

MEMO

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Objet: Oscillations in the BAO spectra (II)

1 Introduction

This note is the natural continuation of the Nançay/Amas/10.02.12 reference. We wonder if there is any correlation between the difference in the ON and OFF offsets and the ~ 3 -5MHz oscillation amplitude. It has been pointed out by E. Gerard (meeting at Meudon on 3/02/2012) that he has observed this correlation, i.e. the bigger the difference between ON and OFF offsets, the greater will be the oscillation amplitude. However, his ON and OFF data were artificially unbalanced, while in our clusters data there is not great difference between ON and OFF spectra.

We calculate the signal offset (for both OFF or ON) for each cycle as the median of the whole power spectrum range, i.e. [1250, 1500] MHz.

We will consider all the processed data from Abell1205, i.e. 937 cycles from 15/04/2011 to 12/12/2011, including the “nasty period” from 22/08/2011 to 22/09/2011.

2 Offset evolution

We show in Figure 1 the offset of the ON/Gain¹ (left) and OFF/Gain (right) spectra as a function of the cycle number, Ch0 in blue and Ch1 in red. This plot is equivalent to the one shown in the Abell1205 MEMO (ref. Nançay/Abell1205/23.11.11), Figure 6 (Raw ON and OFF signals integrated in the frequency band [1400, 1415] MHz). It reflects the system variations within each run and reminds the necessity of using the OFF spectrum (median filtered with 3MHz band width) of each cycle as normalization both for the ON and OFF spectra. Later on we do not use the Gain as normalization.

¹ Here the Gain is a median filtered power spectrum determined with data around the OFF DAB of the OFF part of the cycle taken in the middle of a run.

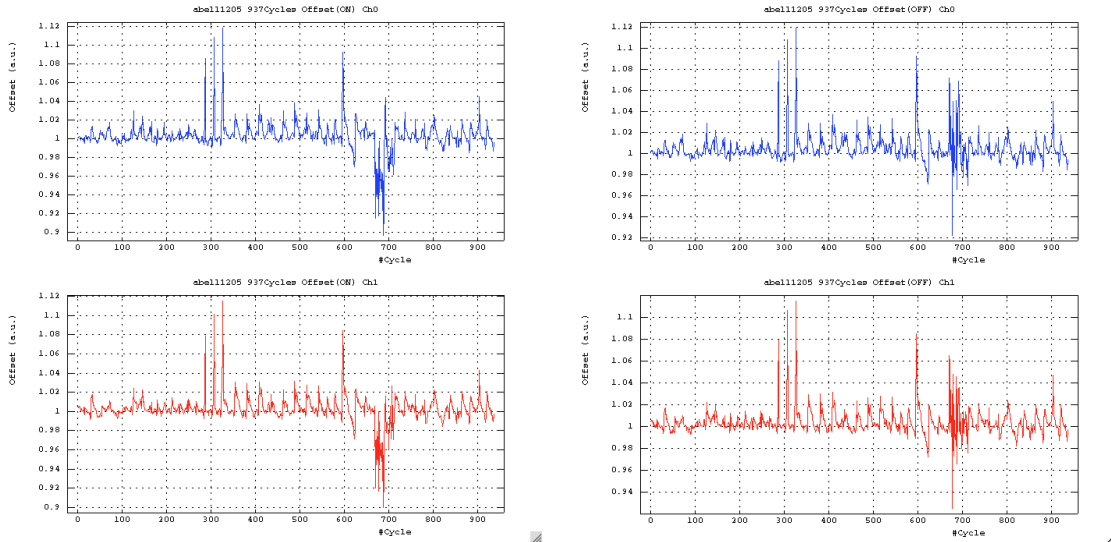


Figure 1. Offset(ON/Gain) (left) and Offset(OFF/Gain) (right) as a function of the cycle number, for Ch0 (blue) and Ch1 (red).

In Figure 2 we plot the offset for ON/OFF_{filt} vs. cycle number. The offset for the OFF/OFF_{filt} spectrum is exactly 1 in general, although there are cases where noise signal may disturb this equality. This plot is equivalent to the one presented in the Abell1205 internal note mentioned above, Figure 8 (integrated Raw ON-OFF intensity from the galactic HI line in [1420.2, 1420.6] MHz). We clearly see the “nasty period” of the data taking.

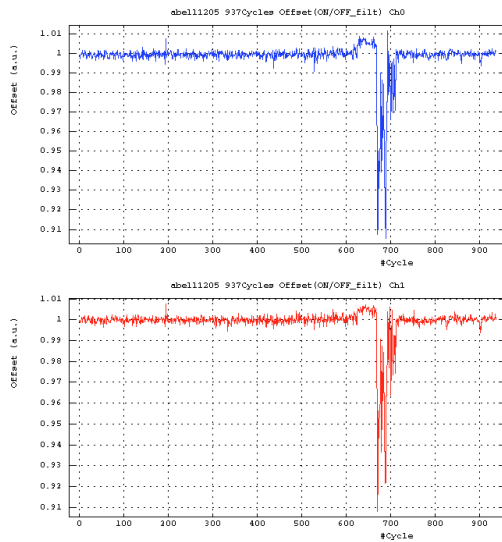


Figure 2. Offset(ON/OFF_{filt}) vs. cycle number for Ch0 (blue) and Ch1 (red).

3 Oscillation amplitude evolution

We estimate the $\sim 3\text{-}5\text{-MHz}$ oscillation amplitude as the difference of the maximum and minimum intensity in a frequency range where we can find one oscillation pattern. Randomly we have chosen the pattern around 1415 MHz from the Figure 1

shown in the “Oscillations in BAO spectra” Nançay/Amas/10.02.12 reference. In Figure 3 (left) we can see a zoom on the [1413, 1417] MHz band where we calculate the maximum and minimum of the signal. The signals shown are the ON/OFF_{filt} and OFF/OFF_{filt} spectra for Ch0 at the top (cyan and blue, respectively) and for Ch1 at the bottom (orange and red, respectively). In Figure 3 (right) we show the evolution of the Max-Min difference vs. cycle number. The Max-Min evolution follows what has already been pointed out in the aforementioned note, that is to say:

- The ~3-MHz oscillation pattern is enhanced in Ch0 compared to Ch1;
- Concerning Ch0, the amplitude of the ~3-MHz oscillation pattern is bigger before the “nasty period”, and rather constant with periods which are worst than others (e.g. May 2011);
- After the “nasty period” the oscillation pattern looks very similar to the Ch1 case.

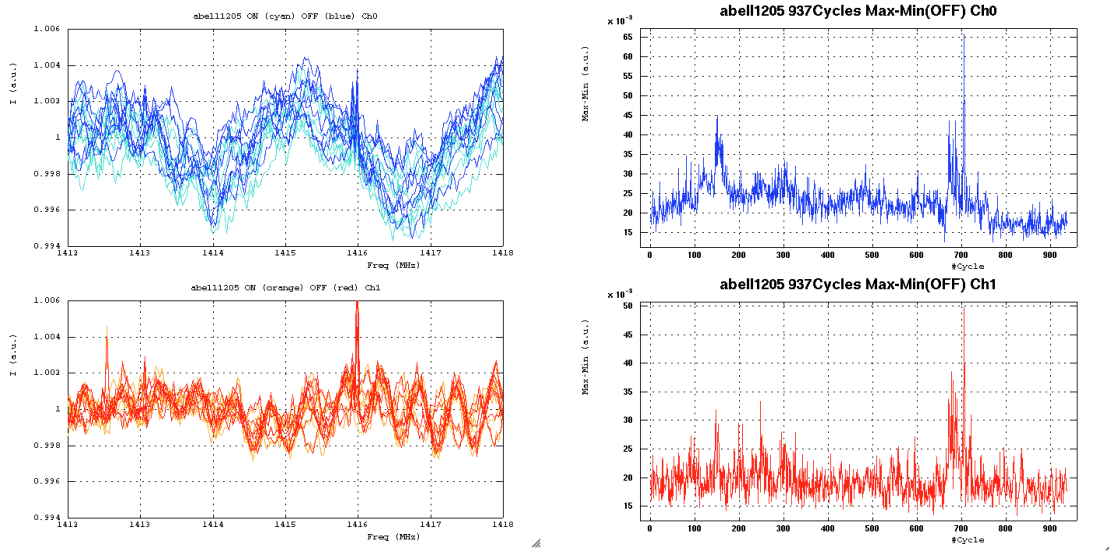


Figure 3. Left: Zoom on the ON/OFF_{filt} (cyan, orange), OFF/OFF_{filt} (blue, red) spectra for Ch0 (top) and Ch1 (bottom). Right: Max-Min evolution in the frequency band [1413, 1417] MHz along the data taking.

4 Offset vs. oscillation amplitude

We show in Figure 4 the Max-Min vs. Offset difference between the ON and OFF signals ($= \text{Offset}^{\text{ON}} - \text{Offset}^{\text{OFF}}$). It is hard to find any correlation between the oscillation amplitude and the offset difference.

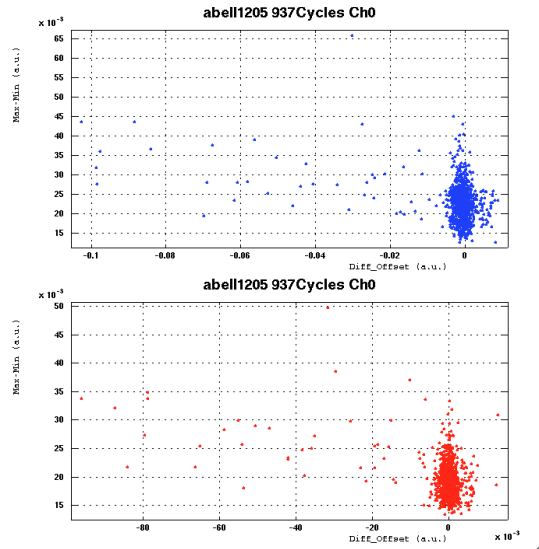


Figure 4. Max-Min vs. $(\text{Offset}^{\text{ON}} - \text{Offset}^{\text{OFF}})$ for Ch0 (blue) and Ch1 (red).

5 Summary

We have investigated the evolution of the Offset difference between the ON/OFF_{filt} and OFF/OFF_{filt} signals vs. cycle number. The plots obtained are equivalent to those of integrated intensity evolution in the radio-protected band already shown in Nançay/Abell1205/23.11.11 reference.

We have estimated the ~ 3 -MHz oscillation amplitude using the Max-Min signal in a frequency range that encloses one oscillation pattern. As already seen in Nançay/Amas/10.02.12 reference, the Max-Min as a function of cycle number evidences the presence of this oscillation in Ch0 much more pronounced than in Ch1, and the dramatic decrease of the oscillation amplitude in October 2011. It is remarkable that the oscillation is gone right after the “nasty period” of data taking from end of August to end of September 2011, when some cabling/hardware rearrangement has probably been done. Is it fortuitous?

The lack of correlation between oscillation amplitude and offset difference found here contrasts with the results obtained by E. Gerard, where the oscillation amplitude was directly related to the offset difference. But as mentioned in the introduction, our cluster data do not show great differences between ON and OFF spectra.