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MeqTree bandpass calibration

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0.5	2004-Nov-25	-	-	Creation
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Abstract

...

1 Introduction

2 Bandpass time variations

Normally, a bandpass calibration estimates separate gains for each channel, which are then applied as constants over the entire observation (or a linear interpolation between before and after, separated by as much as 12 hrs).

Figs ... show the change in bandpass over 12 hours. The calibrator sources are assumed to have a flat spectrum, apart from an SI (slope) , which has been removed.

Tentative conclusions:

- There are significant variations in time. Mostly large-scale.
- The small-scale freq variations are not significant, because the average out in time (??). This is fortunate, because the MeqTree system does not know how to deal with them.

TAO will pre-calibrate with Miriad, removing an average channel-by-channel gain. We will then use MG_JEN_BJones.py to solve for a time-varying BJones on the bright source in the centre of the field (the expected lines are a few channels wide, much too faint to be seen in a single data-point, and in faintish sources elsewhere in the field). This raises the following issues:

- We can do a tiled BJones solution with tiles of (say) 60 time-slots (one hour), and a 2nd degree time polynomial (freq is 5-6th degree). Can we visualise the resulting 1-hour funklets in the MeqParm table, by themselves or collectively?
- If we want to see what is going on with historyCollect nodes, how do we go about that?
- We can do a BJones solution per time-slot. We need MeqParm tools to visualise this series, and to fit a time-polynomial through them. The latter would be expressed in a 'longpolc', which would also be put into the MeqParm table.
- At some point, we must revive the MeqParm code that generates a longpolc from snippet solutions. This has advantages in rejecting 'bad snippets' etc (local intelligence).

After this, we (Marc Verheyen) may make a map, and look at the spectra of the faint sources in the field.

3 General procedure

The general procedure is to use MG_JEN_cps_BJones.py to solve for BJones from calibrators before and after the observation. The solution will be for a 5-6th degree freq polynomial, and perhaps a 1st degree time polynomial. The resulting funklets are put into a MeqPaerm table. If the tree that is used for the science object has access to the same MeqParm tablemay correct for BJones right after the spigots. The BJones MeqParm nodes will 'automatically' get interpolated values for arbitrary domains between the two calibrator funklets (**this still has to be implemented!**).

The BJones solution will ignore the band edges (outre 5-10 channels). We need a procedure that specifies this, without knowing the actual nr of channels in the MS.

The tree for the science object will use the BJones-corrected uv-data to do a GJones solution that allows for a more rapid time variations (atmospheric phase), but virtually no freq variation of. Here also, the outer parts of the spectrum should be ignored (they would not be corrected properly for BJones, and thus distort the solution)

4 Peeling

When we have position-dependent sources, a separate GJones solution will be obtained in the direction of different bright sources. Since the BJones correction is an electronic effect that affects all sources in the same way, it must be applied directly after the spigots.

5 Small-scale frequ variations

Can be ignored?

6 Conclusions

References

[1] Thompson, Moran and Swenson, *Interferometry and Synthesis in Radio Astronomy* (1994)

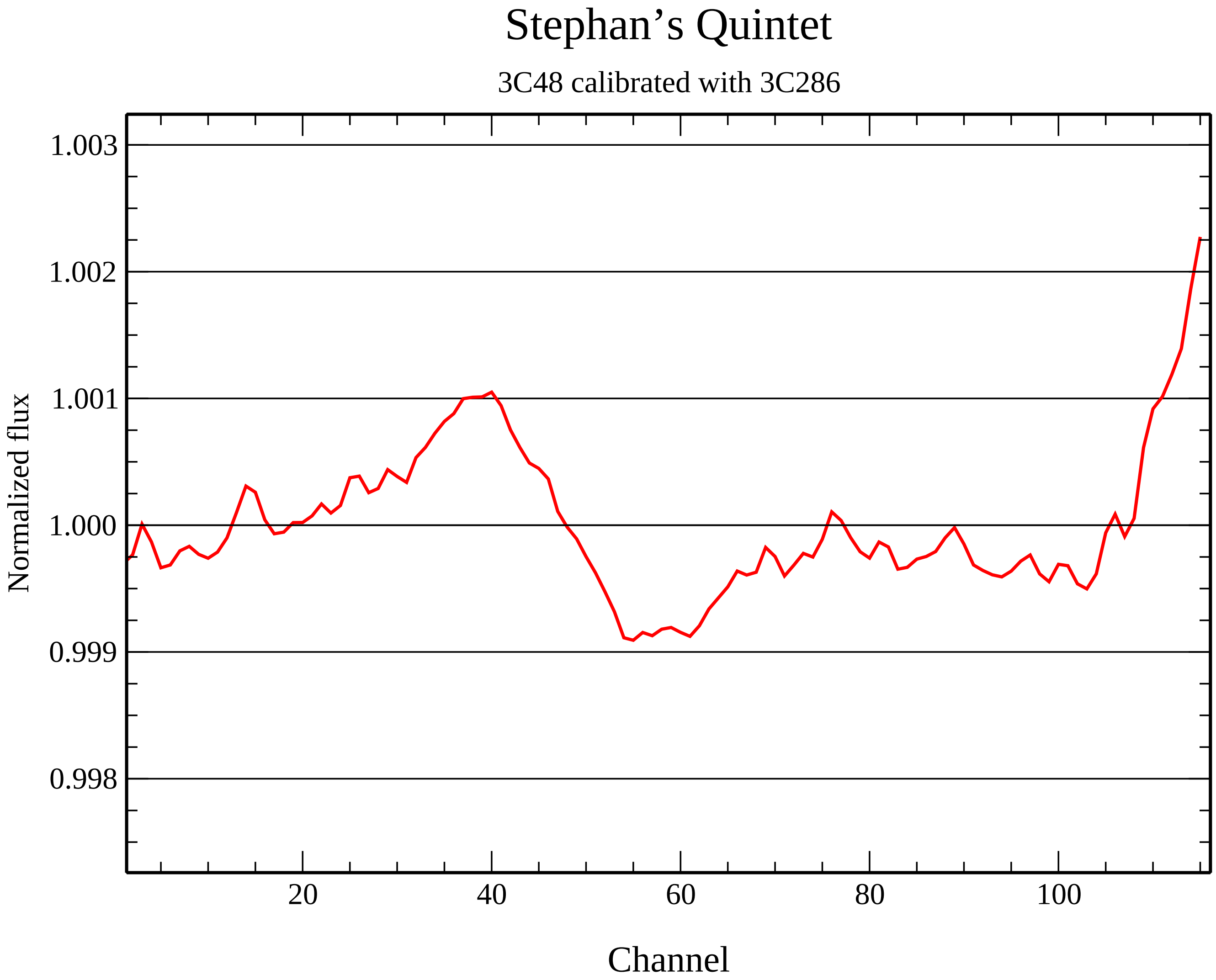


Figure 1: *Sum of all ifrs.*

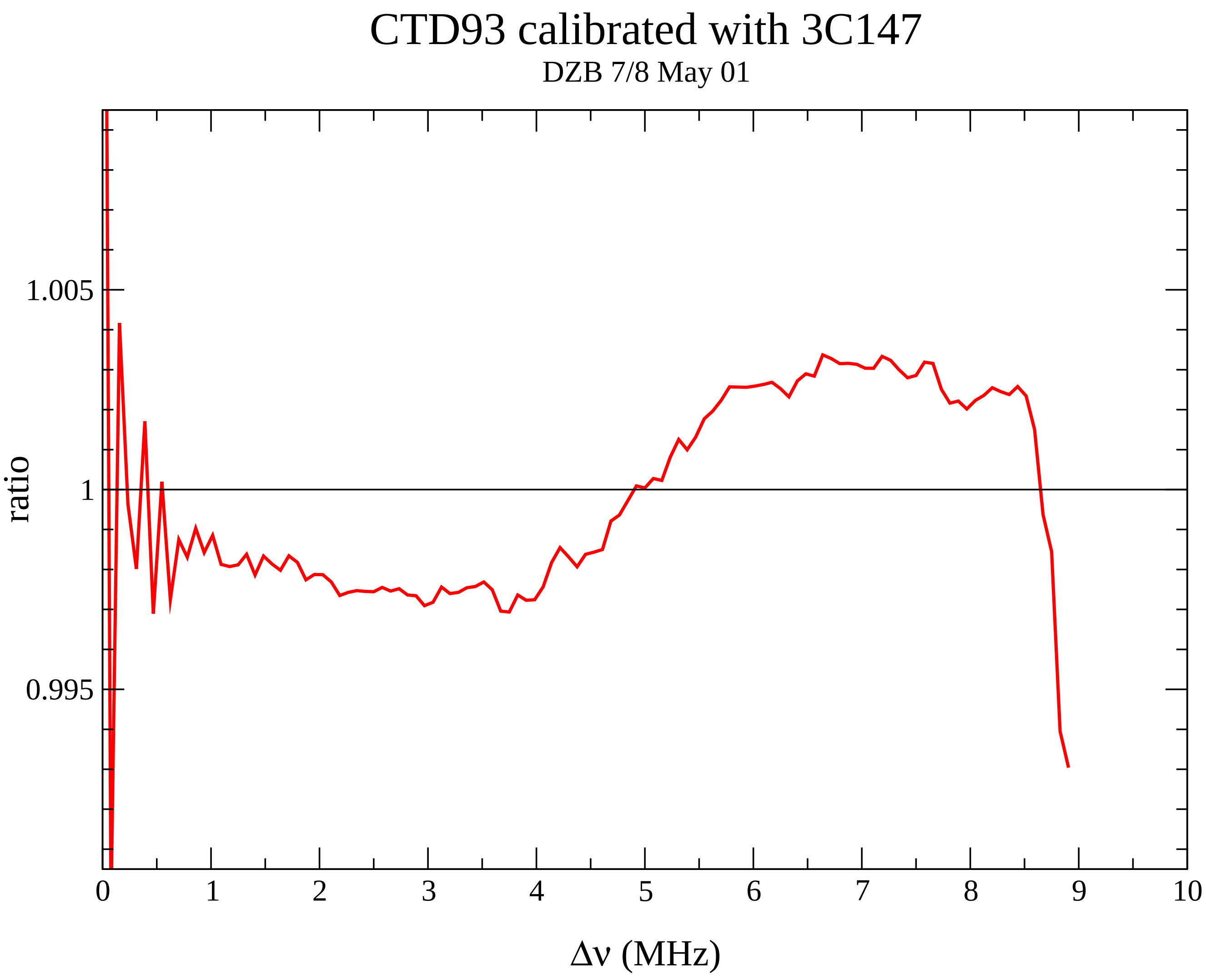


Figure 2: *Sum over all ifrs. The rapid variations on the left are the Gibbs ripple, i.e. an artifact of the FFT that produced the spectrum after correlation. The (antenna-based) IF's before the correlator have several filters. Temperature variations cause variations of different freq-scales. The large-scale variations seem to have the largest amplitudes in time (Kolmogorov-like?). This should be explained. The small-scale variations are partly noise.*

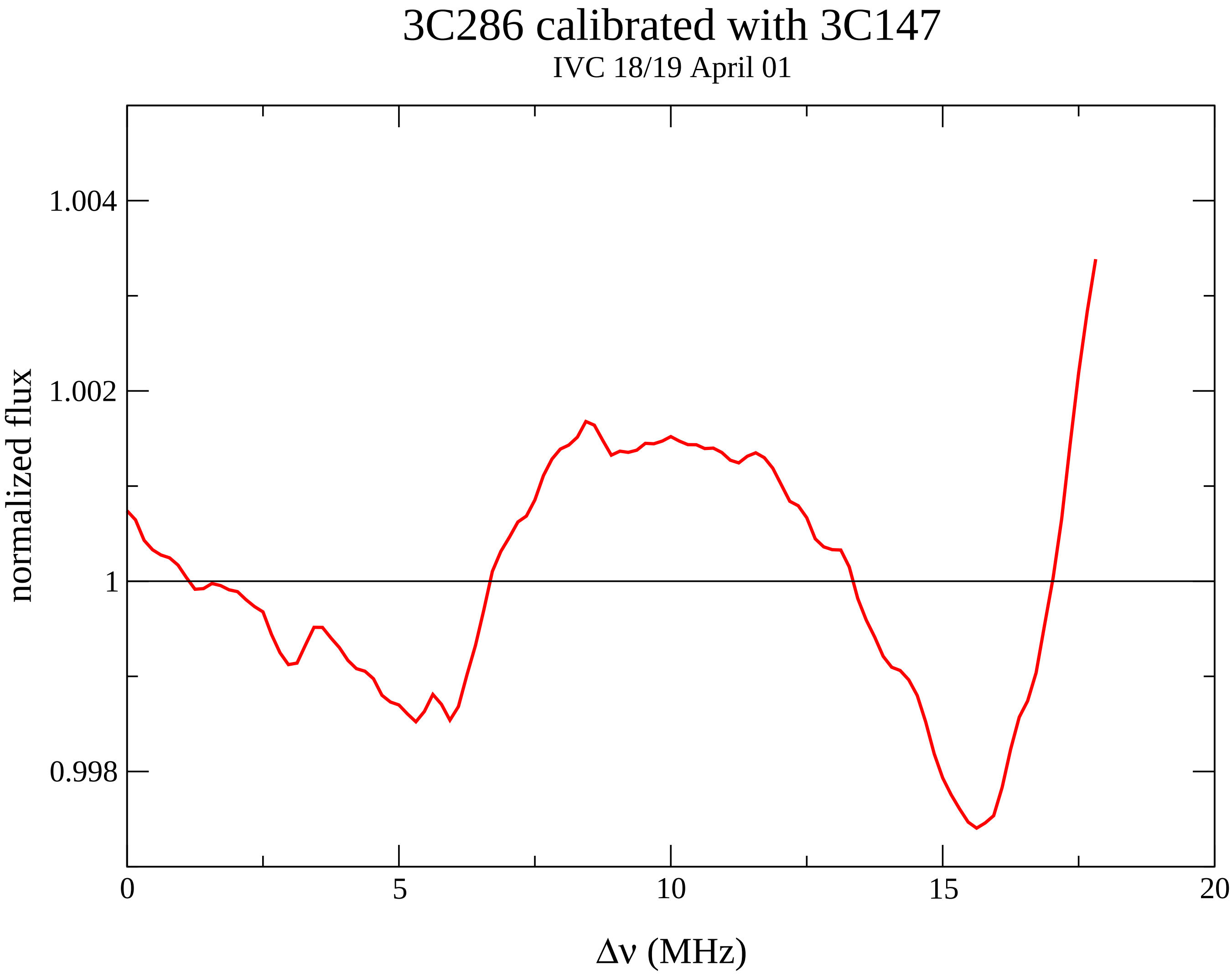


Figure 3: *Sum over all ifrs.*

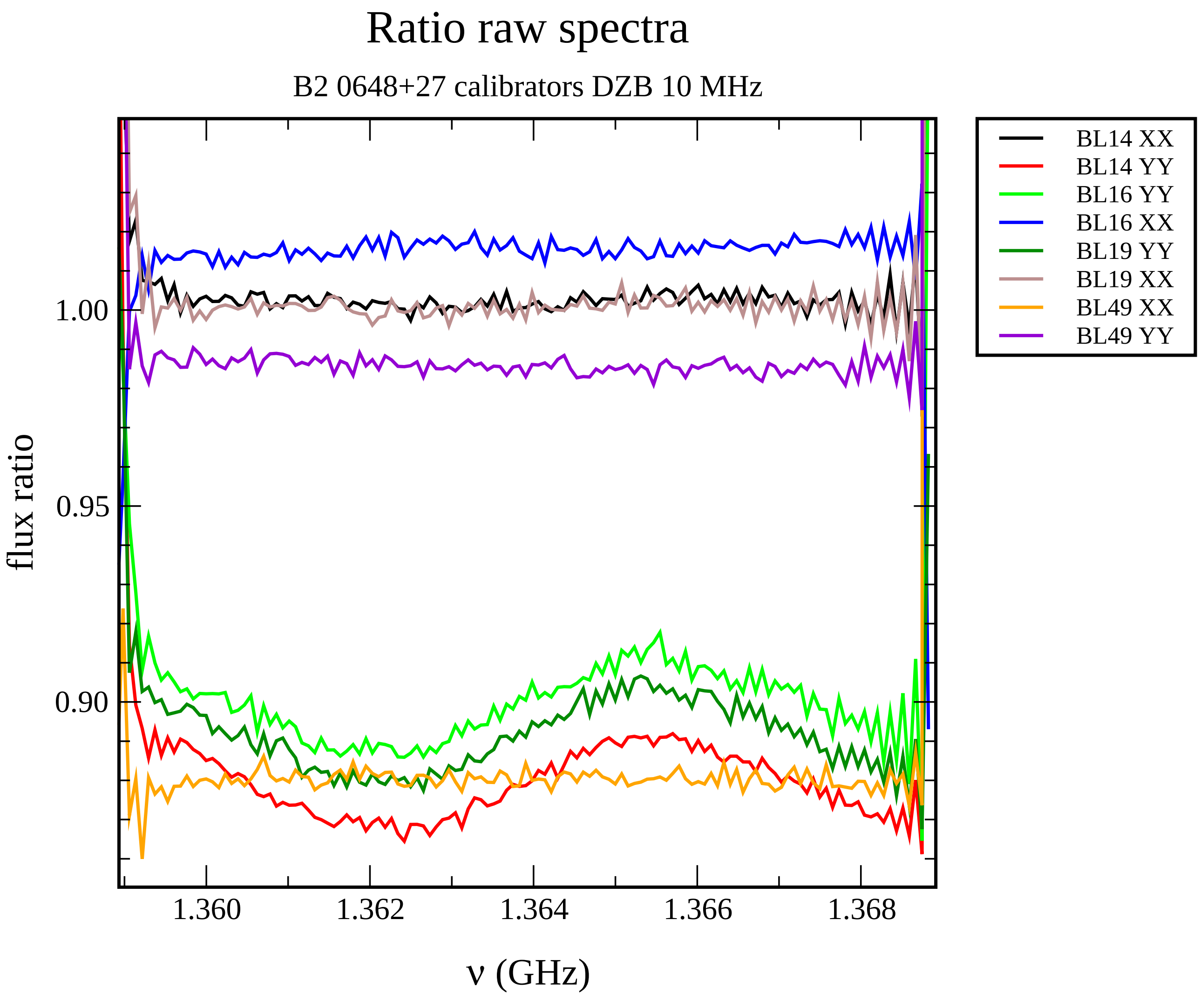
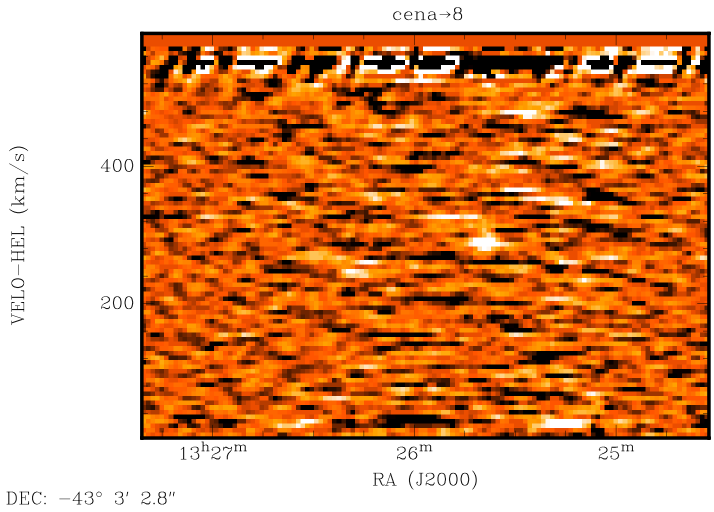


Figure 4: *Some ifrs have a stable bandpass, while others vary quite significantly in 12 hours. Note how the variation seems t be confined to the YY ifrs, and is remarkably similar even though different antennas are involved.*



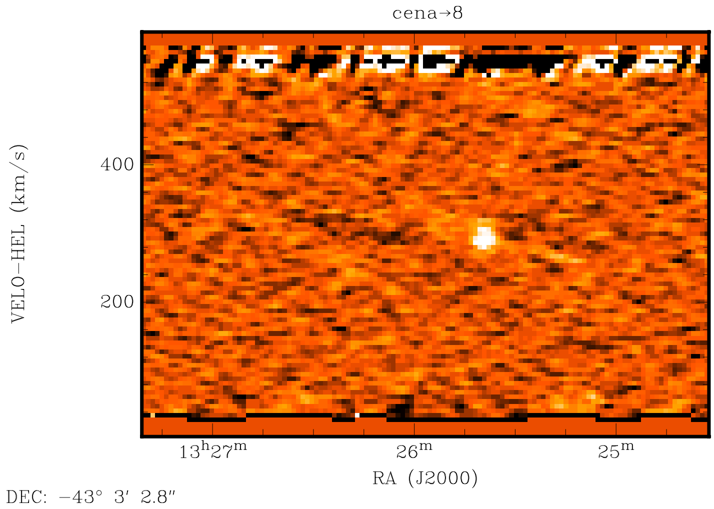


Table 1: *Centaurus A is much brighter than any bandpass calibrator. Therefore, the bandpass correction introduces noise (top). This can be reduced by smoothing the bandpass corrections in frequency (bottom).*

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