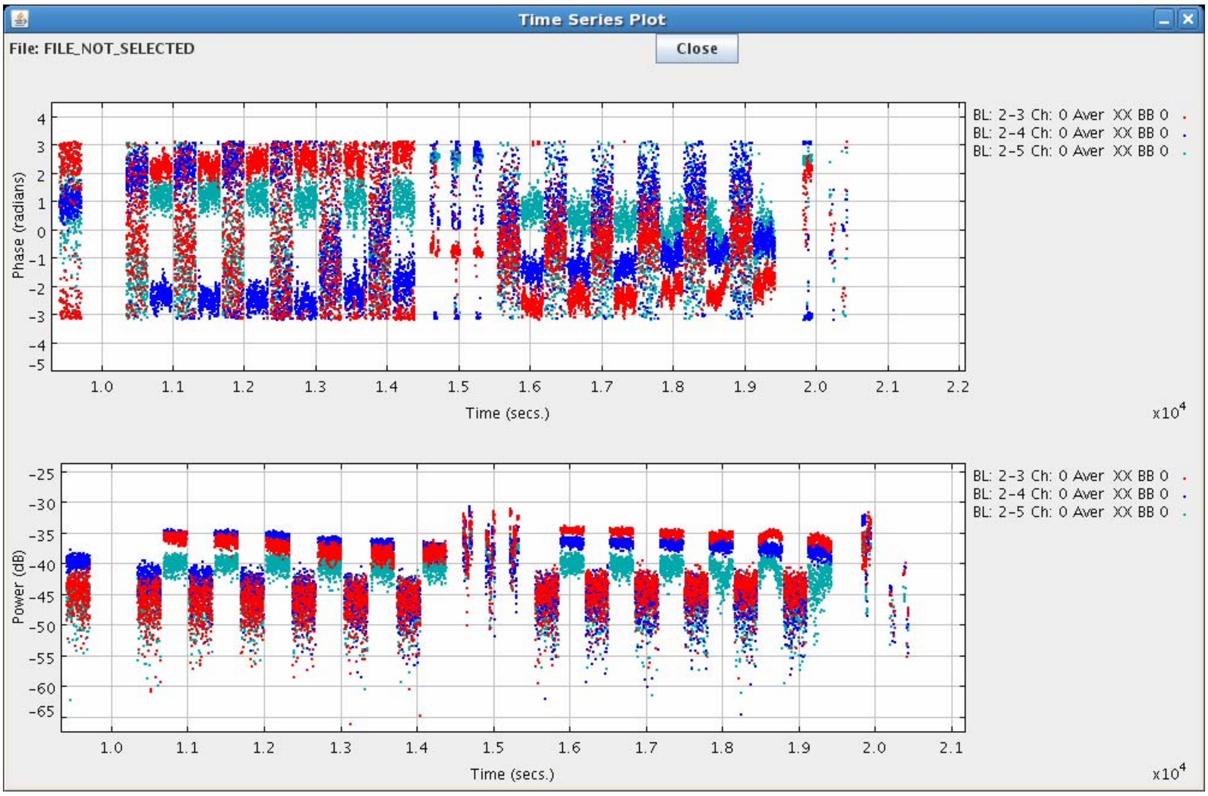
Some Recent Results from ALMA Commissioning

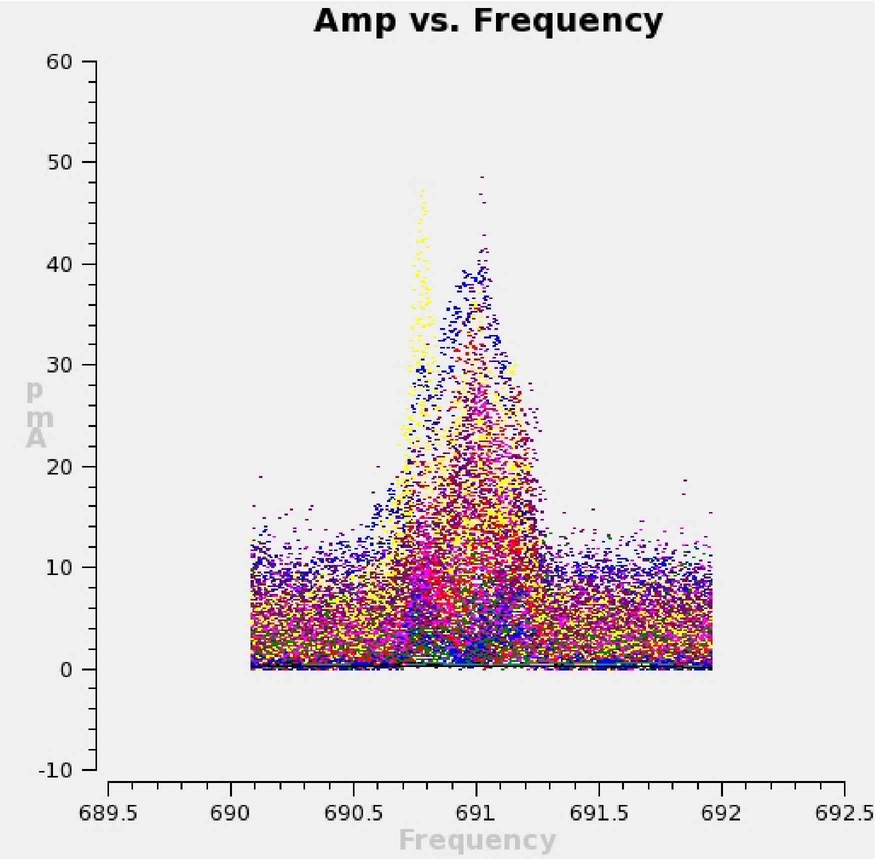
We have been gradually getting to the point where we can try out some of the more challenging tests of the ALMA system, which of course includes observing at high frequencies. In addition to the problems of atmospheric absorption and the need for very accurate antenna surfaces, high frequency observing is made difficult by the fact that the primary beam is small, so that pointing becomes critical, and the lack of bright sources for calibration. As evidence that we are making progress on these issues, here is a track at 690GHz, where we were using Jupiter's moon Io as a calibrator and the source is the well-known galaxy NGC253.



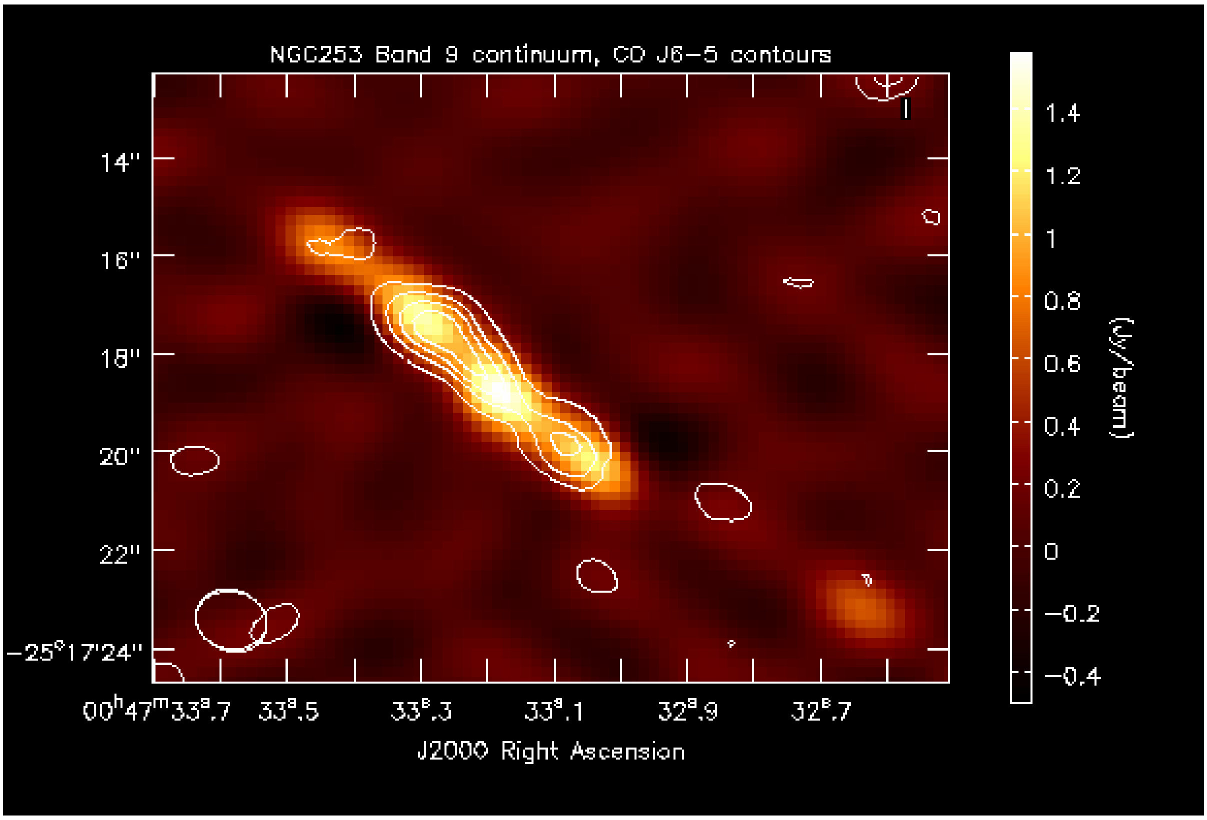
The alternation roughly every 10 minutes between the Io measurements and the galaxy produces the vertical bars. (Only three of the six baselines observed are shown here in order to keep the plot reasonably clear.) In the upper section one can see the phases and the broad red, blue and turquoise bands running across the plot are the Io data showing really quite slow phase drifts over the period of more that 2 hours observed here. These drifts are presumably due to a combination of residual baseline errors and instrumental phase changes. Note that Io is of course moving with respect to the reference frame – this makes it what we call an "ephemeris" object, i.e. one that has its own ephemeris in the software system. The fact that the phase is stable therefore means that all the necessary elements of the control system, in particular a very large amount of quite delicate software to adjust the phase and delay as well as the antenna pointing, are working correctly.

The amplitudes are shown in the lower plot and one can see that they differ on the different baselines, which is at least partly as expected since Io is somewhat resolved. They also sag towards the middle of the plot and then come up again after the pointing was updated (the three short scans in the middle of the plot). This shows that the pointing had in fact drifted off somewhat during the first hour. This will obviously affect the results but we can still proceed with the reduction to see whether we are on the right track.

The sections between the Io observations are of course the signals from NGC253 and at first sight it looks as if these are mainly noise. If we make a plot of these visibilities as a function of frequency, however, we see that the J = 6-5 CO line is actually detected easily (see over).

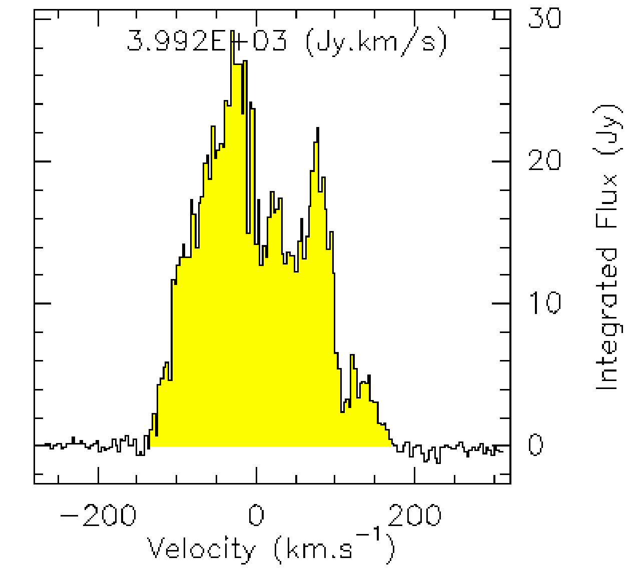


There is in fact considerable continuum flux visible as well. We can therefore go ahead and construct test images of both the line and continuum components:



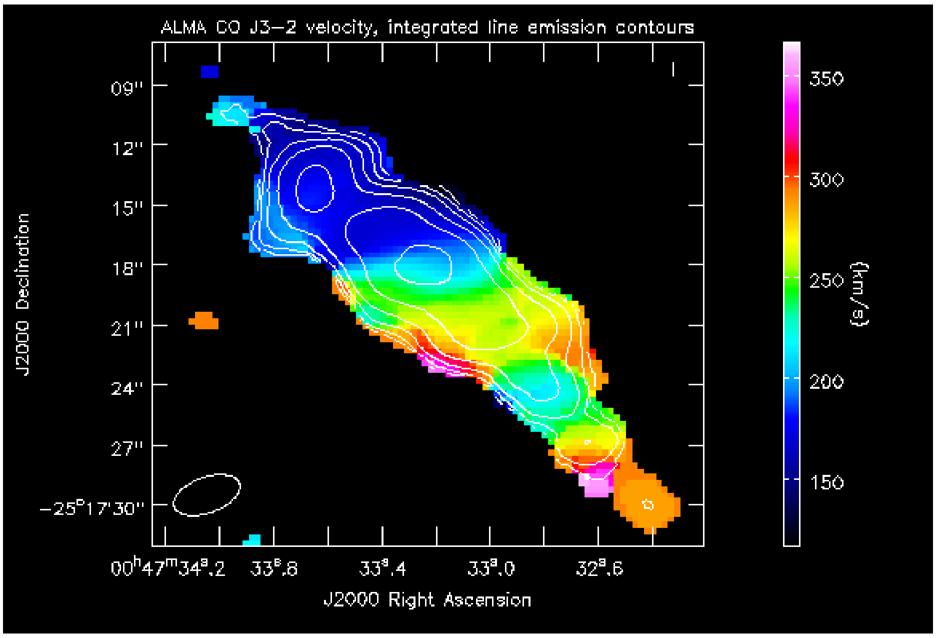
Here the false-colour is the continuum and contours are the J = 6-5 CO line.

The integrated spectrum looks like this, showing that the signal-to-noise ratio is really quite good.



(Obviously the flux figures are not accurate at this stage.)

We also have data on this object at Band 6 (230 GHz) and Band 7 (345 GHz). The band 7 data has also been processed to make a map and here is a plot showing the velocity gradient:



The band 6 data was taken with 6 antennas giving 15 baselines and the quality looks good, but at present we only have a short track and we need to take more data before we can make satisfactory test images.

It is of course true that a huge amount of work by a very large number of people has gone into obtaining these results and it is a pleasure to thank everyone involved for their efforts in getting us to this point.

Richard Hills 13th Sept 2010