How do I convert flux measurements given in Jy km/s or K km/s into the peak flux density required by the OT?

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Suppose you want to observe the CO(1-0) line in a galaxy for which the integrated CO(1-0) line flux density is known from previous observations,or estimated based on simulations etc. Let us first assume that the proposed ALMA observations will not spatially resolve the galaxy. From previous observations we know that the total velocity width of the CO profile is 200 km/s and the integral flux density 20 Jy km/s. If the line shape is approximately boxcar-shaped, this implies that the peak flux density of the line is 0.1 Jy. Detecting this line at 5 sigma requires an rms noise level (sensitivity) of 20 mJy.

If you are only interested in detecting the line and not measure the profile shape in detail, a velocity resolution of ~70 km/s may be sufficient. In that case enter 70 km/s in the Bandwidth used for sensitivity field in the Control and Performance tab, and the Desired sensitivity per pointing should be 20 mJy for a 5 sigma detection. On the other hand, if you need many spectral resolution elements over the full velocity width in order to measure the spectral profile in detail, you want to select (for example) 5 km/s as Bandwidth used for sensitivity. The on-source observing time will increase accordingly. Note that the value that you enter for the desired sensitivity is independent of the velocity resolution that is chosen. In the case that the CO(1-0) emission is not only spectrally resolved, but also spatially resolved by ALMA, one needs to take into account that only a fraction of the total integrated flux density is seen in every spatial resolution element. In the OT, the fluxes must be entered in Jy/beam, i.e. you must provide the peak flux density of the source estimated within one synthesised ALMA beam. For example, if the diameter of the CO disk is assumed to be 5 arcsec, and you observe with ALMA at an angular resolution of 0.5 arcsec, the total CO flux is spread over (5”/0.5”)$^{\hat{}2}$=100 ALMA beams. In addition, the emission is also spread in frequency space. The most conservative assumption would be that the emission is equally distributed in all three dimensions, and therefore the desired sensitivity is 20 mJy/100=0.2 mJy. A more realistic case is that where the CO emission comes from a rotating disk, and hence at each of the spatial resolution elements the CO emission is only spread over (say) 40 km/s. In that case the integrated line flux density per beam is (20 Jy km/s / 100 beams) = 200 mJy km/s, and the average flux per beam is (200 mJy km/s / 40 km/s) = 5 mJy. The desired sensitivity per pointing for a 5sigma detection should then be 1 mJy. The calculations above all assume that the spectral profile is flat-topped. In the case of Gaussian or double-horned profiles, the peak flux density will be higher in some spectral channels, and adjustments may have to be made to the calculations.

If your previous measurement of the CO(1-0) intensity is based on single dish observations and given in terms of integrated brightness temperature that is in units of K km/s, this value needs to be converted to units of Jy km/s first. See How can I estimate the Peak Flux Density per synthesised beam using flux measurements in Jy or K from other observatories? for more details on this conversion. In short, a K per Jy conversion factor is needed, which is dependent on the single dish antenna diameter and the antenna efficiency.

Note that for high redshift molecular line measurements, luminosities are often expressed in units of K km/s pc$^{\hat{}2}$. Such a measurement can be easily converted to integrated flux densities in units of Jy km/s using standard equations. For example, the CO luminosity L’ is related to the CO integrated flux density S_{CO} in units of Jy km/s, using the conversion

$$L' = 3.25\times 10^{\hat{}7} (1+z)^{-3}\, f_{obs}{}^{-2}\, S_{CO}\, D_L{}^{\hat{}2},$$

where D_L is the luminosity distance at redshift z, in Mpc, and f_{obs} is the observing frequency in GHz.