# Report on continuum subtraction quality checks on DINGO Pilot data

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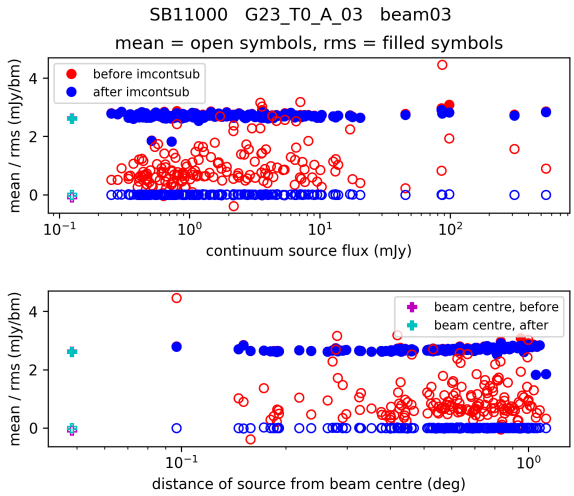
## 1 Overview

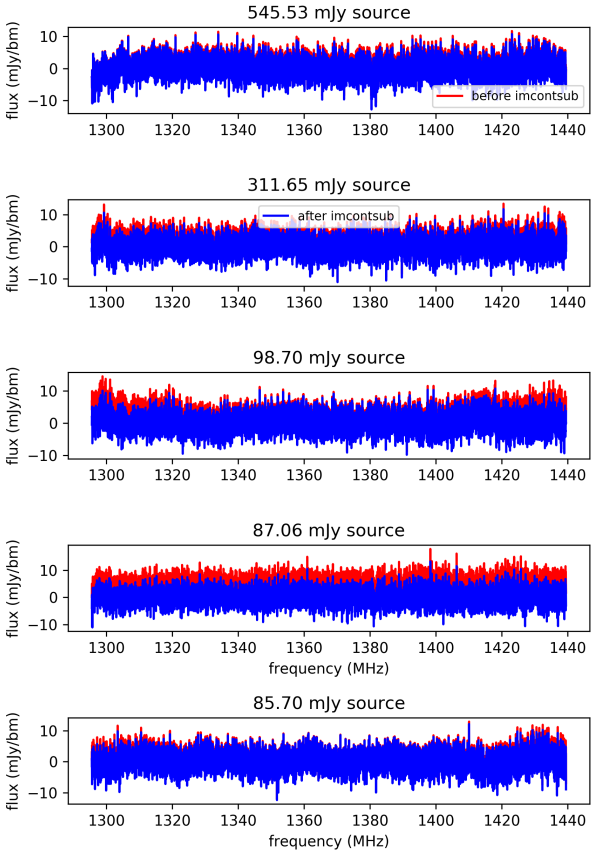
The tests are done on individual beam cubes produced from the observations of a scheduling block. Spectra at the positions of continuum sources as detected by ASKAPsoft source finding algorithm (Selavy) are extracted, along with a spectra at the bore sight of the beam, for the beam cube produced after uv-domain continuum subtraction and the cube produced after the subsequent image-domain continuum subtraction (IMCONTSUB). Various plots are produced to visually inspect the quality of the continuum subtraction.

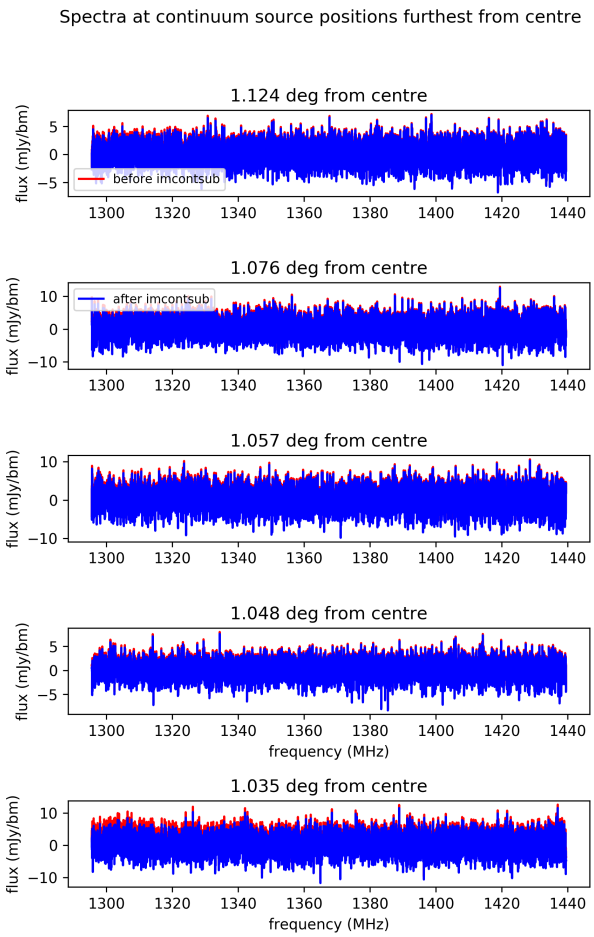
The first plot is intended to be an overall diagnostic plot for the quality of continuum subtraction. The mean and rms of the spectra at all continuum source positions and at the beam bore sight are plotted against (i) the continuum sources fluxes, and (ii) the distance of the continuum source from the bore sight, in order to identify any existing pattern in continuum subtraction with either the flux or the position of the continuum sources. An example of the figure is shown below.



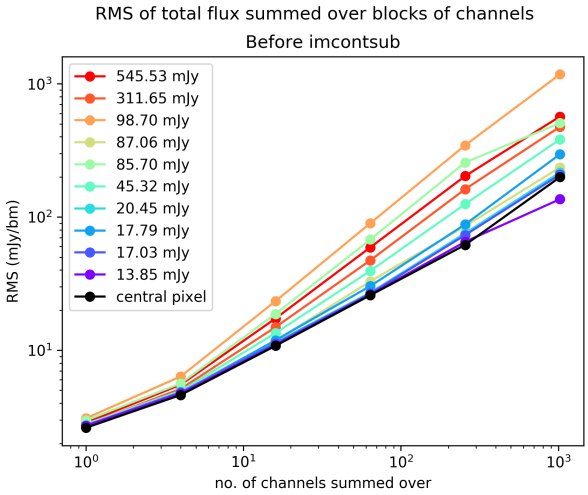

Next a series of spectra are plotted to expand on the 'diagnostic' plot above. First, the spectra before and after IMCONTSUB for the five continuum sources with the highest flux densities are plotted. Next, the spectra before and after IMCONTSUB for the five continuum sources at the largest distances from the beam bore sight are plotted.

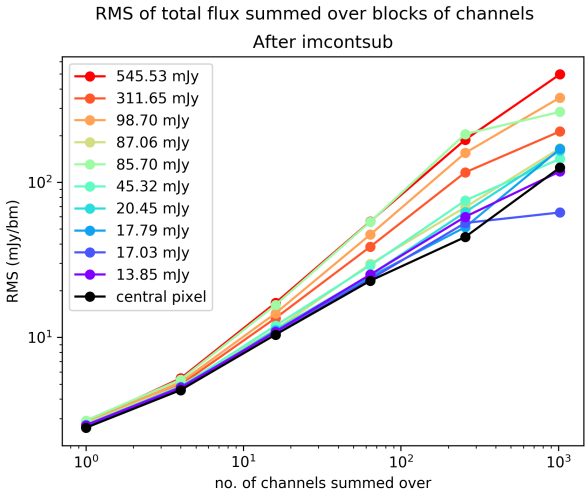
Spectra at brightest continuum source positions



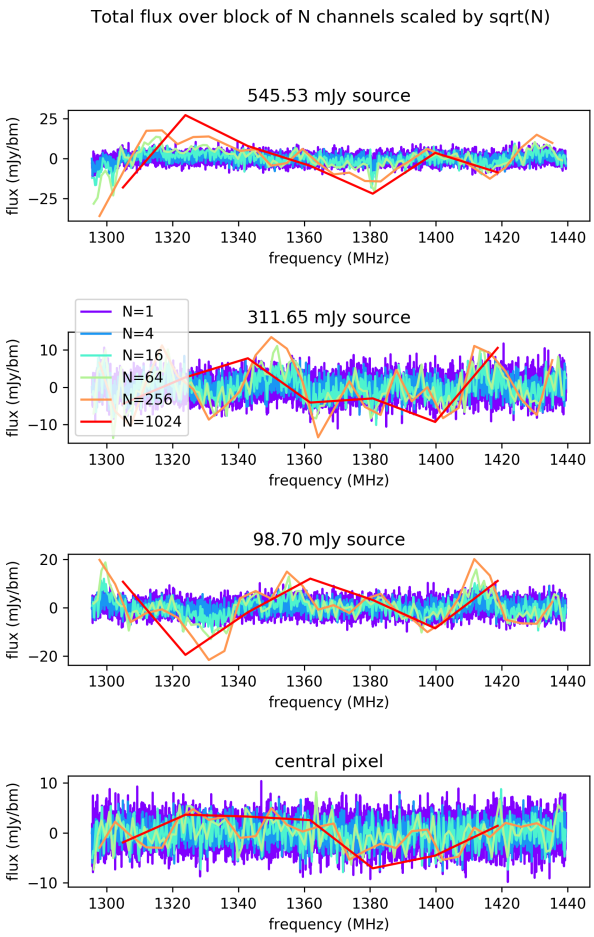



Next, we modify each of the extracted spectra by summing over each $4^n$ adjacent channels. The variation of rms as increasing number of channels are summed over, is plotted for the ten highest flux density continuum sources and the spectrum from the beam bore sight, both before and after IMCONTSUB. The intention is to extract any residual pattern across frequency that might remain (or might have been introduced) after continuum subtraction. As DINGO will create deep images through stacking, such residual patters might become important for us. Examples of the plots are shown below.



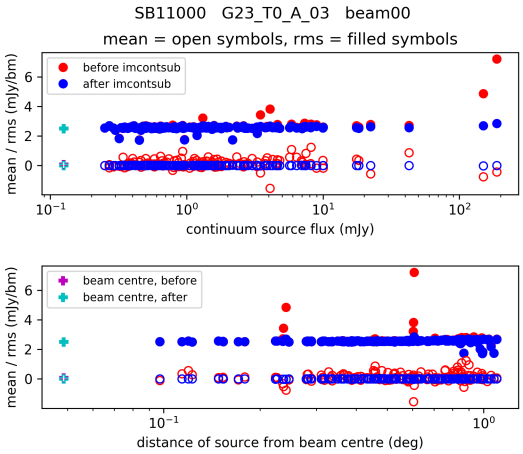

Finally, the summed spectra for three highest flux density continnum sources and the bore sight after IMCONTSUB are overplotted after scaling each spectrum down by $\sqrt{\mathrm{N}}$, where N is the number of adjacent channels summed over to create the spectrum. Any residual pattern that might exist across frequency becomemes quite apparent when looking at these spectra as shown below.

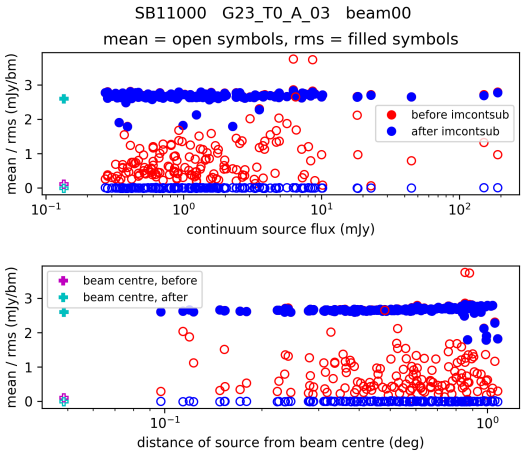


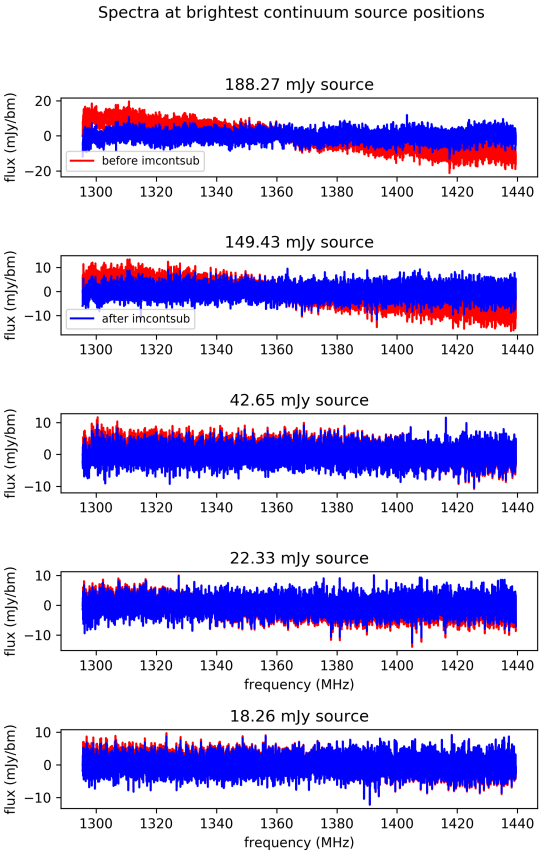

# 2 Some investigations

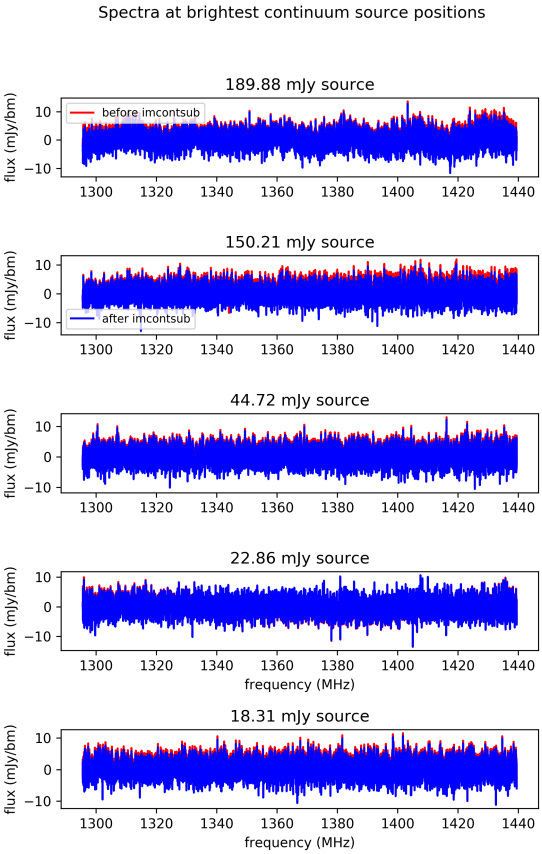
## 2.1 Comparing two CONTSUB_METHODs

Data from a single scheduling block was processed separately by changing the uv-domain continuum subtraction menthod. The two different CONTSUB_METHODs used were Cmodel and CleanModel. Comparing between the sets of figures produced by our tests on the cubes produced by the two different data processing chains as shown below, we deduce the following.
(i) There is no obvious variation in overall continuum subtraction with continuum source flux density or position. At this stage, when primary beam correction has not yet been applied, the higher noise at the edges of the beam is reflected in the large scatter of RMSs of the spectra for continuum sources $> 0.8$ degrees from the beam bore sight. (ii) When using Cmodel many times some (positive or negative) residual emission as well as a slope across the frequency range remains after uv-domain continuum subtraction. When using CleanModel, just positive residual emission remains.
(iii) IMCONTSUB is capable of taking care of both the slope as well as any residual emission.
(iv) Residual pattern in the spectra with frequency seem to exist. These patters are source specific, but even at the beam bore sight there is a distinct pattern with period $\sim 5$ MHz.
*In the following figures, the left panel are with Cmodel and the right panels are with CleanModel.*

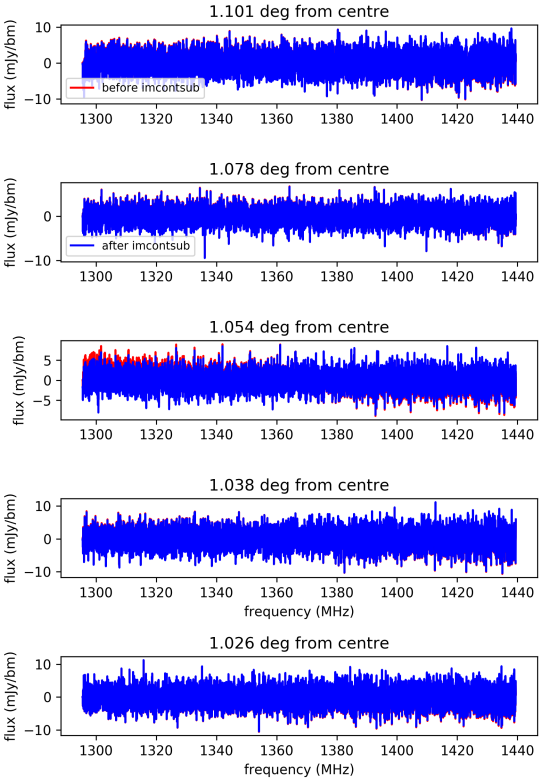

SB11000 G23_T0_A_03 beam00
mean = open symbols, rms = filled symbols
before imcontsub
after imcontsub
mean / rms (mJy/bm)
continuum source flux (mJy)
beam centre, before
beam centre, after
distance of source from beam centre (deg)


SB11000 G23_T0_A_03 beam00
mean = open symbols, rms = filled symbols
before imcontsub
after imcontsub
mean / rms (mJy/bm)
continuum source flux (mJy)
beam centre, before
beam centre, after
distance of source from beam centre (deg)

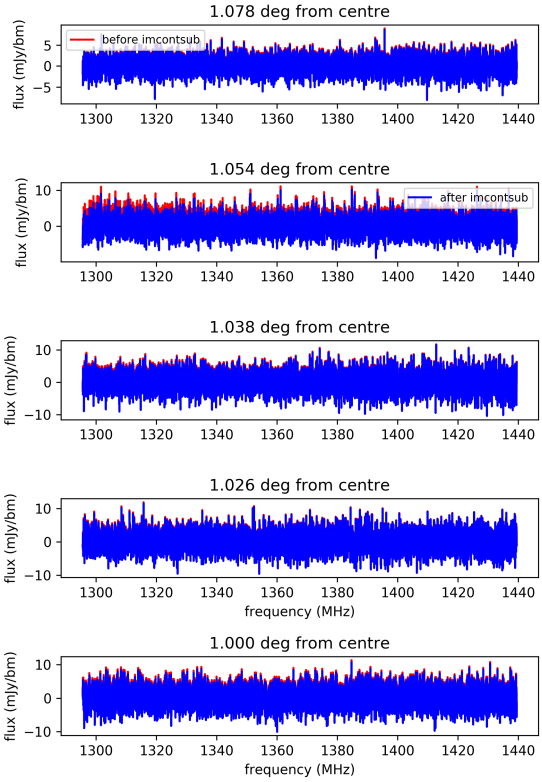

Spectra at brightest continuum source positions
188.27 mJy source
149.43 mJy source
42.65 mJy source
22.33 mJy source
18.26 mJy source
before imcontsub
after imcontsub
flux (mJy/bm)
frequency (MHz)


Spectra at brightest continuum source positions
189.88 mJy source
150.21 mJy source
44.72 mJy source
22.86 mJy source
18.31 mJy source
before imcontsub
after imcontsub
flux (mJy/bm)
frequency (MHz)

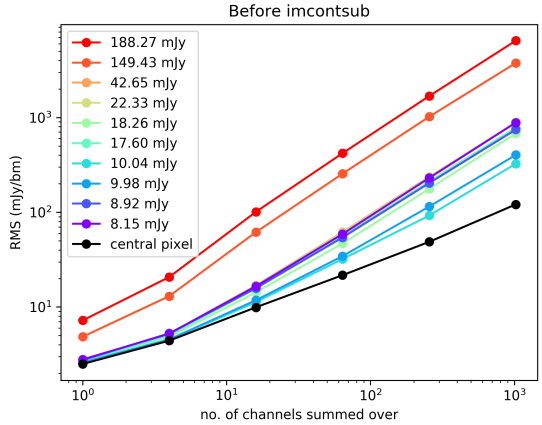
Spectra at continuum source positions furthest from centre



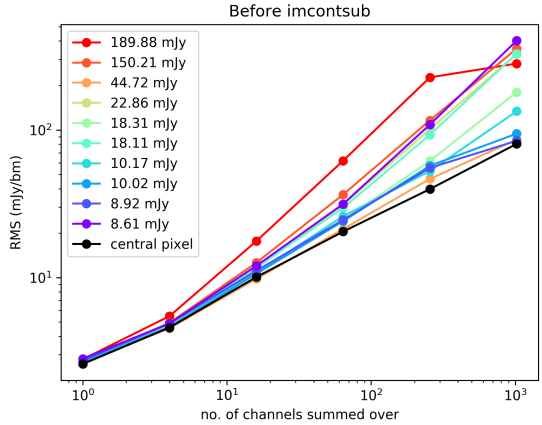

Spectra at continuum source positions furthest from centre

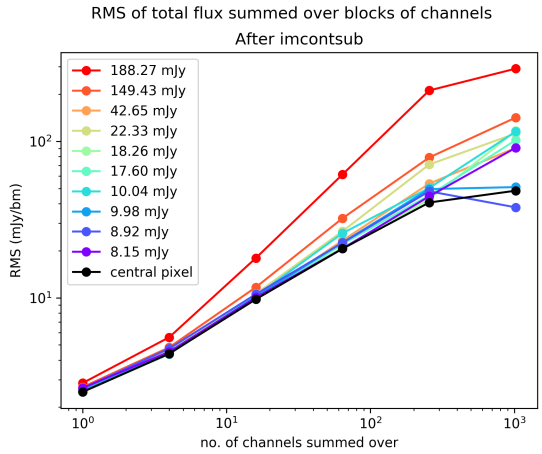


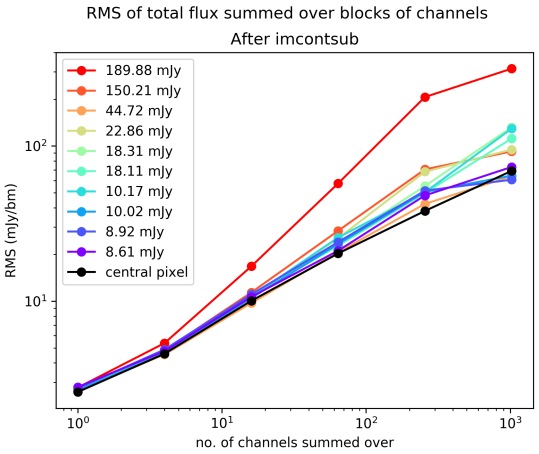

RMS of total flux summed over blocks of channels

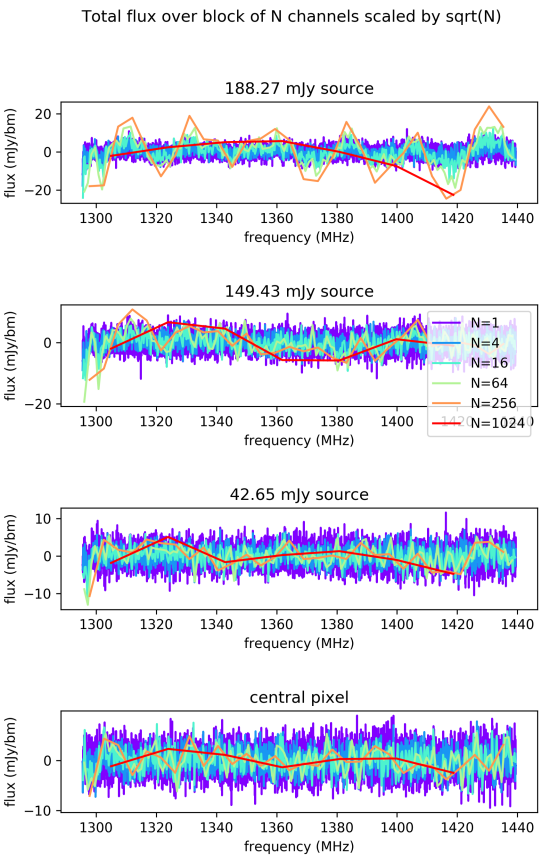


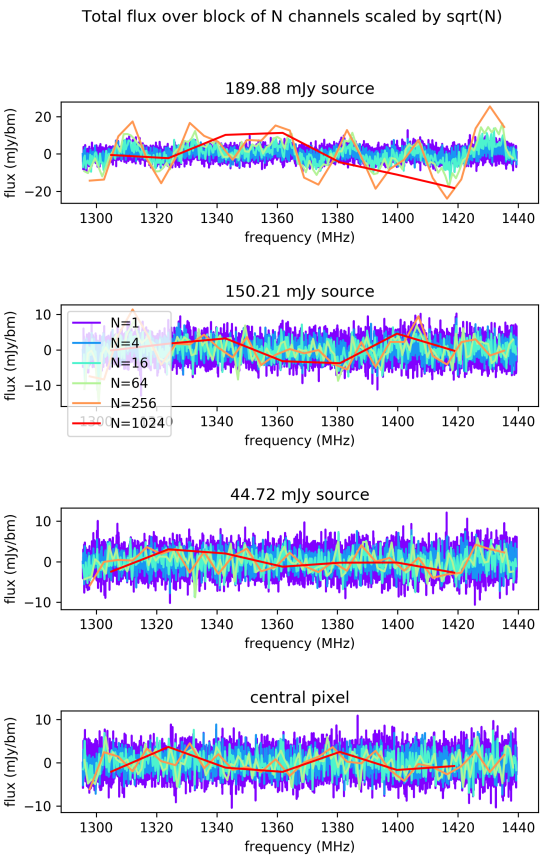

RMS of total flux summed over blocks of channels




RMS of total flux summed over blocks of channels
After imcontsub
188.27 mJy
149.43 mJy
42.65 mJy
22.33 mJy
18.26 mJy
17.60 mJy
10.04 mJy
9.98 mJy
8.92 mJy
8.15 mJy
central pixel
RMS (mJy/bm)
no. of channels summed over


RMS of total flux summed over blocks of channels
After imcontsub
189.88 mJy
150.21 mJy
44.72 mJy
22.86 mJy
18.31 mJy
18.11 mJy
10.17 mJy
10.02 mJy
8.92 mJy
8.61 mJy
central pixel
RMS (mJy/bm)
no. of channels summed over


Total flux over block of N channels scaled by sqrt(N)
188.27 mJy source
149.43 mJy source
42.65 mJy source
central pixel
N=1
N=4
N=16
N=64
N=256
N=1024
flux (mJy/bm)
frequency (MHz)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N=1
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N=1024
flux (mJy/bm)
frequency (MHz)