2 345.796 GHz

CS 7-6 342.883 GHz

HCN 4-3 354.505 GHz

HCO⁺ 4-3 356.734 GHz

Each line of the above must have a velocity resolution of about ~ 0.1 km/s. To obtain the desired velocity resolution, the user has to figure out which observing mode(s) are adequate. Wider spectral windows can cover additional molecular lines at similar frequencies.

Set the “Control and Performance Parameters” tab to get a sensitivity of 20 mJy/beam at $1''$ of angular resolution, and check how much time you would need

to get it.

What happens if you want a velocity resolution of ~ 0.2 km/s? Can you still observe in only Science Goal? Which other mode(s) do you think you can use if you do not need that high velocity resolution? What is the change in the estimated observing time?

Exercise 3

The study of evolved stars also uses spectral lines to calculate chemical composition as ratios between isotopes of molecules, to estimate the evolutionary state of these sources. We want to observe spectral transitions for two CO isotopes, ^{12}CO and ^{13}CO . Work in OT to setup the correlator to observe the next spectral lines

CO 2-1 230.538 GHz

^{13}CO 2-1 220.398 GHz

CO 3-2 345.795 GHz

^{13}CO 3-2 330.587 GHz

CO 1-0 115.271 GHz

^{13}CO 1-0 110.201 GHz

CO 6-5 691.473 GHz

^{13}CO 6-5 661.067 GHz

Look at the OT messages for any errors while choosing the observing modes and the spectral lines. In particular, see how many Science Goals you need. Try to estimate the observing time to get a sensitivity of 50 mJy/beam at a velocity resolution of ~ 0.1 km/s or less, using an angular resolution of $2.5''$, $1.2''$, $1''$, and $0.5''$ for the bands 3, 6, 7, and 9, respectively. How much time do you need for the all project?