MEMO

Authors: J.E Campagne. A.S. Torrentó
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Diffusion : R. Ansari, P. Colom, D. Charlet, E. Gérard, Ch. Magneville, J. M. Martin, M. Moniez, J. Pezzani, C. Dumez-Viou

Objet: Electronic noises in the BAO spectra in the protected band [1400, 1427] MHz during the data taking from April 2011 to January 2012.

1 Introduction

We look in detail at the protected band [1400, 1427] MHz to investigate the presence of RFIs (see also ref. Nançay/Amas/16.03.12). We make use of all the statistics obtained for Abell1205 cluster with the BAO electronics, i.e. 1216 cycles from April 2011 to January 2012.

2 Spectra in the [1400, 1427] MHz band

We show in **Error! Reference source not found.** and Figure 2 the ON/OFF$_{filt}$ and OFF/OFF$_{filt}$ spectra averaged over 1045[1] cycles for Ch0 and Ch1, respectively.

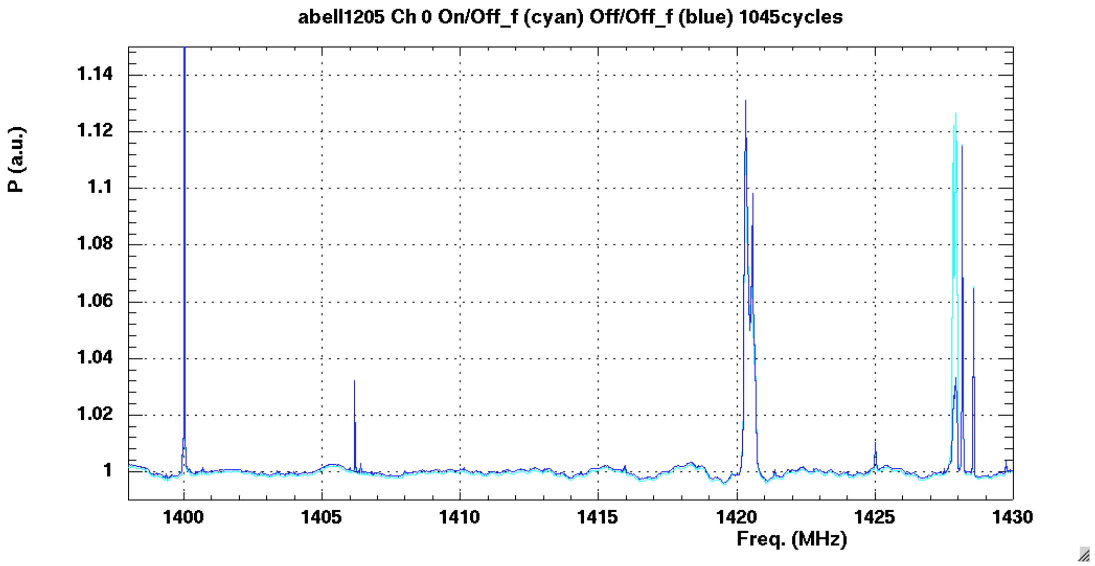

Figure 1. ON/OFF$_{filt}$ (cyan) and OFF/OFF$_{filt}$ (blue) spectra for Ch0.

[1] We have dismissed here 171 cycles from the "bad period", see next section.

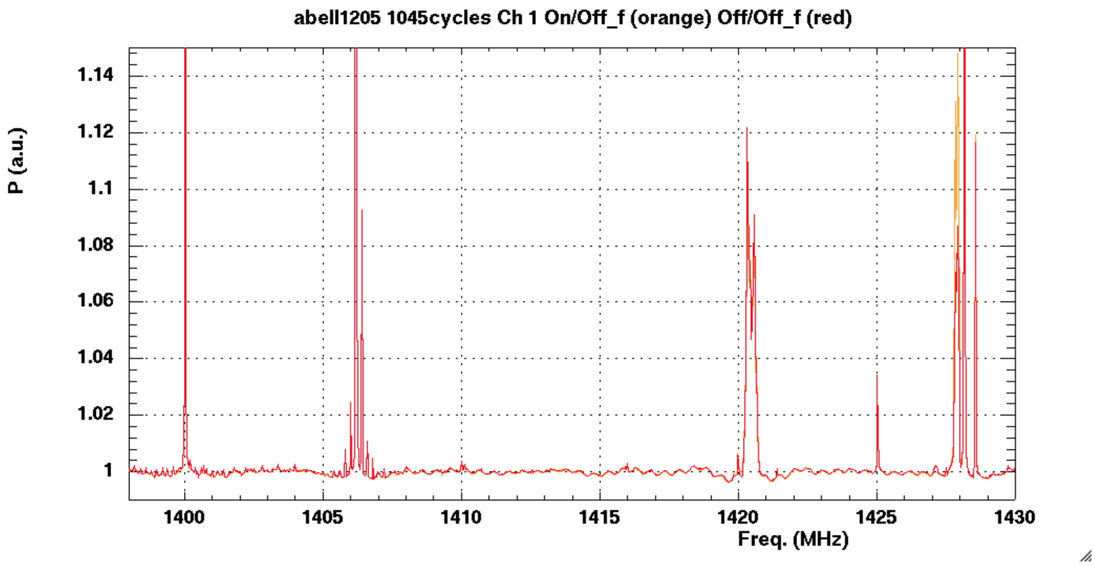

Figure 2. ON/OFF$_{filt}$ (orange) and OFF/OFF$_{filt}$ (red) spectra for Ch1.

We find RFI lines at the following frequencies:

- 1400 MHz: very thin RFI which we have included in the group of the electronic RFI at 1250+k*25 MHz. The peak is at 1.5 a.u. (Ch0) and 1.85 a.u. (Ch1) (out of the scale of the plot).
- 1406 MHz: very thin RFI in Ch0, but wide (1405-1408 MHz) and structured in Ch1 with a peak at 1.92 a.u. (out of the scale of the plot).
- 1410 MHz: extremely small line in Ch0 (almost not visible), it is thin and small in Ch1.
- 1420 MHz: very small thin line only present in Ch1.
- 1420.4 MHz: galactic HI line.
- 1421.38 MHz: very small thin line.
- 1425 MHz: very thin RFI which we have included in the group of the electronic RFI at 1250+k*25 MHz. It is more important in Ch1 than in Ch0.
- 1427.5-1428.7 MHz: group of 3 lines out of the protected band. The first line at 1427.8 MHz is more powerful in the ON spectrum than in the OFF, and it has the same “M” shape as the galactic HI line. The two other lines are thin and they are located at 1428.16 and 1428.56 MHz.

3 Time evolution of line power

In this section we will show the time evolution (vs. cycle number) of the integrated power of all the lines, except the HI galactic line. We indicate in Table 1 the frequency bands where this integration has been performed.

ν_{line} (MHz)	ν_{min} (MHz)	ν_{max} (MHz)
1400	1399	1401
1406	1405	1408
1410	1409.85	1410.25
1420	1419.5	1420.05
1421.38	1421.3	1421.45
1425	1424	1426
1427.8	1427.5	1428.05
1428.16	1428.05	1428.3
1428.56	1428.45	1428.65

Table 1. Frequency bands considered to calculate the integrated power of the different lines.

In the evolution plots, we have taken into account the so-called "bad period" which includes 171 cycles from 7th Aug to 15th Sep 2011. Two phases can be distinguished:

- From 7th Aug to 5th Sep 2011 (from ~600 to 730 cycle): the solar noon happens at ±1^{h} from the beginning of the observations, which translates into an increase of the power in both channels at all frequencies.
- From 12th to 15th Sep 2011 (from ~730 to 770 cycles): **the system has a big problem, still to be determined.**

It is also worth mentioning that there is a stability worsening at the end of the data taking (cycle number > 1068, 26th Dec 2011) which is also seen in all frequency bands. Its origin has not been identified yet.

Last caution: the dates quoted hereafter to indicate changes on the line integrated power are approximate, as they are restricted to the observations of Abell1205 cluster.

3.1 RFI in the protected band

3.1.1 1400 MHz

We show in Figure 3 a zoom of the spectrum around this line for Ch0 (left) and Ch1 (right).

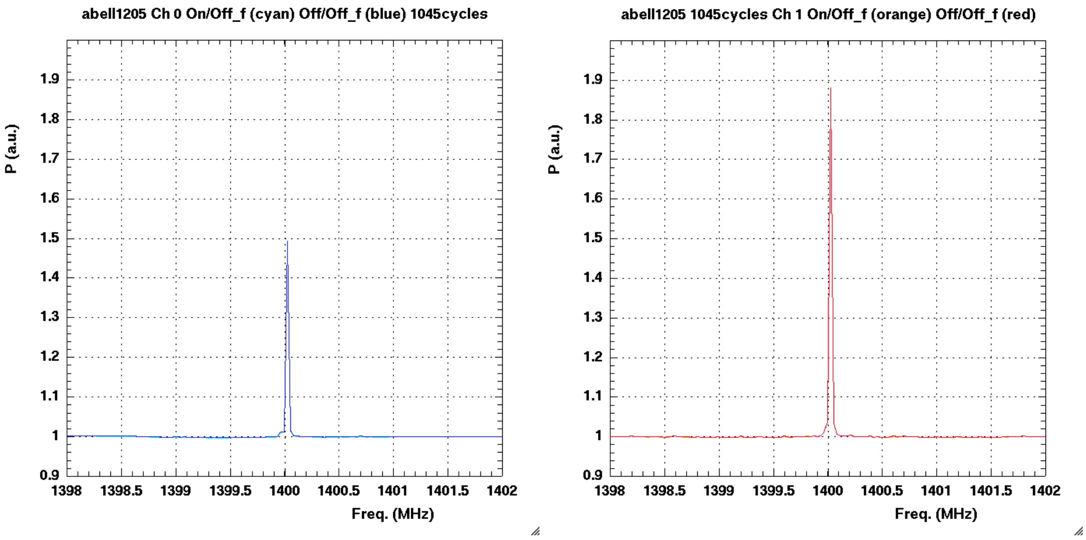

Figure 3. RFI line at 1400 MHz in ch0 (left) and Ch1 (right).

In Figure 4 we show the time evolution of the integrated power of this line. Remember that the steady increase of the signal at ~700 cycle is seen in all frequency bands considered, not only in RFI lines, and it corresponds to the solar noon happening ±1^h before/after the beginning of the observations.

Until beginning of July 2011 (~380 cycle), this line has more power in Ch1 than in Ch0. After this date, it is Ch0 who shows more power than Ch1.

In Ch0, this line shows up from 15th Apr to 2nd May 2011, then it nearly disappears until the 7th Jul 2011, where it reactivates in two distinct periods: 7th – 25th Jul 2011 (from ~380 to 550 cycle) and 25th Jul – 18th Aug 2011 (from ~550 to 650 cycle), the first having more mean power than the second. We remark the "disappearance" of the line in this second period, on 22nd Aug 2011.

In Ch1, before July 2011, the power first increases in steps and then makes a dramatic rise on 28th Apr. After this date it decreases continuously until the 8th May 2011 (cycle number ~225), after having had a burst on 2nd May 2011. After the 8th May 2011 we find a period where the mean power is smaller than in the previous period. In this case the power varies in steps (i.e. run-basis), and we emphasize the burst on 15th Jun 2011.

After the "bad period" (around ~770 cycle), the line remains more or less quiet and it reactivates on 16th Nov 2011 (~950 cycle) in both channels. In Ch0 the power increases again on 26th Dec 2011 (~1060 cycle).

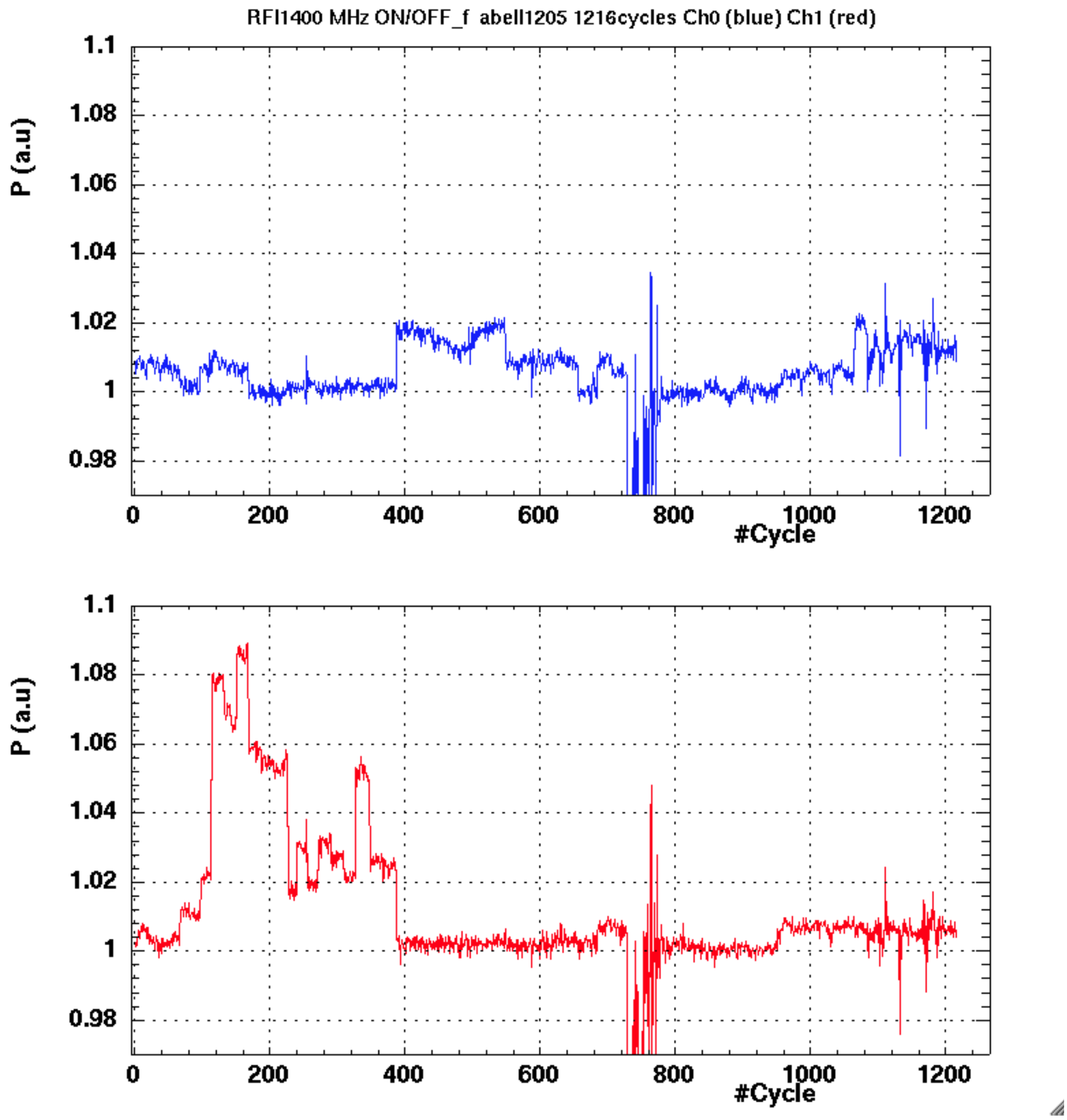

Figure 4. Integrated power of the 1400-MHz line vs. cycle number.

3.1.2 1406 MHz

We show in Figure 5 a zoom of the spectrum around this line for Ch0 (left) and Ch1 (right).

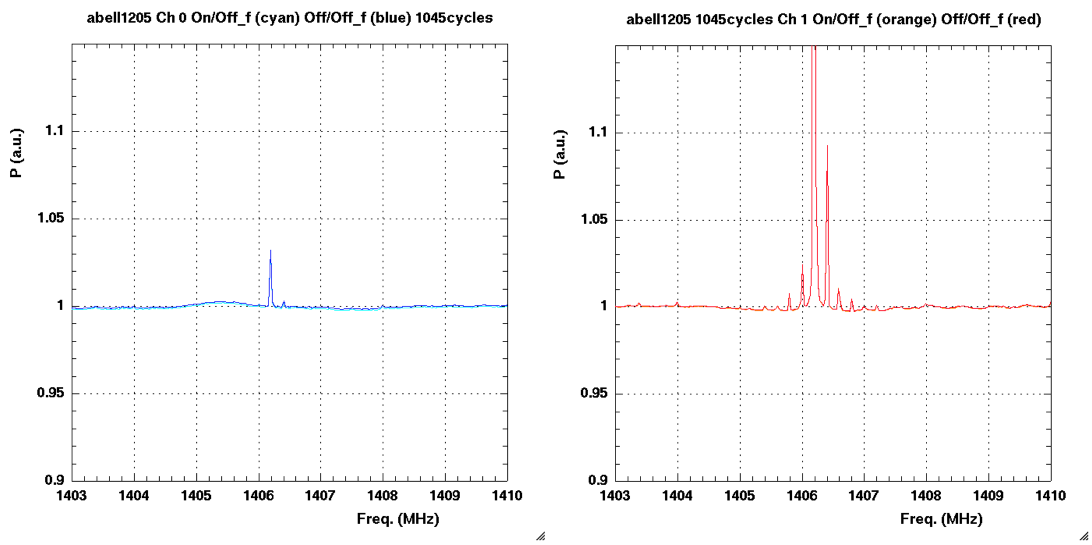

Figure 5. RFI line at 1406 MHz in Ch0 (left) and Ch1 (right).

In Figure 6 we plot the time evolution of the integrated power of this line. We see that it is always present in Ch1 and absent in Ch0, except the 17th Oct 2011, where it "jumps" from Ch1 to Ch0 reaching at this channel the same level it had in Ch1. At the beginning of July, the power in Ch1 has stepped up.

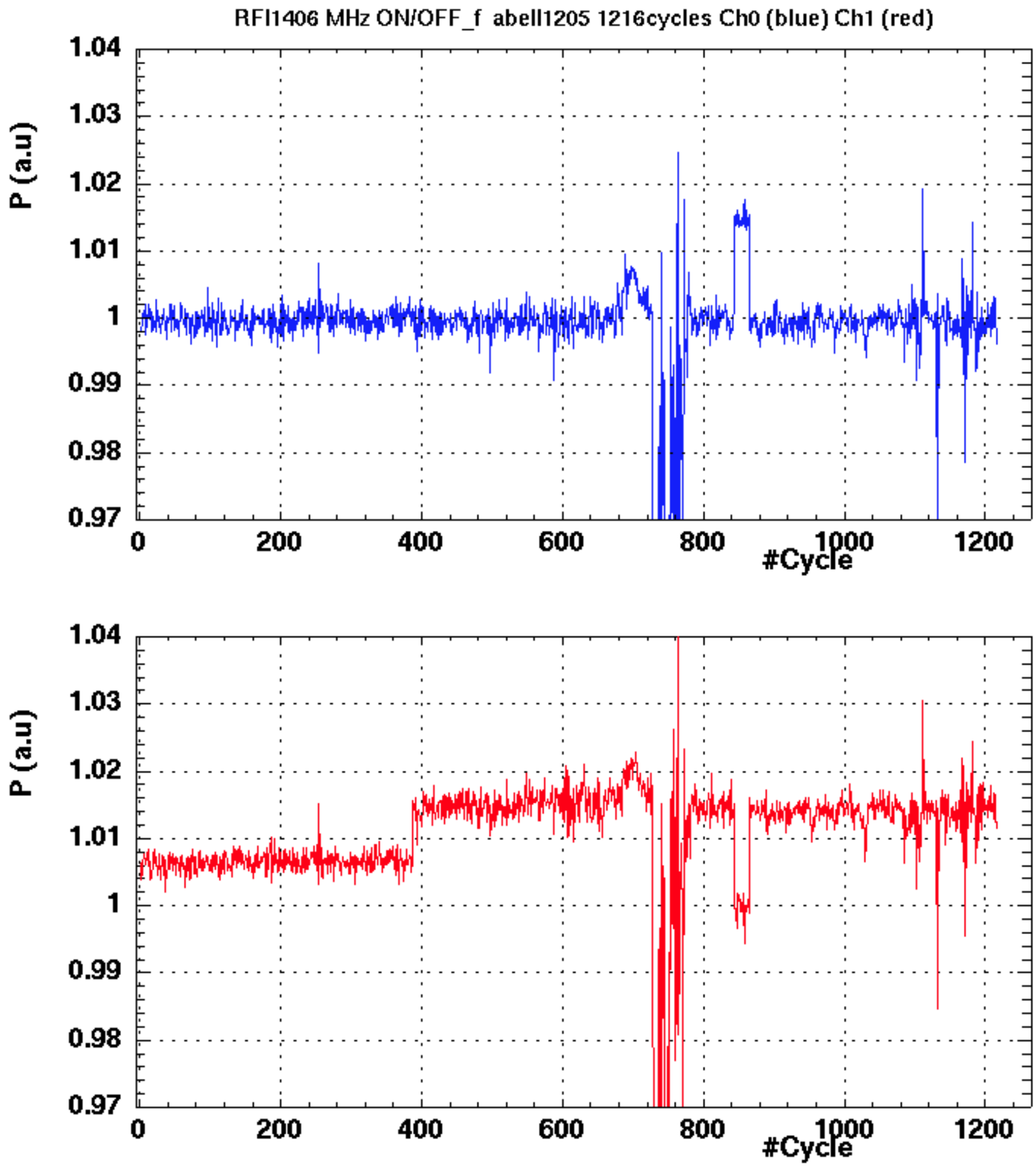

Figure 6. Integrated power of the 1406-MHz line vs. cycle number.

3.1.3 1410 MHz

We show in Figure 7 a zoom of the spectrum around this line for Ch0 (left) and Ch1 (right). Remember that this spectrum has been averaged over 1045 cycles, so in Ch0 the line has almost disappeared. We notice a (smaller) second peak at 1410.12 MHz, but we have not followed its time evolution.

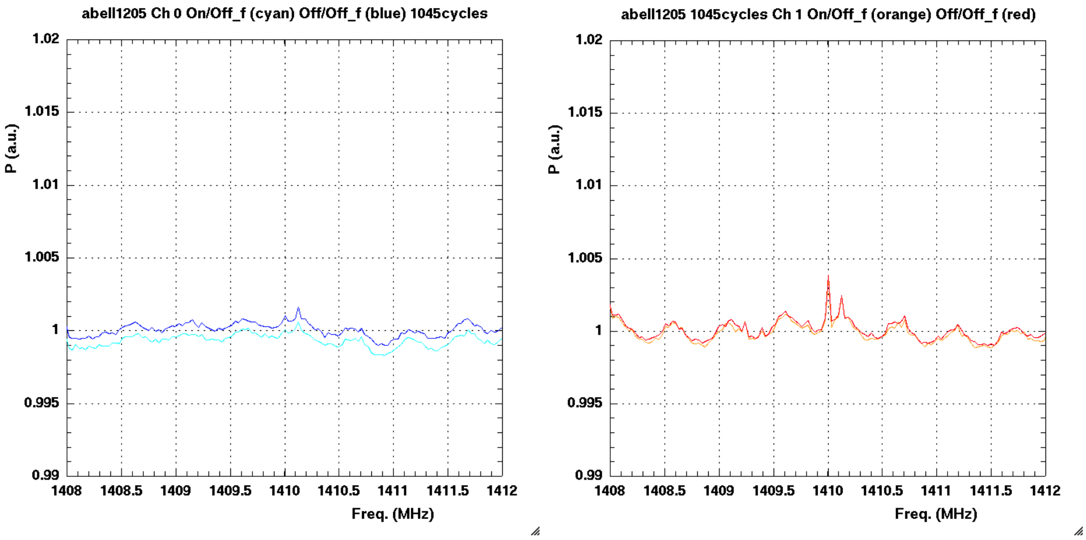

Figure 7. RFI line at 1410 MHz in Ch0 (left) and Ch1 (right).

In Figure 8 we show the time evolution of the integrated power of the line at 1410 MHz. We observe that this line more stable in Ch1 than in Ch0. It shows in both channels an increase in activity at the beginning of the “bad period”, from 7th to 18th Aug 2011.

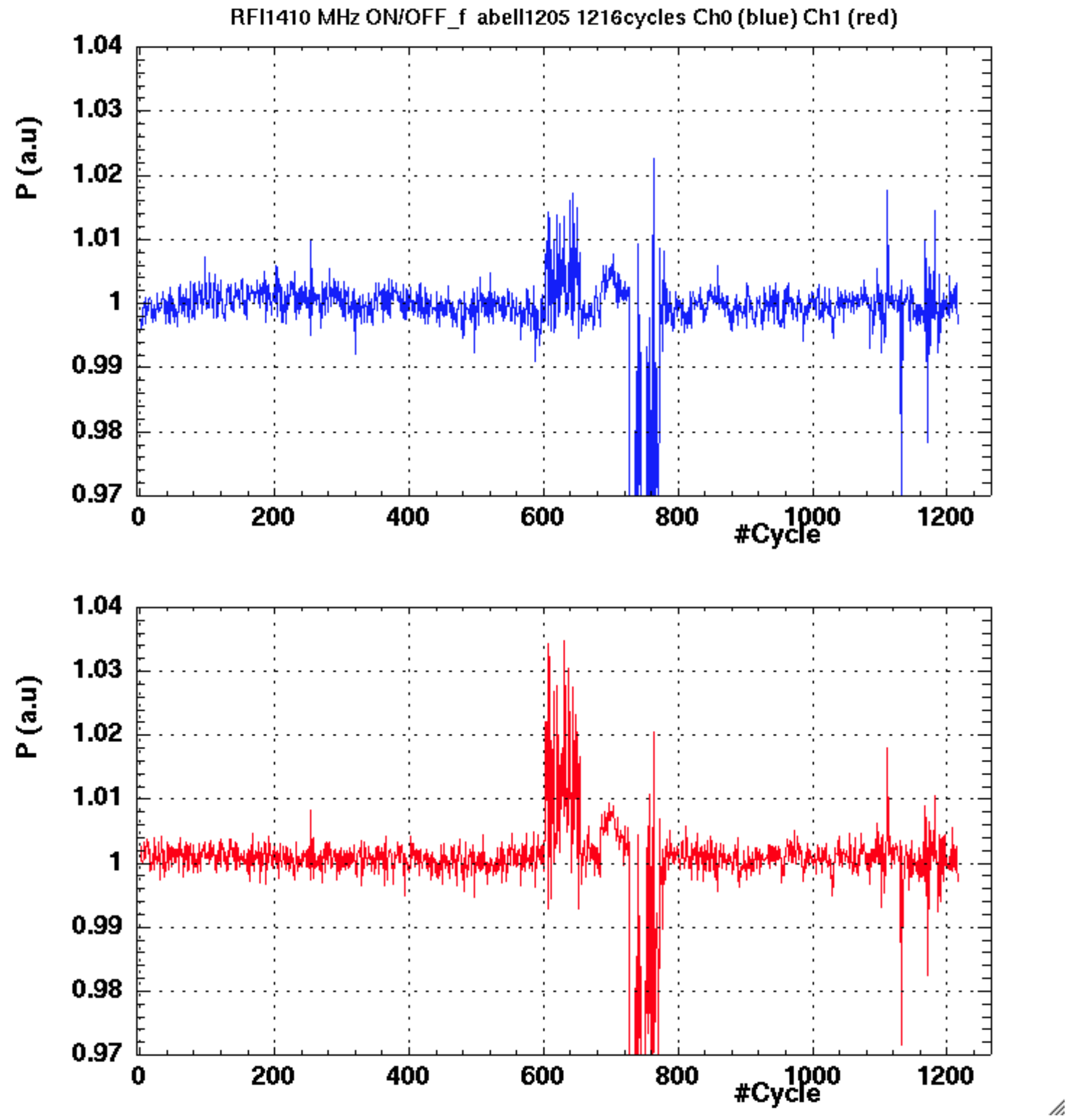

Figure 8. Integrated power of the 1410-MHz line vs. cycle number.

3.1.4 1420 MHz

We show in Figure 9 a zoom of the spectrum around this line for Ch0 (left) and Ch1 (right).

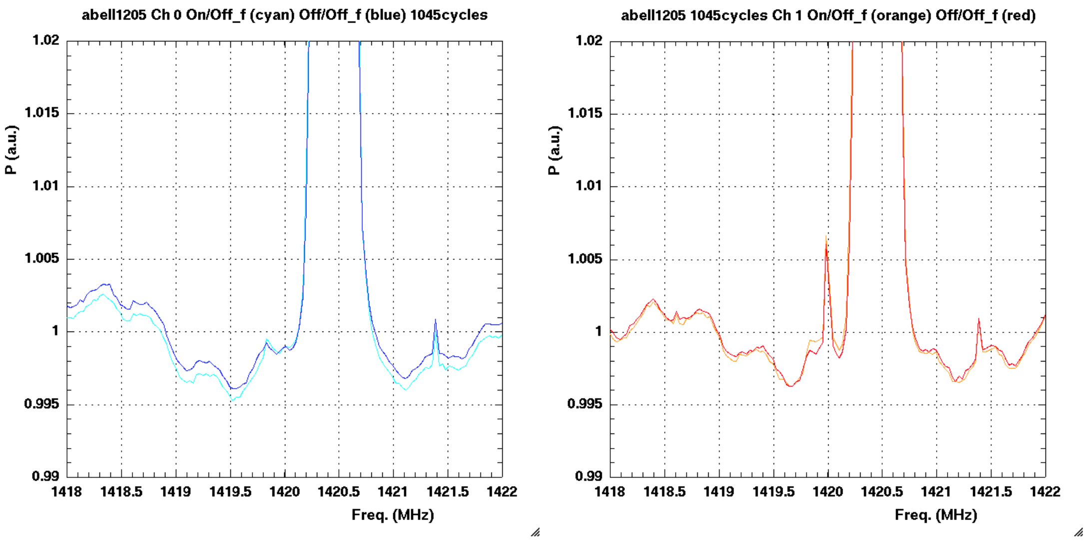

Figure 9. RFI line at 1420 MHz in Ch0 (left) and Ch1 (right). The big line at 1420.4 MHz is the galactic HI.

In Figure 10 we show the time evolution of the integrated power of this line. In general, the power from the OFF spectrum is greater than that from the ON spectrum (hence we have values of the $ON/OFF_{filt} < 1$). This is more evident in Ch0 (especially for cycle number < 340, i.e. from April to June 2011), and in both channels after the "bad period" (15th September 2011).

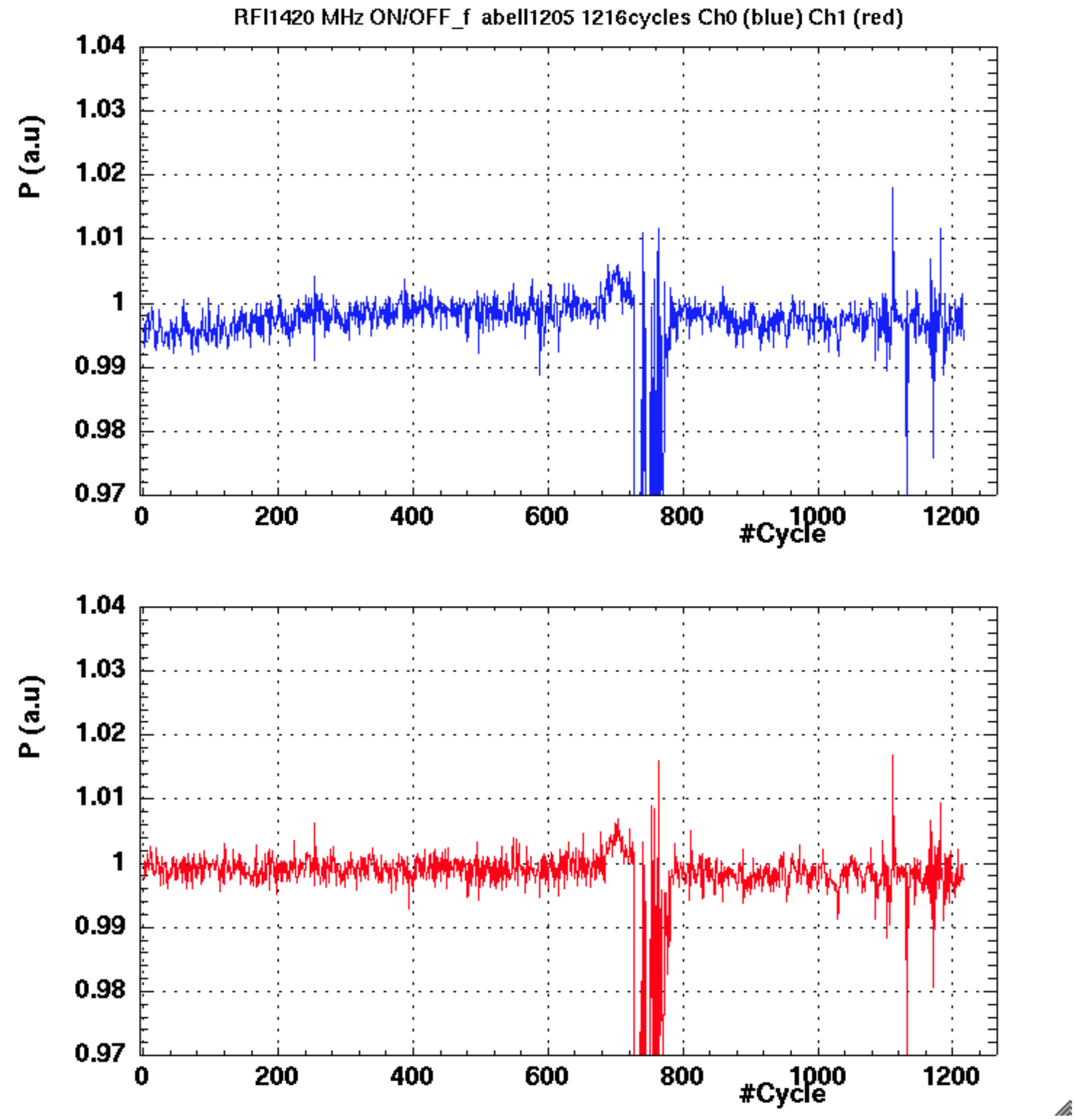

Figure 10. Integrated power of the 1420-MHz line vs. cycle number.

3.1.5 1421.38 MHz

We show in Figure 11 a zoom of the spectrum around this line for Ch0 (left) and Ch1 (right).

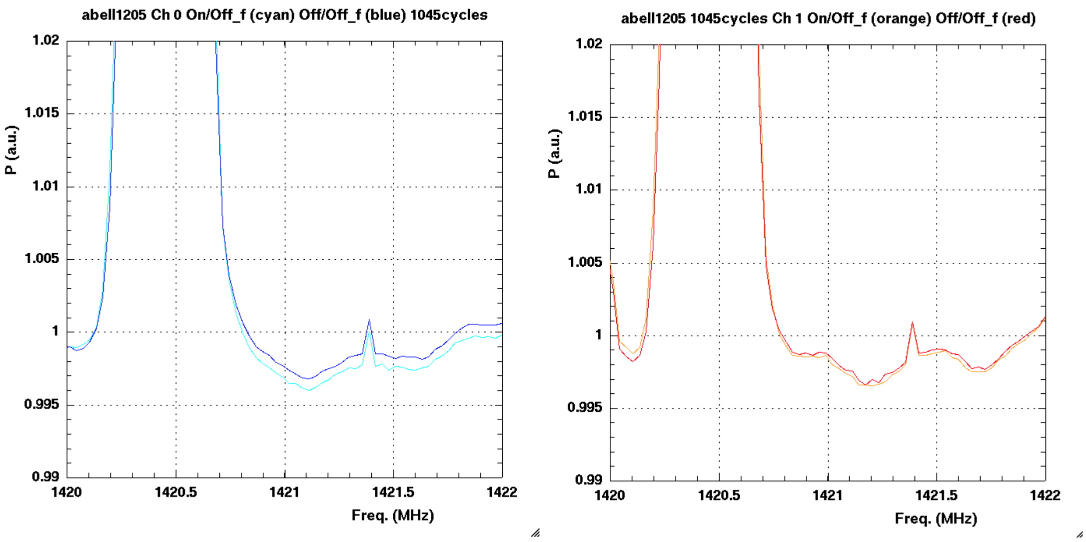

Figure 11. RFI line at 1421.38 MHz in Ch0 (left) and Ch1 (right). The big line at 1420.4 MHz is the galactic HI.

In Figure 12 we show the time evolution of the integrated power of this line. Similarly to the previous line, the ON spectrum is less powerful than the OFF specially for cycle number < 200 (up to 3rd May 2011). Right afterwards there is a "burst" of activity on 5th May 2011, and then the situation "normalizes" to mean ~1 being more stable in Ch0 than in Ch1.

The origin of this line has been recently identified (email communication from P. Colom). The culprit is the Nançay radio heliograph (RH), which has several clock frequencies around 5 MHz. These frequencies are multiplied by 80 (for the sky frequencies of the RH, ranging from 150 to ~500 MHz) and by 3 (if we take the 3rd harmonic), giving a RFI line with frequency of 1421.397 MHz. The width of the line is ~200 Hz, but here we see a width of ~60 kHz (=2 BAO channels of 30 kHz) as it has fallen in the middle of two channels.

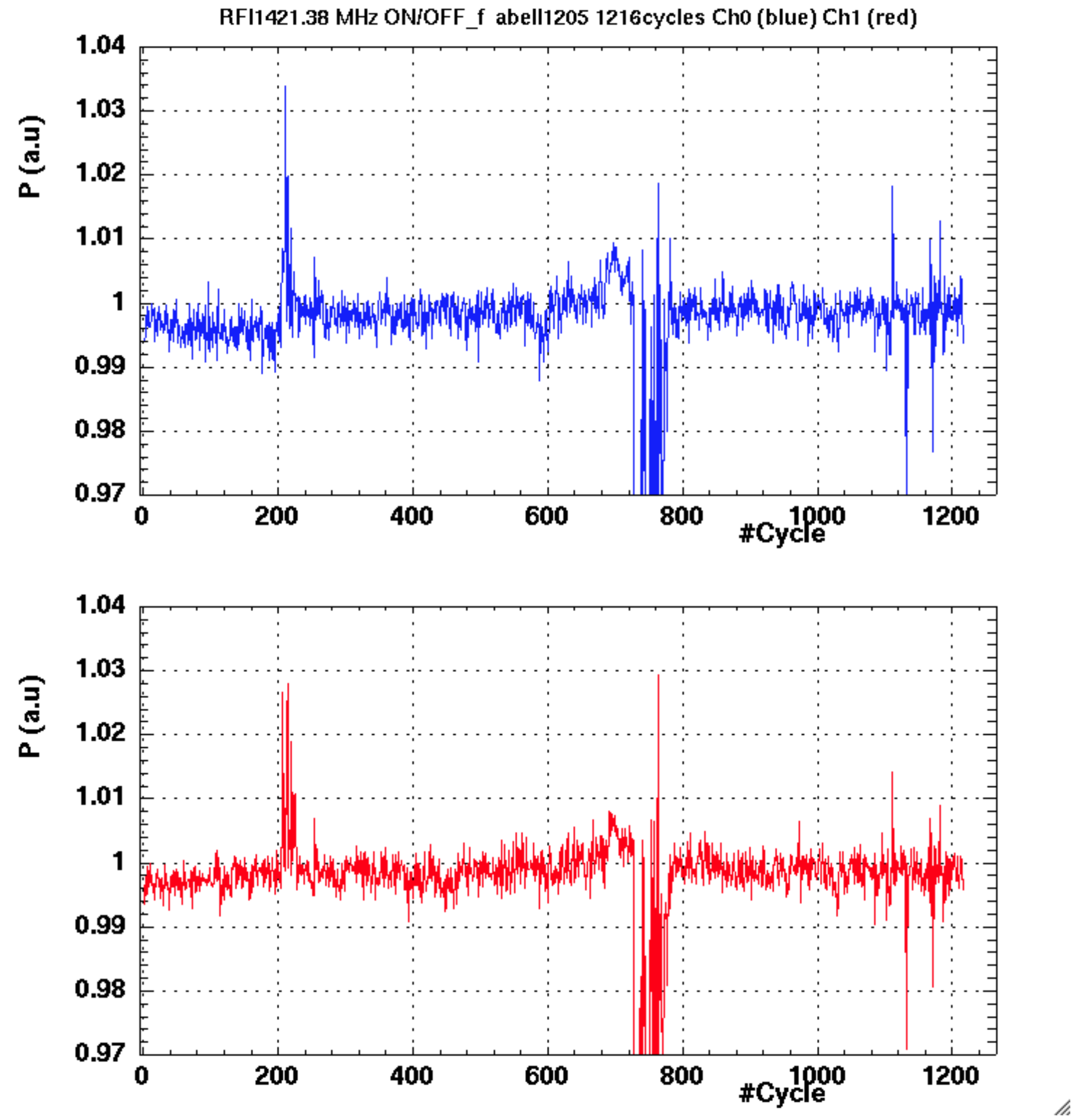

Figure 12. Integrated power of the 1421.38-MHz line vs. cycle number.

3.1.6 1425 MHz

We show in Figure 13 a zoom of the spectrum around this line for Ch0 (left) and Ch1 (right).

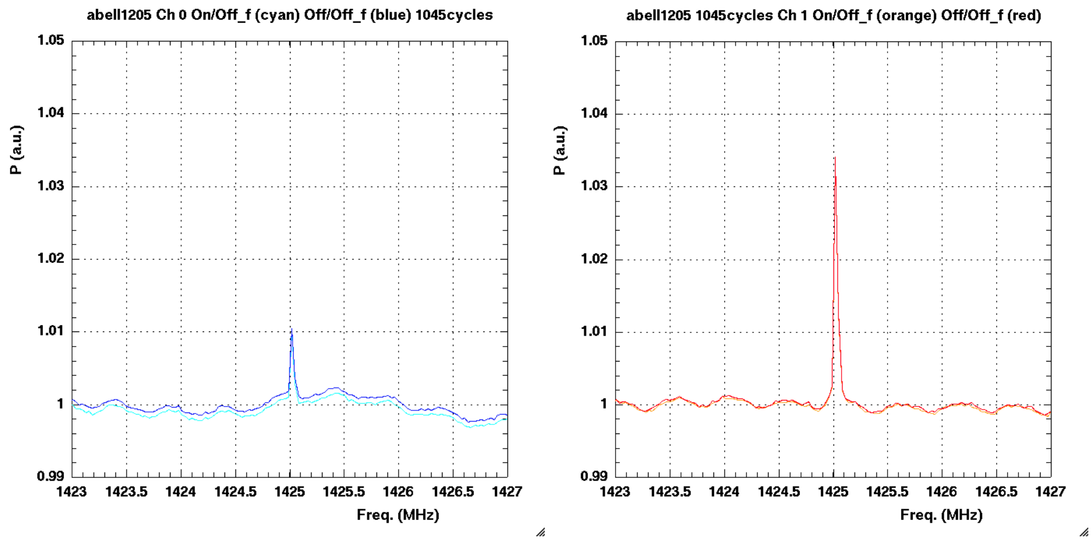

Figure 13. RFI line at 1425 MHz in Ch0 (left) and Ch1 (right).

In Figure 14 we show the time evolution of the integrated power of this line. In Ch0 there is no remarkable feature. In Ch1 we see a "bumpy" increase from 26th April to 2nd May 2011 (cycles from 90 to 170). Also in this channel, the level decreases slightly at the beginning of July 2011.

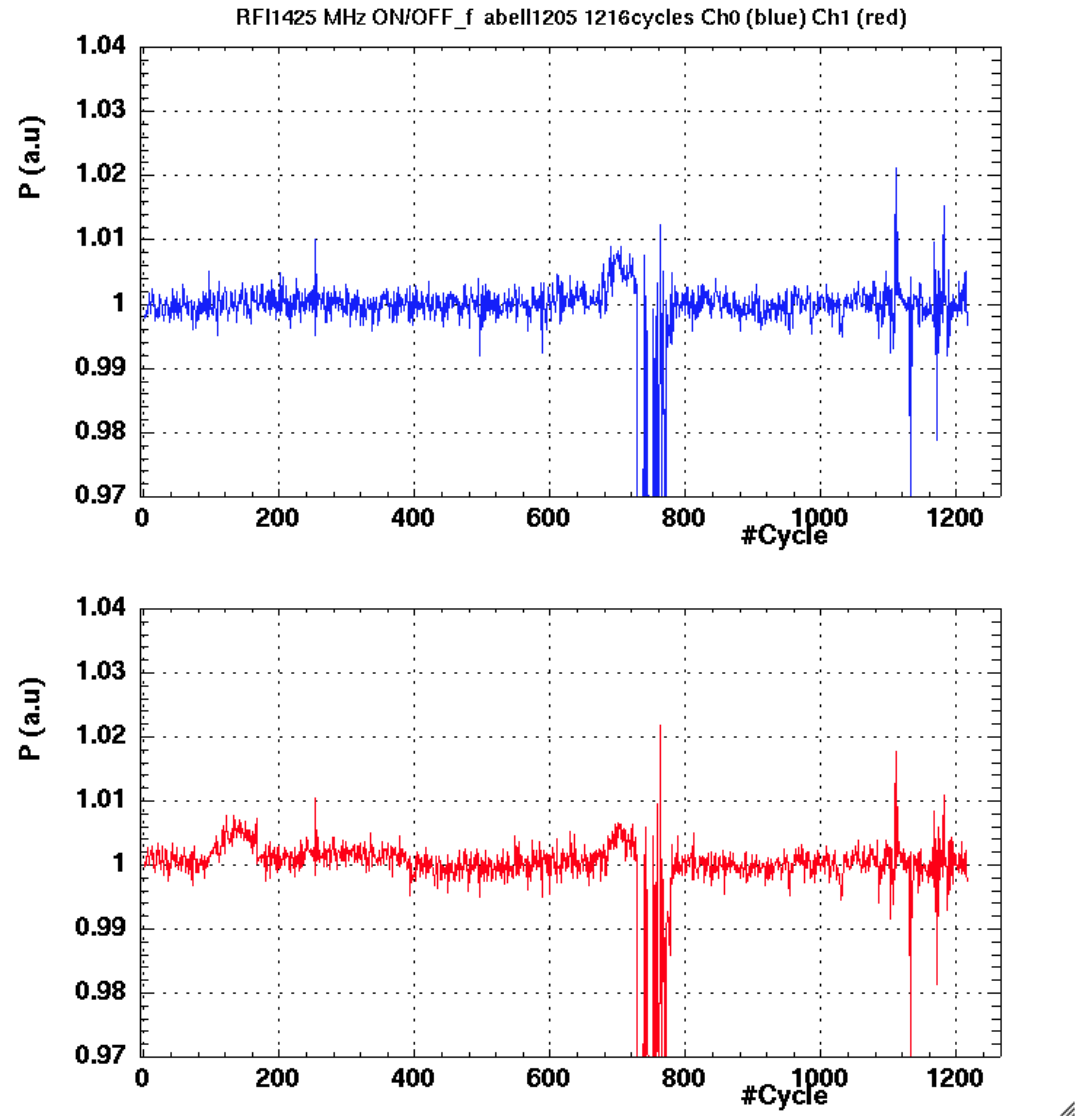

Figure 14. Integrated power of the 1425-MHz line vs. cycle number.

3.2 *RFI __next to__ the protected band*

For completeness of this study, we have also investigated the lines just next to the protected band, at frequencies 1427.8, 1428.16 and 1428.56 MHz. We show in Figure 15 a zoom of the spectrum around these lines for Ch0 (left) and Ch1 (right).

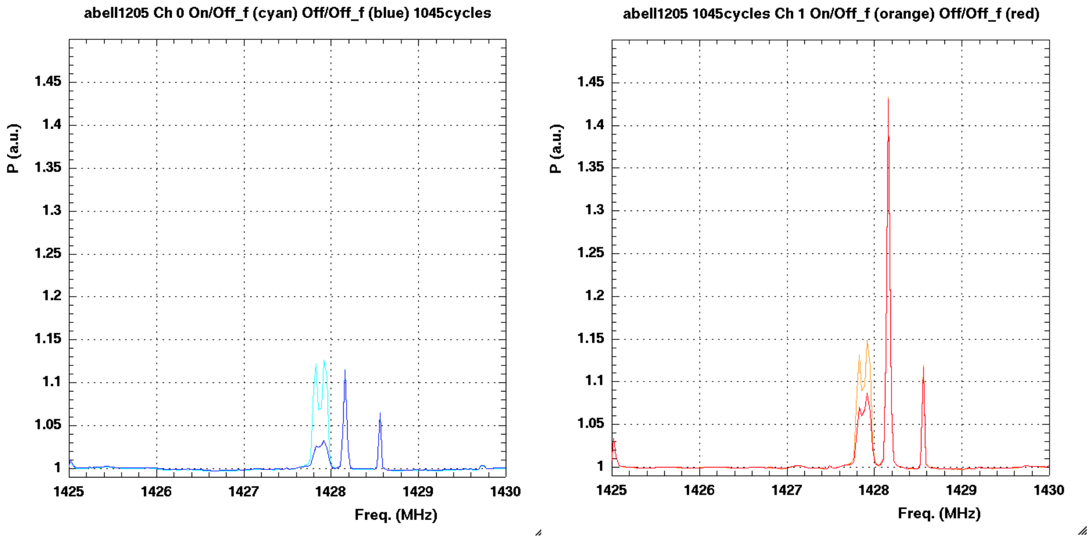

Figure 15. RFI lines at 1427.8 MHz, 1428.16 MHz and 1428.56 MHz in Ch0 (left) and Ch1 (right).

As previously done with the lines in the protected band, we show below the plots of the integrated power vs. cycle number. Note that contrary to the previous plots, which all have the same scaling, here we have set automatic scaling to see more in detail each case.

3.2.1 1427.8 MHz

In Figure 16 and Figure 17 (zoom of the first one) we show the time evolution of the integrated power of this line. In Figure 16 we focus on the big peaks. In Ch0 this happens in the last 5 cycles of the run on 5th Oct 2011 (cycle ~840). In Ch1, this happens in the last 3 cycles of the run taken on 22nd Sep 2011 (cycle ~800) and in the 2 first cycles of run on 26th Dec 2011 (cycle ~1088).

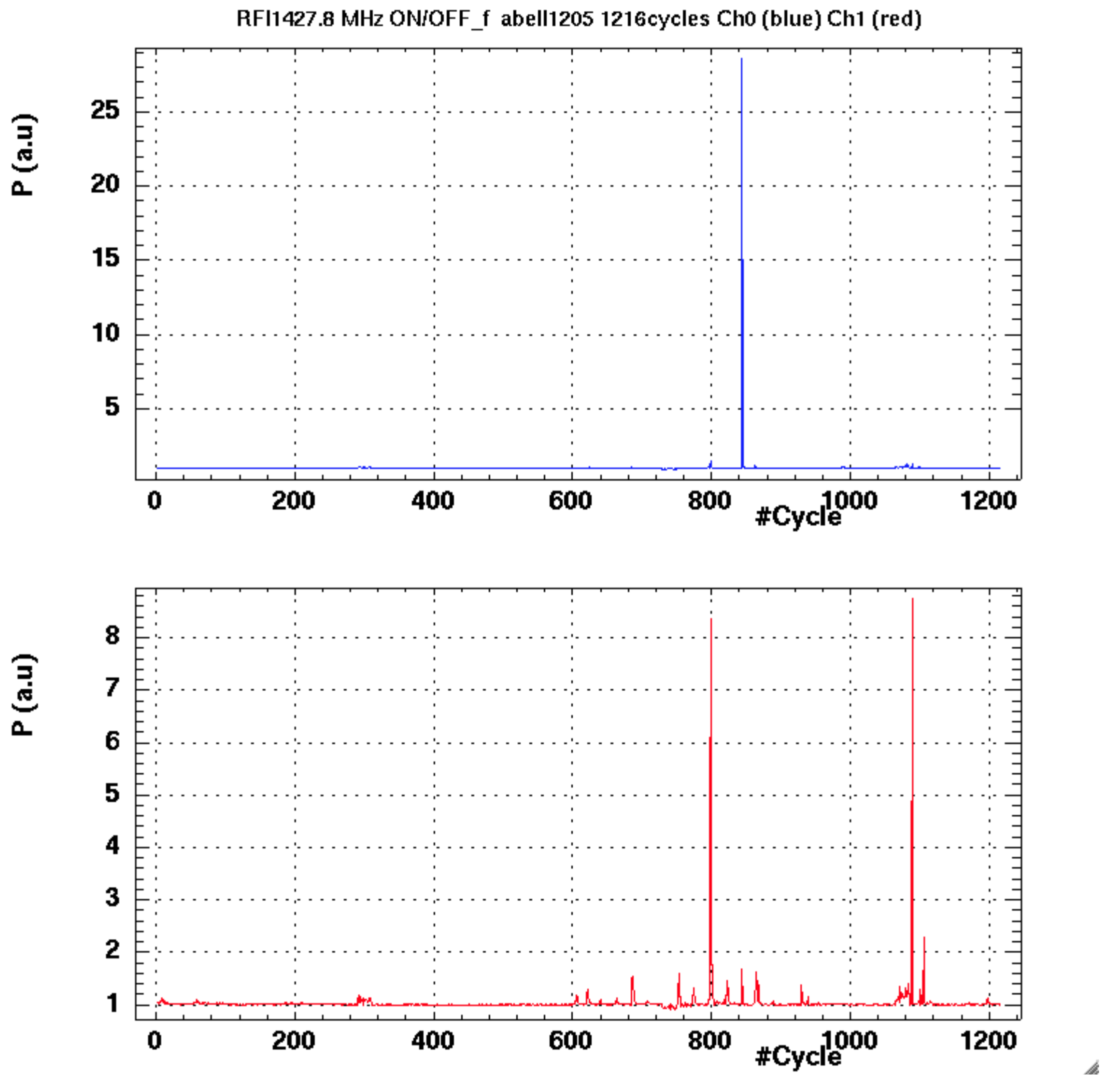

Figure 16. Integrated power of the 1427.8-MHz line vs. cycle number. Note the different scaling of the plots to appreciate the height of the biggest peaks.

In the zoom on Figure 17 we can observe two different periods of activity:

- Before August 2011 (cycle < 600): calm period with small increases of power on 15th Apr 2011 (cycle < 17), 19th-26th April 2011 (cycles 66-97), 7th-31st May 2011 (cycles 185-257) and 12th Jun 2011 (cycles 289-310).
- After august 2011 (cycle > 600): this is a period of great activity, especially on Ch1, up to the 27th Nov 2011 (cycles 600-909). After this date, the power is reduced, just having a "burst" on 26th Dec 2011 followed by several peaks until 28th Dec 2011 (cycles 1063-1117).

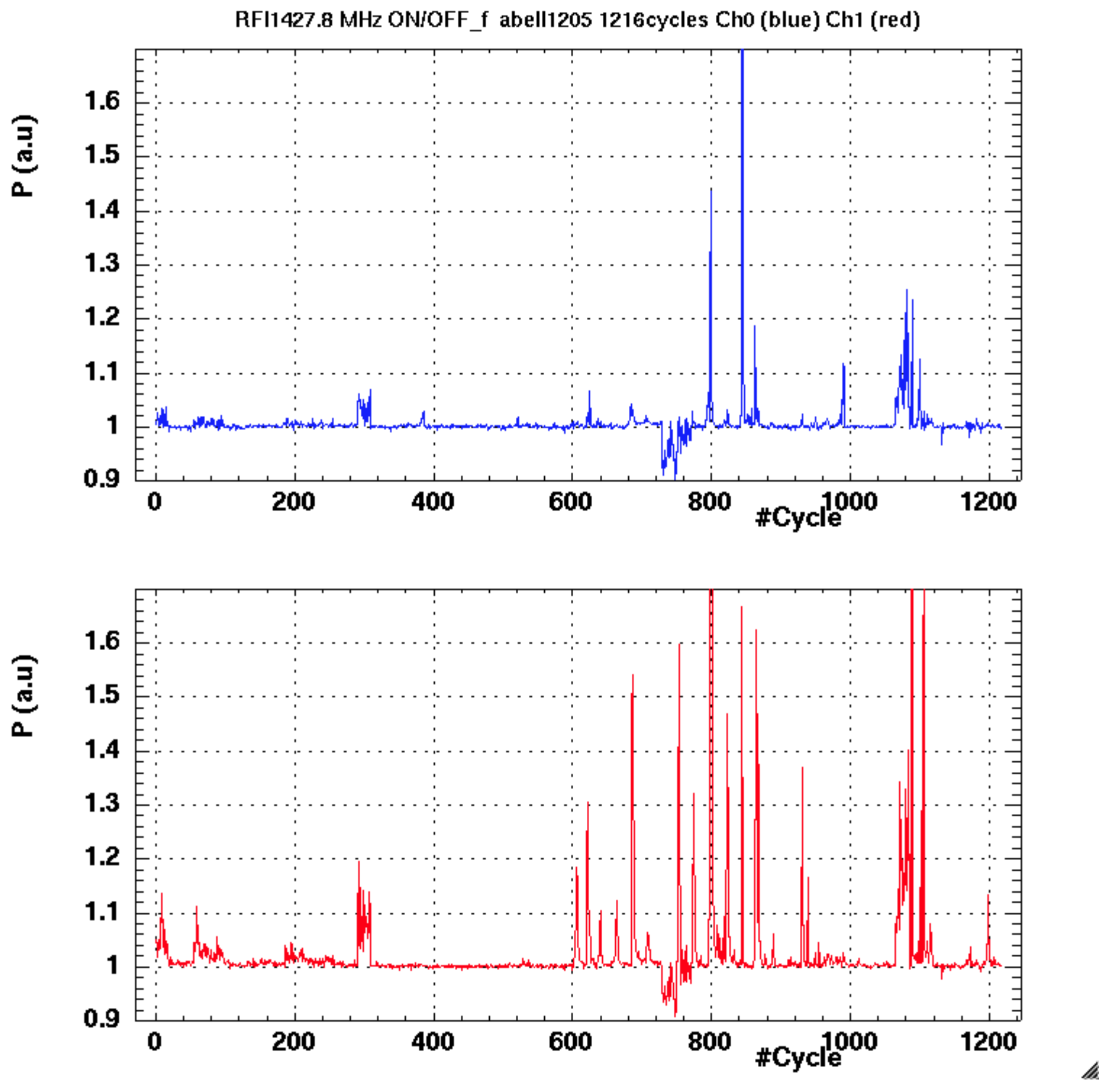

Figure 17. Integrated power of the 1427.8-MHz line vs. cycle number. Zoom on the less powerful peaks.

3.2.2 1428.16 MHz

In Figure 18 we show the time evolution of the integrated power of this line, which "appears" at the beginning of July 2011. The line shows more power in Ch1 than Ch0, excepting the 4 last cycles on 5th Oct 2011, where it "jumps" from Ch1 to Ch0. During the following run, on 17th Oct 2011, the level is still higher in Ch0 than in Ch1. From 19th Oct 2011 on, we recover the initial trend.

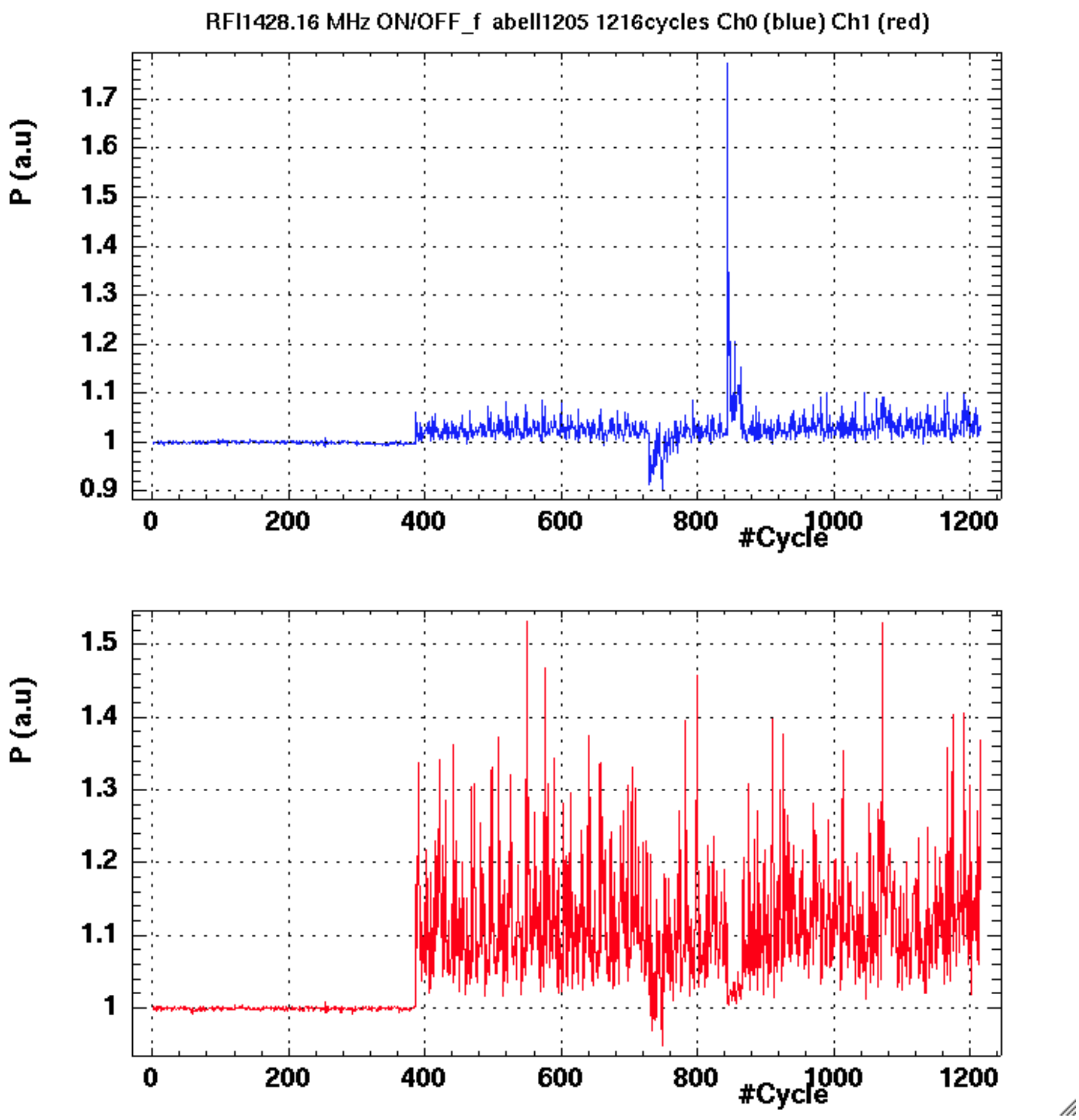

Figure 18. Integrated power of the 1428.16-MHz line vs. cycle number. Note the different scaling of the plots.

3.2.3 1428.56 MHz

We see in Figure 19 that this line is a bit more active in Ch1 than in Ch0, but without great differences (note the different scaling of the plots). It presents a great power increase in both channels on 30th May 2011 (~230 cycles), on 12th Jun 2011 (~300 cycles), and only on Ch0 in the 1st cycle on 17th Oct 2011 (~840 cycles).

There are other periods with small power increase in both channels on 19th Apr 2011 (~65 cycles), in the period 20th – 27th Jul 2011 (cycles 467-572), on 29th Oct 2011

(~910 cycles) and on 26th Dec 2011 (~1070 cycles). Only for Ch0 we have also a small increase in the period 10th – 22nd Aug 2011 (~630-680 cycles), and only for Ch1 in the first cycles of 24th Sep 2011 (~800 cycles).

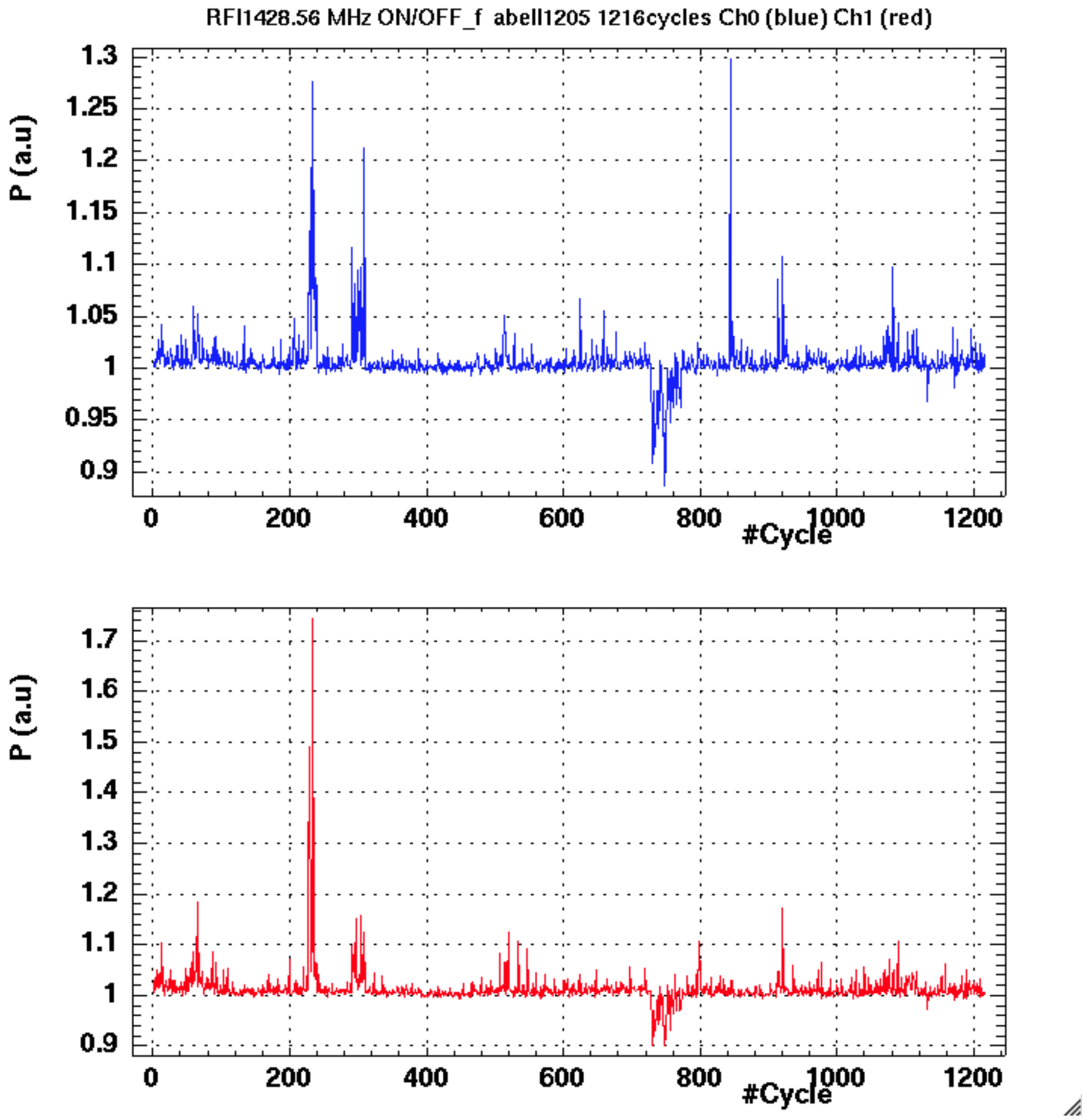

Figure 19. Integrated power of the 1428.56-MHz line vs. cycle number. Note the different scaling of the plots.

4 Conclusions

We have reported the existence of RFI lines in the protected frequency band [1400, 1427] MHz. For each line we have studied the time evolution of the integrated power, and extracted the dates where there are changes in the lines' power, to help with working out its origin. We have done the same work for some lines just next to the protected band, between 1427 and 1428 MHz. We summarise these dates in Table 2. Just keep in mind that these dates have been obtained from Abell1205 observations, thus they are approximate. Unless indicated, the comments refer to both channels.

Remember that it has already noticed that at the beginning of July 2011, after an intervention in Nançay to install 3 servers for FAN (4th Jul 2011), the power of several RFI lines (not only those in the protected band) has experienced major changes.

RFI line (MHz)	Date	Comments
1400	15th Apr – 2nd May 2011	Appears in Ch0
	28th Apr 2011	Dramatic rise in Ch1
	2nd May 2011	Burst in Ch1
	8th May 2011	Power decrease in Ch1
	15th Jun 2011	Burst in Ch1
	7th Jul 2011	Reactivates in Ch0; quiet in Ch1
	25th Jul 2011	Power decrease, Ch0
	22nd Aug 2011	Quiet in Ch0
	16th Nov 2011	Reactivates
1406	Beginning Jul 2011	Increase of power in Ch1
	17th Oct 2011	"Jump" from Ch1 to Ch0
1410	7th - 18th Aug 2011	Burst
1420	Apr – Jun 2011	OFF more powerful than ON, Ch0
	> 15th Sep 2011	OFF more powerful than ON
1421.38	< 3rd May 2011	OFF more powerful than ON
	5th May 2011	Burst
1425	26th Apr – 2nd May 2011	"Bumpy" power increase, Ch1
	< Beginning Jul 2011	Power steps up, Ch1
1427.8	< Aug 2011 (15thApr, 19th-26thApr, 7th-31st May, 12th Jun)	Small power increase
	7th Sep – 27th Nov	Big activity, esp. Ch1
	26th Dec 2011 (– 28th Dec)	Burst (+ decreasing activity)
1428.16	Beginning July 2011	Shows up, Ch1 > Ch0
	15th Oct 2011 (last 4 cycles) (– 17th Oct)	Burst + jump from Ch1 to Ch0 (+ decreasing activity)
1428.56	19th Apr 2011	Small power increase
	30th May 2011	Burst
	12th Jun 2011	Burst
	20th – 27th Jul 2011	Small power increase
	10th – 22nd Aug 2011	Small power increase, Ch0
	24th Sep 2011 (first cycles)	Small power increase, Ch1
	17th Oct 2011	Burst, Ch0 (first cycle)
	29th Oct 2011	Small power increase
	26th Dec 2011	Small power increase

Table 2. List of dates which mark a change in the power of the RFI lines quoted.

5 Appendix B. List of observations.

We include the list of observations done at Nançay by user no. 230, where the run date can be related to the corresponding scan number. This list is the output of the script lstnco230 in the baotest/work directory in Nançay. We have kept all the observations, not only those of Abell 1205, to facilitate traceability. Note that the time is reversed, i.e. the most recent observations will be listed first.

fil159881.230 - 20 01 2012 02:40:38 - AH= -30.79mn - NbrCyc= 26 - SOU #1124 ABELL1205- - MAP #241 px 40x1s HI M3C1 1320.8MHz Abe
fil159644.230 - 12 01 2012 03:41:17 - AH= -1.50mn - NbrCyc= 12 - SOU #1124 ABELL1205- - MAP #241 px 40x1s HI M3C1 1320.8MHz Abe
fil159512.230 - 08 01 2012 03:28:37 - AH= -29.97mn - NbrCyc= 26 - SOU #1124 ABELL1205- - MAP #241 px 40x1s HI M3C1 1320.8MHz Abe
fil159438.230 - 06 01 2012 03:38:02 - AH= -28.42mn - NbrCyc= 25 - SOU #1124 ABELL1205- - MAP #241 px 40x1s HI M3C1 1320.8MHz Abe
fil159302.230 - 02 01 2012 04:24:07 - AH= 2.02mn - NbrCyc= 15 - SOU #1391 ABELL1205- - MAP #259 px 40x1s HI M3C1 1320.8MHz Abe
fil159279.230 - 01 01 2012 04:03:18 - AH= -22.80mn - NbrCyc= 28 - SOU #1391 ABELL1205- - MAP #259 px 40x1s HI M3C1 1320.8MHz Abe
fil159218.230 - 30 12 2011 04:01:26 - AH= -32.55mn - NbrCyc= 16 - SOU #1391 ABELL1205- - MAP #259 px 40x1s HI M3C1 1320.8MHz Abe
fil159185.230 - 29 12 2011 04:31:30 - AH= -6.35mn - NbrCyc= 17 - SOU #1124 ABELL1205- - MAP #241 px 40x1s HI M3C1 1320.8MHz Abe
fil159159.230 - 28 12 2011 04:34:59 - AH= -6.80mn - NbrCyc= 17 - SOU #1124 ABELL1205- - MAP #241 px 40x1s HI M3C1 1320.8MHz Abe
fil159130.230 - 27 12 2011 04:38:46 - AH= -6.95mn - NbrCyc= 17 - SOU #1124 ABELL1205- - MAP #241 px 40x1s HI M3C1 1320.8MHz Abe
fil159103.230 - 26 12 2011 04:43:04 - AH= -6.56mn - NbrCyc= 20 - SOU #1391 ABELL1205- - MAP #259 px 40x1s HI M3C1 1320.8MHz Abe
fil159081.230 - 25 12 2011 04:36:20 - AH= -17.26mn - NbrCyc= 31 - SOU #1391 ABELL1205- - MAP #259 ROBIN 1140MHz nocha nomir imm
fil158978.230 - 22 12 2011 04:45:46 - AH= -19.63mn - NbrCyc= 22 - SOU #1391 ABELL1205- - MAP #259 ROBIN 1140MHz nocha nomir imm
fil158905.230 - 19 12 2011 18:27:15 - AH= -15.86mn - NbrCyc= 10 - SOU #1125 ABELL0085- - MAP #258 dr 180s HI M3C1 1346.2MHz Abel
fil158567.230 - 12 12 2011 05:37:43 - AH= -6.95mn - NbrCyc= 17 - SOU #1124 ABELL1205- - MAP #241 px 40x1s HI M3C1 1320.8MHz Abe
fil158494.230 - 10 12 2011 05:40:04 - AH= -12.49mn - NbrCyc= 20 - SOU #1124 ABELL1205- - MAP #241 px 40x1s HI M3C1 1320.8MHz Abe
fil158425.230 - 08 12 2011 05:57:24 - AH= -2.99mn - NbrCyc= 15 - SOU #1124 ABELL1205- - MAP #241 px 40x1s HI M3C1 1320.8MHz Abe
fil158371.230 - 06 12 2011 19:19:26 - AH= -14.80mn - NbrCyc= 15 - SOU #1125 ABELL0085- - MAP #239 px 40x1s HI M3C1 1346.2MHz Abe
fil158360.230 - 06 12 2011 05:54:03 - AH= -14.23mn - NbrCyc= 21 - SOU #1124 ABELL1205- - MAP #241 px 40x1s HI M3C1 1320.8MHz Abe
fil158281.230 - 04 12 2011 06:04:00 - AH= -12.13mn - NbrCyc= 20 - SOU #1124 ABELL1205- - MAP #241 px 40x1s HI M3C1 1320.8MHz Abe
fil158029.230 - 27 11 2011 06:52:28 - AH= 8.87mn - NbrCyc= 9 - SOU #1124 ABELL1205- - MAP #241 px 40x1s HI M3C1 1320.8MHz Abe
fil157823.230 - 21 11 2011 07:07:18 - AH= 0.09mn - NbrCyc= 14 - SOU #1124 ABELL1205- - MAP #241 px 40x1s HI M3C1 1320.8MHz Abe
fil157789.230 - 20 11 2011 07:05:01 - AH= -6.14mn - NbrCyc= 17 - SOU #1124 ABELL1205- - MAP #241 px 40x1s HI M3C1 1320.8MHz Abe
fil157641.230 - 16 11 2011 07:24:28 - AH= -2.41mn - NbrCyc= 15 - SOU #1124 ABELL1205- - MAP #241 px 40x1s HI M3C1 1320.8MHz Abe
fil157282.230 - 05 11 2011 08:01:40 - AH= -8.47mn - NbrCyc= 18 - SOU #1124 ABELL1205- - MAP #241 px 40x1s HI M3C1 1320.8MHz Abe
fil157090.230 - 30 10 2011 08:18:15 - AH= -15.50mn - NbrCyc= 21 - SOU #1124 ABELL1205- - MAP #241 px 40x1s HI M3C1 1320.8MHz Abe
fil157056.230 - 29 10 2011 08:23:52 - AH= -13.80mn - NbrCyc= 20 - SOU #1124 ABELL1205- - MAP #241 px 40x1s HI M3C1 1320.8MHz Abe
fil157041.230 - 28 10 2011 21:41:47 - AH= -25.82mn - NbrCyc= 28 - SOU #1125 ABELL0085- - MAP #239 px 40x1s HI M3C1 1346.2MHz Abe
fil156996.230 - 27 10 2011 08:30:36 - AH= -14.93mn - NbrCyc= 21 - SOU #1124 ABELL1205- - MAP #241 px 40x1s HI M3C1 1320.8MHz Abe
fil156983.230 - 26 10 2011 21:52:50 - AH= -22.62mn - NbrCyc= 27 - SOU #1125 ABELL0085- - MAP #239 px 40x1s HI M3C1 1346.2MHz Abe
fil156805.230 - 20 10 2011 22:16:34 - AH= -22.48mn - NbrCyc= 28 - SOU #1125 ABELL0085- - MAP #239 px 40x1s HI M3C1 1346.2MHz Abe
fil156720.230 - 18 10 2011 09:01:50 - AH= -19.10mn - NbrCyc= 23 - SOU #1124 ABELL1205- - MAP #241 px 40x1s HI M3C1 1320.8MHz Abe
fil156685.230 - 17 10 2011 09:08:28 - AH= -16.39mn - NbrCyc= 22 - SOU #1124 ABELL1205- - MAP #241 px 40x1s HI M3C1 1320.8MHz Abe
fil156419.230 - 05 10 2011 09:52:17 - AH= -19.76mn - NbrCyc= 23 - SOU #1124 ABELL1205- - MAP #241 px 40x1s HI M3C1 1320.8MHz Abe
fil156140.230 - 24 09 2011 10:33:06 - AH= -22.21mn - NbrCyc= 25 - SOU #1124 ABELL1205- - MAP #241 px 40x1s HI M3C1 1320.8MHz Abe

fil156084.230 - 22 09 2011 10:43:51 - AH= -19.31mn - NbrCyc= 24 - SOU #1124 ABELL1205- - MAP #241 px 40x1s HI M3C1 1320.8MHz Abe
fil155691.230 - 15 09 2011 11:10:31 - AH= -20.15mn - NbrCyc= 22 - SOU #1124 ABELL1205- - MAP #241 px 40x1s HI M3C1 1320.8MHz Abe
fil155586.230 - 12 09 2011 11:26:04 - AH= -16.40mn - NbrCyc= 22 - SOU #1124 ABELL1205- - MAP #241 px 40x1s HI M3C1 1320.8MHz Abe
fil155403.230 - 05 09 2011 11:50:17 - AH= -17.94mn - NbrCyc= 22 - SOU #1108 ABELL1205 - MAP #241 px 40x1s HI M3C1 1320.8MHz Abe
fil155334.230 - 03 09 2011 11:58:12 - AH= -17.89mn - NbrCyc= 22 - SOU #1108 ABELL1205 - MAP #241 px 40x1s HI M3C1 1320.8MHz Abe
fil154962.230 - 22 08 2011 12:33:49 - AH= -31.25mn - NbrCyc= 32 - SOU #1124 ABELL1205- - MAP #241 px 40x1s HI M3C1 1320.8MHz Abe
fil154853.230 - 18 08 2011 12:53:52 - AH= -26.92mn - NbrCyc= 20 - SOU #1124 ABELL1205- - MAP #247 px60s 1301MHz ROACH EWGD (from
fil154694.230 - 13 08 2011 13:09:24 - AH= -31.05mn - NbrCyc= 20 - SOU #1124 ABELL1205- - MAP #247 px60s 1301MHz ROACH EWGD (from
fil154649.230 - 12 08 2011 02:49:47 - AH= -24.48mn - NbrCyc= 25 - SOU #1125 ABELL0085- - MAP #239 px 40x1s HI M3C1 1346.2MHz Abe
fil154616.230 - 11 08 2011 03:00:22 - AH= -17.80mn - NbrCyc= 25 - SOU #1125 ABELL0085- - MAP #239 px 40x1s HI M3C1 1346.2MHz Abe
fil154598.230 - 10 08 2011 13:24:47 - AH= -27.45mn - NbrCyc= 19 - SOU #1124 ABELL1205- - MAP #247 px60s 1301MHz ROACH EWGD (from
fil154556.230 - 09 08 2011 03:03:46 - AH= -22.28mn - NbrCyc= 27 - SOU #1125 ABELL0085- - MAP #239 px 40x1s HI M3C1 1346.2MHz Abe
fil154521.230 - 08 08 2011 03:11:47 - AH= -18.18mn - NbrCyc= 25 - SOU #1125 ABELL0085- - MAP #239 px 40x1s HI M3C1 1346.2MHz Abe
fil154501.230 - 07 08 2011 13:36:35 - AH= -27.45mn - NbrCyc= 19 - SOU #1124 ABELL1205- - MAP #247 px60s 1301MHz ROACH EWGD (from
fil154452.230 - 06 08 2011 03:19:23 - AH= -18.45mn - NbrCyc= 26 - SOU #1125 ABELL0085- - MAP #239 px 40x1s HI M3C1 1346.2MHz Abe
fil154411.230 - 05 08 2011 03:19:54 - AH= -21.88mn - NbrCyc= 24 - SOU #1125 ABELL0085- - MAP #239 px 40x1s HI M3C1 1346.2MHz Abe
fil154302.230 - 30 07 2011 14:08:06 - AH= -27.39mn - NbrCyc= 27 - SOU #1124 ABELL1205- - MAP #241 px 40x1s HI M3C1 1320.8MHz Abe
fil154258.230 - 29 07 2011 03:41:12 - AH= -28.11mn - NbrCyc= 27 - SOU #1125 ABELL0085- - MAP #239 px 40x1s HI M3C1 1346.2MHz Abe
fil154202.230 - 27 07 2011 14:19:51 - AH= -27.44mn - NbrCyc= 27 - SOU #1124 ABELL1205- - MAP #241 px 40x1s HI M3C1 1320.8MHz Abe
fil154171.230 - 26 07 2011 03:57:00 - AH= -24.09mn - NbrCyc= 25 - SOU #1125 ABELL0085- - MAP #239 px 40x1s HI M3C1 1346.2MHz Abe
fil154154.230 - 25 07 2011 14:27:39 - AH= -27.50mn - NbrCyc= 26 - SOU #1124 ABELL1205- - MAP #241 px 40x1s HI M3C1 1320.8MHz Abe
fil154125.230 - 23 07 2011 14:35:36 - AH= -27.42mn - NbrCyc= 27 - SOU #1124 ABELL1205- - MAP #241 px 40x1s HI M3C1 1320.8MHz Abe
fil154072.230 - 22 07 2011 04:23:38 - AH= -13.16mn - NbrCyc= 20 - SOU #1125 ABELL0085- - MAP #239 px 40x1s HI M3C1 1346.2MHz Abe
fil153948.230 - 18 07 2011 04:40:57 - AH= -11.56mn - NbrCyc= 22 - SOU #1125 ABELL0085- - MAP #239 px 40x1s HI M3C1 1346.2MHz Abe
fil153746.230 - 11 07 2011 15:22:42 - AH= -27.51mn - NbrCyc= 27 - SOU #1124 ABELL1205- - MAP #241 px 40x1s HI M3C1 1320.8MHz Abe
fil153668.230 - 09 07 2011 15:31:19 - AH= -26.74mn - NbrCyc= 27 - SOU #1124 ABELL1205- - MAP #241 px 40x1s HI M3C1 1320.8MHz Abe
fil153628.230 - 08 07 2011 05:19:37 - AH= -12.20mn - NbrCyc= 22 - SOU #1125 ABELL0085- - MAP #239 px 40x1s HI M3C1 1346.2MHz Abe
fil153609.230 - 07 07 2011 15:38:48 - AH= -27.12mn - NbrCyc= 27 - SOU #1124 ABELL1205- - MAP #241 px 40x1s HI M3C1 1320.8MHz Abe
fil153524.230 - 04 07 2011 15:50:14 - AH= -27.49mn - NbrCyc= 27 - SOU #1124 ABELL1205- - MAP #241 px 40x1s HI M3C1 1320.8MHz Abe
fil153495.230 - 01 07 2011 05:37:33 - AH= -21.81mn - NbrCyc= 27 - SOU #1125 ABELL0085- - MAP #239 px 40x1s HI M3C1 1346.2MHz Abe
fil154028.230 - 20 07 2011 14:47:23 - AH= -27.42mn - NbrCyc= 27 - SOU #1124 ABELL1205- - MAP #241 px 40x1s HI M3C1 1320.8MHz Abe
fil152948.230 - 17 06 2011 17:19:59 - AH= -4.53mn - NbrCyc= 19 - SOU #1124 ABELL1205- - MAP #241 px 40x1s HI M3C1 1320.8MHz Abe
fil152919.230 - 16 06 2011 17:21:38 - AH= -6.81mn - NbrCyc= 20 - SOU #1124 ABELL1205- - MAP #241 px 40x1s HI M3C1 1320.8MHz Abe
fil152883.230 - 15 06 2011 17:22:27 - AH= -9.93mn - NbrCyc= 21 - SOU #1124 ABELL1205- - MAP #241 px 40x1s HI M3C1 1320.8MHz Abe

fil152829.230 - 13 06 2011 17:30:04 - AH= -10.18mn - NbrCyc= 17 - SOU #1124 ABELL1205- - MAP #241 px 40x1s HI M3C1 1320.8MHz Abe
fil152813.230 - 13 06 2011 04:32:29 - AH= -19.32mn - NbrCyc= 24 - SOU #1123 ABELL2440 - MAP #244 px 40x1s HI M3C1 1304.2MHz Abe
fil152801.230 - 12 06 2011 17:33:28 - AH= -10.71mn - NbrCyc= 19 - SOU #1124 ABELL1205- - MAP #241 px 40x1s HI M3C1 1320.8MHz Abe
fil152783.230 - 12 06 2011 06:56:14 - AH= -17.82mn - NbrCyc= 17 - SOU #1125 ABELL0085- - MAP #239 px 40x1s HI M3C1 1346.2MHz Abe
fil152766.230 - 11 06 2011 17:35:07 - AH= -13.01mn - NbrCyc= 20 - SOU #1124 ABELL1205- - MAP #241 px 40x1s HI M3C1 1320.8MHz Abe
fil152747.230 - 11 06 2011 04:40:00 - AH= -19.67mn - NbrCyc= 22 - SOU #1123 ABELL2440 - MAP #244 px 40x1s HI M3C1 1304.2MHz Abe
fil152717.230 - 10 06 2011 07:02:05 - AH= -19.84mn - NbrCyc= 18 - SOU #1125 ABELL0085- - MAP #239 px 40x1s HI M3C1 1346.2MHz Abe
fil152663.230 - 08 06 2011 17:49:08 - AH= -10.78mn - NbrCyc= 20 - SOU #1124 ABELL1205- - MAP #241 px 40x1s HI M3C1 1320.8MHz Abe
fil152646.230 - 08 06 2011 07:11:18 - AH= -18.49mn - NbrCyc= 17 - SOU #1125 ABELL0085- - MAP #239 px 40x1s HI M3C1 1346.2MHz Abe
fil152624.230 - 07 06 2011 17:54:09 - AH= -9.70mn - NbrCyc= 17 - SOU #1124 ABELL1205- - MAP #241 px 40x1s HI M3C1 1320.8MHz Abe
fil152609.230 - 07 06 2011 04:57:43 - AH= -17.66mn - NbrCyc= 23 - SOU #1123 ABELL2440 - MAP #244 px 40x1s HI M3C1 1304.2MHz Abe
fil152583.230 - 06 06 2011 07:21:02 - AH= -16.60mn - NbrCyc= 16 - SOU #1125 ABELL0085- - MAP #239 px 40x1s HI M3C1 1346.2MHz Abe
fil152545.230 - 05 06 2011 05:05:14 - AH= -18.01mn - NbrCyc= 23 - SOU #1123 ABELL2440 - MAP #244 px 40x1s HI M3C1 1304.2MHz Abe
fil152518.230 - 04 06 2011 07:27:08 - AH= -18.37mn - NbrCyc= 17 - SOU #1125 ABELL0085- - MAP #239 px 40x1s HI M3C1 1346.2MHz Abe
fil152482.230 - 03 06 2011 05:16:37 - AH= -14.48mn - NbrCyc= 21 - SOU #1123 ABELL2440 - MAP #244 px 40x1s HI M3C1 1304.2MHz Abe
fil152451.230 - 02 06 2011 07:40:52 - AH= -12.48mn - NbrCyc= 14 - SOU #1125 ABELL0085- - MAP #239 px 40x1s HI M3C1 1346.2MHz Abe
fil152410.230 - 01 06 2011 05:18:59 - AH= -19.99mn - NbrCyc= 24 - SOU #1123 ABELL2440 - MAP #244 px 40x1s HI M3C1 1304.2MHz Abe
fil152393.230 - 31 05 2011 18:22:12 - AH= -9.16mn - NbrCyc= 15 - SOU #1124 ABELL1205- - MAP #241 px 40x1s HI M3C1 1320.8MHz Abe
fil152363.230 - 30 05 2011 18:37:04 - AH= 1.80mn - NbrCyc= 13 - SOU #1124 ABELL1205- - MAP #241 px 40x1s HI M3C1 1320.8MHz Abe
fil152332.230 - 29 05 2011 07:36:11 - AH= -32.95mn - NbrCyc= 33 - SOU #1125 ABELL0085- - MAP #239 px 40x1s HI M3C1 1346.2MHz Abe
fil152316.230 - 28 05 2011 18:32:43 - AH= -10.45mn - NbrCyc= 11 - SOU #1124 ABELL1205- - MAP #241 px 40x1s HI M3C1 1320.8MHz Abe
fil152268.230 - 16 05 2011 06:30:41 - AH= -11.17mn - NbrCyc= 19 - SOU #1123 ABELL2440 - MAP #244 px 40x1s HI M3C1 1304.2MHz Abe
fil152225.230 - 15 05 2011 06:25:10 - AH= -20.65mn - NbrCyc= 24 - SOU #1123 ABELL2440 - MAP #244 px 40x1s HI M3C1 1304.2MHz Abe
fil152189.230 - 14 05 2011 08:35:10 - AH= -32.94mn - NbrCyc= 24 - SOU #1125 ABELL0085- - MAP #239 px 40x1s HI M3C1 1346.2MHz Abe
fil152153.230 - 13 05 2011 08:39:06 - AH= -32.94mn - NbrCyc= 24 - SOU #1125 ABELL0085- - MAP #239 px 40x1s HI M3C1 1346.2MHz Abe
fil152087.230 - 11 05 2011 08:46:57 - AH= -32.96mn - NbrCyc= 24 - SOU #1125 ABELL0085- - MAP #239 px 40x1s HI M3C1 1346.2MHz Abe
fil152005.230 - 08 05 2011 19:46:40 - AH= -15.15mn - NbrCyc= 21 - SOU #1124 ABELL1205- - MAP #241 px 40x1s HI M3C1 1320.8MHz Abe
fil151970.230 - 07 05 2011 19:53:20 - AH= -12.40mn - NbrCyc= 20 - SOU #1124 ABELL1205- - MAP #241 px 40x1s HI M3C1 1320.8MHz Abe
fil151955.230 - 07 05 2011 09:02:41 - AH= -32.94mn - NbrCyc= 24 - SOU #1125 ABELL0085- - MAP #239 px 40x1s HI M3C1 1346.2MHz Abe
fil151938.230 - 06 05 2011 20:00:17 - AH= -9.38mn - NbrCyc= 19 - SOU #1124 ABELL1205- - MAP #241 px 40x1s HI M3C1 1320.8MHz Abe
fil151880.230 - 05 05 2011 07:07:09 - AH= -17.96mn - NbrCyc= 23 - SOU #1123 ABELL2440 - MAP #244 px 40x1s HI M3C1 1304.2MHz Abe
fil151800.230 - 02 05 2011 20:14:19 - AH= -11.08mn - NbrCyc= 18 - SOU #1124 ABELL1205- - MAP #241 px 40x1s HI M3C1 1320.8MHz Abe
fil151786.230 - 02 05 2011 09:32:07 - AH= -23.14mn - NbrCyc= 17 - SOU #1125 ABELL0085- - MAP #239 px 40x1s HI M3C1 1346.2MHz Abe
fil151741.230 - 30 04 2011 09:50:06 - AH= -12.99mn - NbrCyc= 15 - SOU #1125 ABELL0085- - MAP #239 px 40x1s HI M3C1 1346.2MHz Abe

fil151724.230 - 29 04 2011 20:24:38 - AH= -12.57mn - NbrCyc= 19 - SOU #1124 ABELL1205- - MAP #241 px 40x1s HI M3C1 1320.8MHz Abe
fil151694.230 - 28 04 2011 20:31:38 - AH= -9.49mn - NbrCyc= 18 - SOU #1124 ABELL1205- - MAP #241 px 40x1s HI M3C1 1320.8MHz Abe
fil151675.230 - 28 04 2011 09:58:37 - AH= -12.34mn - NbrCyc= 14 - SOU #1125 ABELL0085- - MAP #239 px 40x1s HI M3C1 1346.2MHz Abe
fil151657.230 - 27 04 2011 20:39:02 - AH= -6.00mn - NbrCyc= 16 - SOU #1124 ABELL1205- - MAP #241 px 40x1s HI M3C1 1320.8MHz Abe
fil151624.230 - 26 04 2011 20:38:37 - AH= -10.37mn - NbrCyc= 18 - SOU #1124 ABELL1205- - MAP #241 px 40x1s HI M3C1 1320.8MHz Abe
fil151556.230 - 24 04 2011 10:13:50 - AH= -12.85mn - NbrCyc= 14 - SOU #1125 ABELL0085- - MAP #239 px 40x1s HI M3C1 1346.2MHz Abe
fil151526.230 - 23 04 2011 07:55:57 - AH= -16.34mn - NbrCyc= 20 - SOU #1123 ABELL2440 - MAP #244 px 40x1s HI M3C1 1304.2MHz Abe
fil151497.230 - 22 04 2011 10:22:29 - AH= -12.05mn - NbrCyc= 14 - SOU #1125 ABELL0085- - MAP #239 px 40x1s HI M3C1 1346.2MHz Abe
fil151480.230 - 21 04 2011 21:05:08 - AH= -3.49mn - NbrCyc= 15 - SOU #1124 ABELL1205- - MAP #241 px 40x1s HI M3C1 1320.8MHz Abe
fil151414.230 - 19 04 2011 21:12:29 - AH= -4.00mn - NbrCyc= 12 - SOU #1124 ABELL1205- - MAP #241 px 40x1s HI M3C1 1320.8MHz Abe
fil151368.230 - 18 04 2011 08:14:51 - AH= -17.11mn - NbrCyc= 21 - SOU #1123 ABELL2440 - MAP #244 px 40x1s HI M3C1 1304.2MHz Abe
fil151356.230 - 17 04 2011 20:59:17 - AH= -25.14mn - NbrCyc= 25 - SOU #1124 ABELL1205- - MAP #241 px 40x1s HI M3C1 1320.8MHz Abe
fil151338.230 - 17 04 2011 10:23:31 - AH= -30.73mn - NbrCyc= 23 - SOU #1125 ABELL0085- - MAP #239 px 40x1s HI M3C1 1346.2MHz Abe
fil151320.230 - 16 04 2011 21:27:52 - AH= -0.40mn - NbrCyc= 13 - SOU #1124 ABELL1205- - MAP #241 px 40x1s HI M3C1 1320.8MHz Abe
fil151300.230 - 16 04 2011 10:26:57 - AH= -31.23mn - NbrCyc= 24 - SOU #1125 ABELL0085- - MAP #239 px 40x1s HI M3C1 1346.2MHz Abe
fil151279.230 - 15 04 2011 21:23:56 - AH= -8.30mn - NbrCyc= 17 - SOU #1124 ABELL1205- - MAP #241 px 40x1s HI M3C1 1320.8MHz Abe
fil151260.230 - 15 04 2011 08:24:41 - AH= -19.07mn - NbrCyc= 26 - SOU #1123 ABELL2440 - MAP #244 px 40x1s HI M3C1 1304.2MHz Abe
fil151206.230 - 13 04 2011 21:35:09 - AH= -4.94mn - NbrCyc= 12 - SOU #1124 ABELL1205- - MAP #241 px 40x1s HI M3C1 1320.8MHz Abe
fil151116.230 - 10 04 2011 21:36:36 - AH= -15.30mn - NbrCyc= 20 - SOU #1124 ABELL1205- - MAP #241 px 40x1s HI M3C1 1320.8MHz Abe
fil151099.230 - 10 04 2011 11:09:15 - AH= -12.47mn - NbrCyc= 14 - SOU #1125 ABELL0085- - MAP #239 px 40x1s HI M3C1 1346.2MHz Abe
fil151065.230 - 09 04 2011 08:48:28 - AH= -18.87mn - NbrCyc= 22 - SOU #1123 ABELL2440 - MAP #244 px 40x1s HI M3C1 1304.2MHz Abe
fil151026.230 - 08 04 2011 08:53:59 - AH= -17.29mn - NbrCyc= 21 - SOU #1123 ABELL2440 - MAP #244 px 40x1s HI M3C1 1304.2MHz Abe
fil151013.230 - 07 04 2011 21:51:59 - AH= -11.70mn - NbrCyc= 18 - SOU #1124 ABELL1205- - MAP #241 px 40x1s HI M3C1 1320.8MHz Abe
fil150940.230 - 04 04 2011 22:02:34 - AH= -12.92mn - NbrCyc= 18 - SOU #1124 ABELL1205- - MAP #241 px 40x1s HI M3C1 1320.8MHz Abe
fil150867.230 - 02 04 2011 22:06:13 - AH= -17.15mn - NbrCyc= 21 - SOU #1124 ABELL1205- - MAP #241 px 40x1s HI M3C1 1320.8MHz Abe
fil150837.230 - 01 04 2011 22:09:04 - AH= -18.24mn - NbrCyc= 19 - SOU #1124 ABELL1205- - MAP #241 px 40x1s HI M3C1 1320.8MHz Abe
fil150667.230 - 26 03 2011 22:38:08 - AH= -12.75mn - NbrCyc= 19 - SOU #1124 ABELL1205- - MAP #241 px 40x1s HI M3C1 1320.8MHz Abe
fil150585.230 - 24 03 2011 09:49:31 - AH= -14.44mn - NbrCyc= 24 - SOU #1109 ABELL2430 - MAP #240 px 40x1s HI M3C1 1304.2MHz Abe
fil150535.230 - 22 03 2011 23:00:14 - AH= -6.35mn - NbrCyc= 13 - SOU #1124 ABELL1205- - MAP #241 px 40x1s HI M3C1 1320.8MHz Abe
fil150509.230 - 21 03 2011 22:57:41 - AH= -12.85mn - NbrCyc= 16 - SOU #1124 ABELL1205- - MAP #241 px 40x1s HI M3C1 1320.8MHz Abe
fil150490.230 - 21 03 2011 10:38:41 - AH= 16.74mn - NbrCyc= 7 - SOU #1123 ABELL2440 - MAP #244 px 40x1s HI M3C1 1304.2MHz Abe
fil150258.230 - 14 03 2011 13:31:36 - AH= -8.07mn - NbrCyc= 16 - SOU #1110 ABELL0168 - MAP #239 px 40x1s HI M3C1 1346.2MHz Abe
fil150254.230 - 14 03 2011 10:24:41 - AH= -18.60mn - NbrCyc= 20 - SOU #1109 ABELL2430 - MAP #240 px 40x1s HI M3C1 1304.2MHz Abe
fil149881.230 - 07 03 2011 13:58:52 - AH= -8.09mn - NbrCyc= 16 - SOU #1121 ABELL0168- - MAP #242 px 40x1s HI M3C1 1359.5MHz Abe

fil149780.230 - 04 03 2011 14:07:20 - AH= -11.45mn - NbrCyc= 18 - SOU #1121 ABELL0168- - MAP #242 px 40x1s HI M3C1 1359.5MHz Abe
fil149719.230 - 02 03 2011 14:18:38 - AH= -8.00mn - NbrCyc= 19 - SOU #1121 ABELL0168- - MAP #242 px 40x1s HI M3C1 1359.5MHz Abe
fil149656.230 - 28 02 2011 14:25:52 - AH= -8.86mn - NbrCyc= 16 - SOU #1121 ABELL0168 - MAP #242 px 40x1s HI M3C1 1359.5MHz Abe
fil149653.230 - 28 02 2011 11:26:42 - AH= -11.60mn - NbrCyc= 22 - SOU #1109 ABELL2430 - MAP #240 px 40x1s HI M3C1 1304.2MHz Abe
fil149570.230 - 25 02 2011 14:27:24 - AH= -19.14mn - NbrCyc= 22 - SOU #1110 ABELL0168 - MAP #242 px 40x1s HI M3C1 1359.5MHz Abe
fil149567.230 - 25 02 2011 11:36:31 - AH= -13.58mn - NbrCyc= 23 - SOU #1109 ABELL2430 - MAP #240 px 40x1s HI M3C1 1304.2MHz Abe
fil149234.230 - 11 02 2011 15:51:29 - AH= 9.98mn - NbrCyc= 7 - SOU #1110 ABELL0168 - MAP #242 px 40x1s HI M3C1 1359.5MHz Abe
fil149233.230 - 11 02 2011 15:31:06 - AH= 23.07mn - NbrCyc= 5 - SOU #1111 ABELL0085 - MAP #239 px 40x1s HI M3C1 1346.2MHz Abe
fil149230.230 - 11 02 2011 12:33:23 - AH= -11.76mn - NbrCyc= 22 - SOU #1109 ABELL2430 - MAP #240 px 40x1s HI M3C1 1304.2MHz Abe
fil149082.230 - 07 02 2011 15:56:27 - AH= -0.83mn - NbrCyc= 13 - SOU #1110 ABELL0168 - MAP #242 px 40x1s HI M3C1 1359.5MHz Abe
fil149079.230 - 07 02 2011 15:40:14 - AH= -17.08mn - NbrCyc= 6 - SOU #1110 ABELL0168 - MAP #239 px 40x1s HI M3C1 1346.2MHz Abe
fil149076.230 - 07 02 2011 12:49:13 - AH= -11.64mn - NbrCyc= 22 - SOU #1109 ABELL2430 - MAP #240 px 40x1s HI M3C1 1304.2MHz Abe
fil149041.230 - 04 02 2011 13:25:54 - AH= 13.30mn - NbrCyc= 10 - SOU #1109 ABELL2430 - MAP #240 px 40x1s HI M3C1 1304.2MHz Abe
fil148932.230 - 01 02 2011 16:07:50 - AH= -13.06mn - NbrCyc= 19 - SOU #1110 ABELL0168 - MAP #242 px 40x1s HI M3C1 1359.5MHz Abe
fil148905.230 - 31 01 2011 16:10:32 - AH= -14.29mn - NbrCyc= 19 - SOU #1110 ABELL0168 - MAP #242 px 40x1s HI M3C1 1359.5MHz Abe
fil148721.230 - 25 01 2011 16:15:57 - AH= -32.53mn - NbrCyc= 28 - SOU #1110 ABELL0168 - MAP #239 px 40x1s HI M3C1 1346.2MHz Abe
fil148669.230 - 23 01 2011 16:23:48 - AH= -32.53mn - NbrCyc= 28 - SOU #1110 ABELL0168 - MAP #239 px 40x1s HI M3C1 1346.2MHz Abe
fil148608.230 - 21 01 2011 16:31:40 - AH= -32.53mn - NbrCyc= 28 - SOU #1110 ABELL0168 - MAP #239 px 40x1s HI M3C1 1346.2MHz Abe
fil148231.230 - 10 01 2011 17:25:31 - AH= 11.63mn - NbrCyc= 11 - SOU #1111 ABELL0085 - MAP #239 px 40x1s HI M3C1 1346.2MHz Abe