Internal Report

The ORT Analog Correlator: correlation on a source as a function of the injected uncorrelated noise and its implication on flux measurement

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1 Introduction

The flux of 1830-211 as measured by the ORT is found to be 5 Jy. This is about 1.8 times less than the earlier measured value near this frequency. This source is known to be a variable source especially at frequencies above tens of GHz. Therefore initially it was thought that the discrepancy in the measured flux is due to the intrinsic variability of the source. Recent measurement using the VLA at 327 MHz showed that the flux is about 9 Jy (Niruj Mohan, JAP, B'lore, Anantharamaiah, RRI, B'lore 1997). Repeated observations using the ORT have again measured a flux of 5 Jy. This lead to the suspicion of the non-linear characteristics of the analog correlator connected to Beam 7 when the system temperature changes. Because the source 1830-211 is near the Galactic Plane and hence the system temperature can be considerably (> 3 dB) higher than the cold sky background. In this report we present the results of the experiment conducted to characterize the Analog correlator.

2 Experiment

The basic idea is to check whether the measured correlation on a source using the analog correlator changes when the uncorrelated power is changed. We observed the source 3c161 using four modules of the ORT (N1,N2,S1 & S2). Uncorrelated noise is injected through the modules N6 and S6. One of the PA1 amplifier is terminated at its input and then cascaded with a second PA1 for generating the noise. The outputs of the terminated PA1's are connected to PA2s of N6 and S6. A variable attenuator, connected at the output of the second PA1, is used to change the injected noise power. The correlation on the source with respected to an offsource, obtained by randomizing the declination (i.e using +99 00 00), was then measured using the IPS acquisition program. The total power at the inputs of the correlator (ie both North and south inputs) was measured at the total power combiner output of beam 7 using a spectrum analyzer (Mode: zero span, CF = 30 MHz, BW = 5 MHz, VB = 10 Hz).

Table 1 gives the measured values. Column 1 and 2 are the onsource and offsource counts respectively, column 3 gives the total power at the combiner output measured using the spectrum analyzer, column 4 and 5 gives the PA3 currents respectively for north and south half of the telescope. For all these measurements a time constant of 500 ms was used.

Table 1: Characterizing the Analog correlator

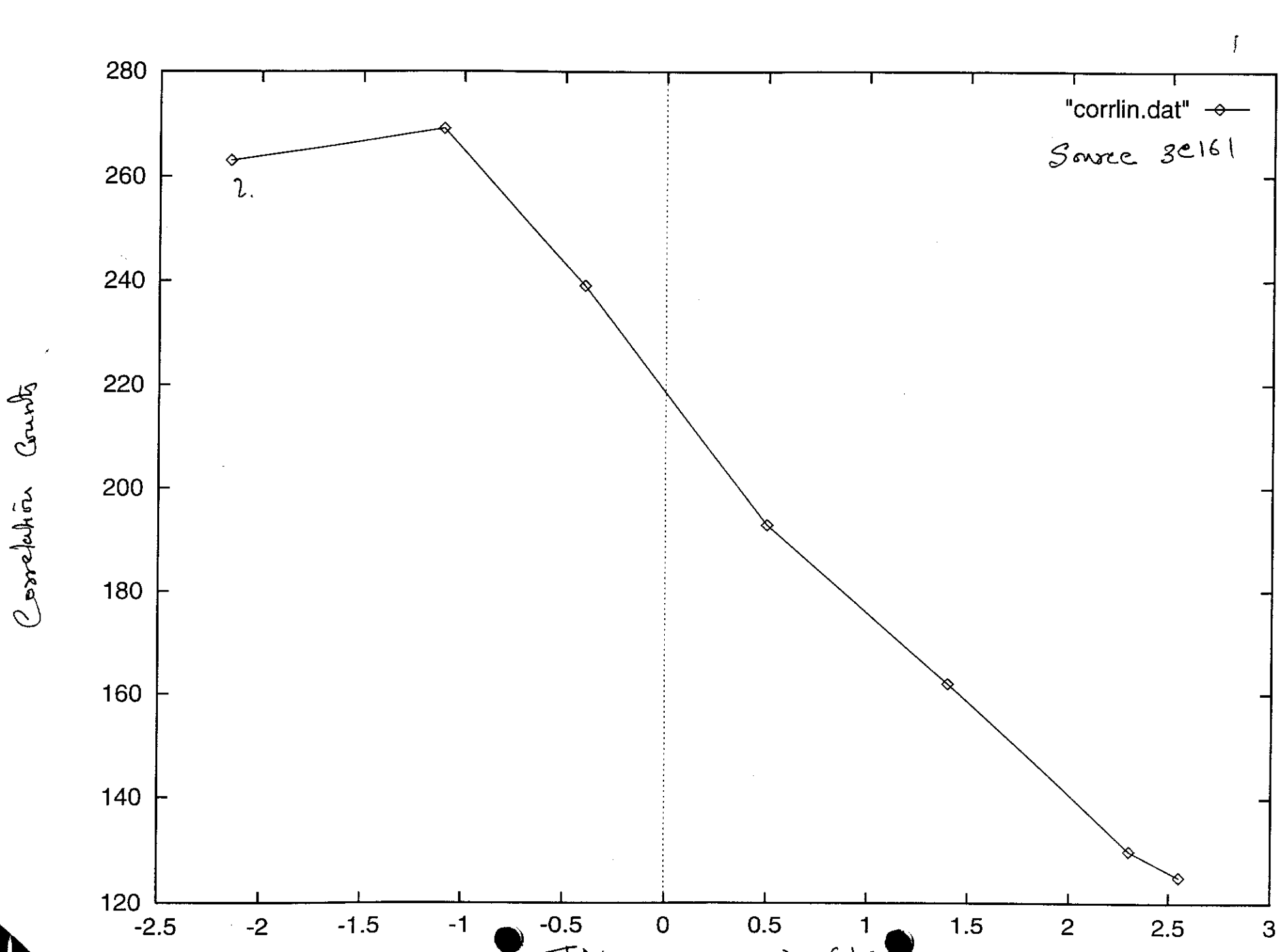
Offsource counts	Onsource counts	Total power (dBm)	PA3 currents North (μA)	South (μA)
2041	2304	-2.15	20	22
2010	2279	-1.1	25	26
2010	2248	-0.4	30	30
2008	2201	0.5	34	34
2000	2162	1.4	40	40
1992	2122	2.3	46	48
1985	2110	2.55	48	48

3 Results

Fig. 1 shows the plot of the correlation measured on 3c161 as a function of the total power. It is clear that the correlator does not measure the same correlation when the uncorrelated power is varied. It should be noted that the correlator does not measure the correlation coefficient and hence one expect the correlation count to remain same while the offsource R.M.S changes with the uncorrelated noise. We also found that the offsource counts itself changes with the uncorrelated noise (see Fig. 2). Thus the measurement of the flux of a source using the correlator when the sky background temperature near the source of interest is different from that near the calibrator should take this effect into account. Although the factor (~ 2) by which the correlation counts changes when the uncorrelated noise power is increased by nearly 3 dB can explain the measured discrepancy in the flux of 1830-211 a more careful measurement should be done to get an accurate flux value for this source using the ORT.

Acknowledgment

We thank Mahesh for helping us is getting the required cables, attenuators etc for doing the experiment and also helping in observing with the ORT. We thank S. Srinivasan for making available his IPS acquisition program which could take the sample number as an input parameter.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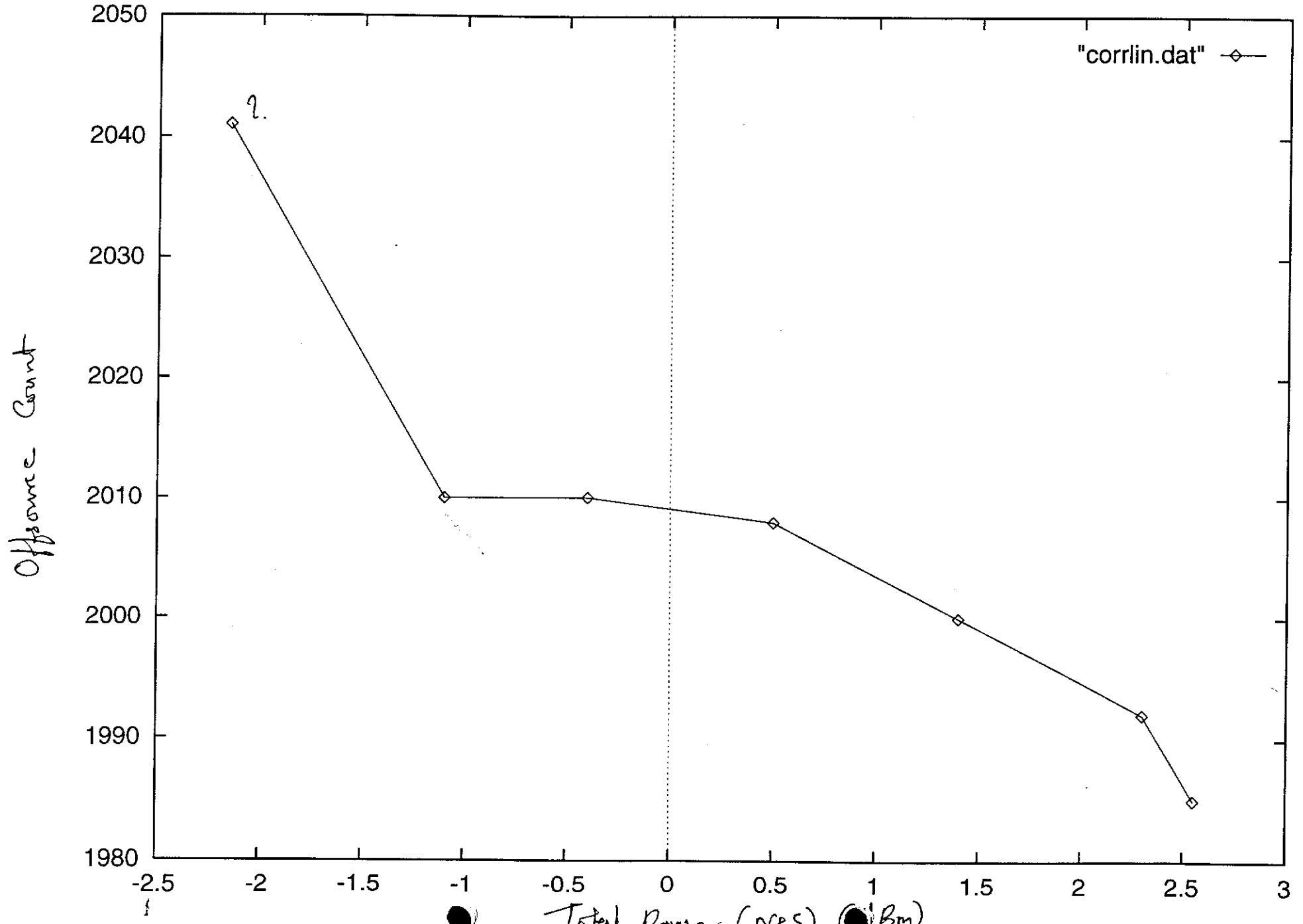
Source 3e161
2.
Correlation Counts
280
260
240
220
200
180
160
140
120
-2.5
-2
-1.5
-1
-0.5
0
0.5
1
1.5
2
2.5
3


"corrlin.dat"
2050
2040
2030
2020
2010
2000
1990
1980
-2.5
-2
-1.5
-1
-0.5
0
0.5
1
1.5
2
2.5
3
Offshore Count
Total Power (pcs) (dBm)