Spectral modes expected to be available for ALMA Cycle 0

1. Time Division Modes (TDM).
   These are intended for all observations of continuum sources and for objects with wide, smooth spectral lines, e.g. distant galaxies. Short integration times, e.g. 0.1 seconds, are possible.

TDM modes		Point Spacing[1] (MHz) →		
Band-	MHz	7.8	15.6	31.3
width[2]	1800	1^3	$\mathbf{2}^3$	4^3

"ASAC" modes in red

Notes :

1) This is the spacing of the data points in the spectrum. The actual spectral resolution depends on what smoothing function is applied to reduce "ringing": the FWHM ranges between 1.21 and about 2 times the point spacing.
2) This is the bandwidth for <u>one</u> baseband. There are normally <u>four</u> available.
3) The numbers "N_pol" in these cells show the number of polarization products provided: 1 – single pol, **2** – both polarizations, 4 – Full Stokes. In general case **2** will be preferred, but for polarization measurements case 4 must be used. Band 7 may require the use of case 4 due to a front-end set-up issue.

Spectral modes expected to be available for Cycle 0 (continued)

2. Frequency Division Modes (FDM). These will be used for most spectral line observations. Resolution and bandwidth can be chosen in steps of a factor of 2 as shown in the table. The integration times can be ~1 second, typically substantially longer.

FDM modes		Spacing of spectral points[1] (kHz)→							
Band-	MHz	7.6	15.3	30.5	61	122	244	488	977
width[2]	1800						1[3]	**2**[3]	4[3]
↓	938					1	**2**	4	
	469				1	**2**	4		
	234			1	**2**	4			
	117		1	**2**	4				
	58.6	1	**2**	4					

Notes as for previous slide. In addition note that:

4) For FDM the digitization efficiency is ~85% whereas for TDM it is ~88%.
5) The 4 basebands need to have the same mode, i.e. bandwidth / resolution.

Limitations

- Multi-region modes (where one makes up say 469 MHz of bandwidth with 8 disjoint sub-bands) will not be supported. This will come in R9.0?
- The even more sophisticated modes (“multi-resolution modes”) where different parts of the same quadrant are used with different set-ups are also excluded. R9.1?
- The requirement that all the basebands are set to the same bandwidth is a software limitation which is in fact likely to be lifted by the start of Early Science – R8.1. We will however not be able to demonstrate the use of different bandwidths on each baseband before ~August and this will therefore not be included in the call.

Continuum Sensitivity when observing lines

- The following calculation shows that for most observing the fact that we cannot use different configurations for the different quadrants is not a major limitation.
- Consider observations at 230 GHz using a channel spacing of 122 kHz, which gives a spectral resolution of 0.32 km/s (FWHM after Hanning smoothing). Using dual polarization, we have 469 MHz bandwidth per baseband so we end up with 1876 MHz of continuum bandwidth.
- Compare this with 5870 MHz: the maximum we could have had if this limitation were not there. The increase in the noise on the continuum data is only a factor of 1.77.
- The three-sigma continuum sensitivity with this factor included is then about 0.2 mJy per beam, in one hour.
- If you needed still higher spectral resolution for the lines then for e.g. 30.5 kHz resolution the sensitivity is 0.4 mJy.