LYRA Dark Currents – Update for 30°-40°, and for Head 3

IED 02 Dec 2010

Since the last report on the dark currents of head 2, in my eMail from 18 Oct 2010 (added further below in this document for completeness), the temperature interval between 30 and 40 degree C could be specified by exploiting a long observation on 25 Nov 2010 when covers were accidentally closed, and a campaign on 02 Dec 2010 when eclipse profiles were acquired.

Additionally, values from the same set of six calibration campaigns that were used in the other report – 26 May, 23 Jun, 14 Jul, 11 Aug, 29 Sep, and 14 Oct 2010 - plus now 25 Nov and 02 Dec 2010, were used to estimate the dark currents from the temperatures of head 3.

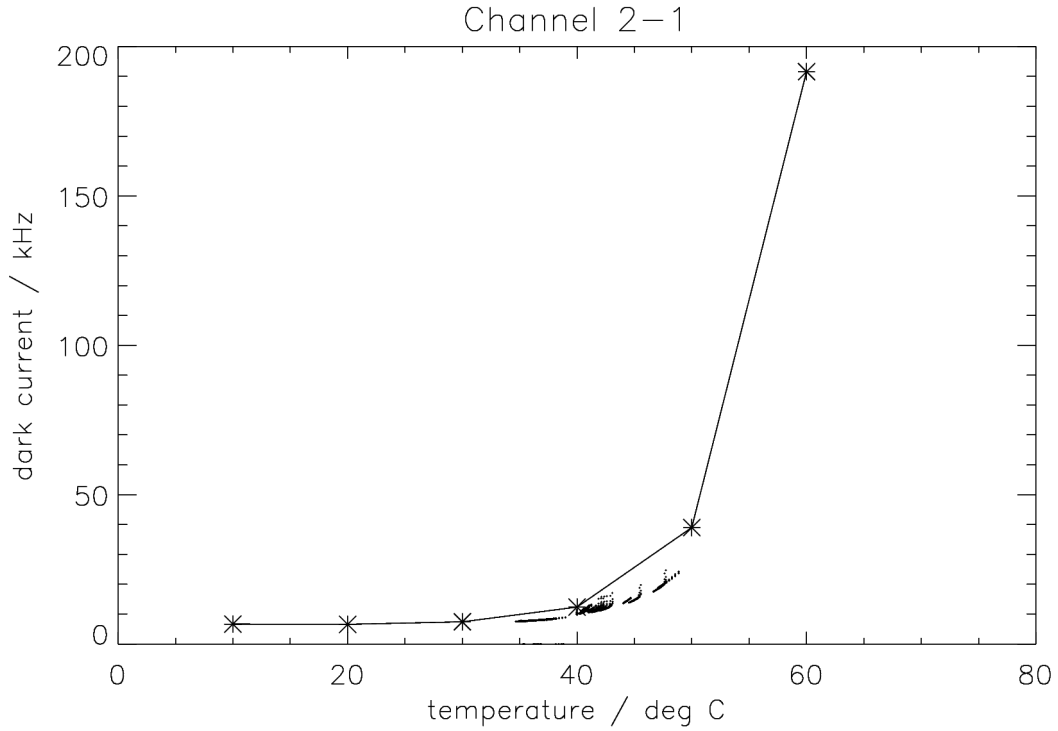
The values from November and December have the advantage that the temperatures are cooler (33-39 C) than in the earlier campaigns (40-49 C), due to the eclipse season that started again in November. Thus, we now have a rather complete temperature range for the estimation of the dark currents.

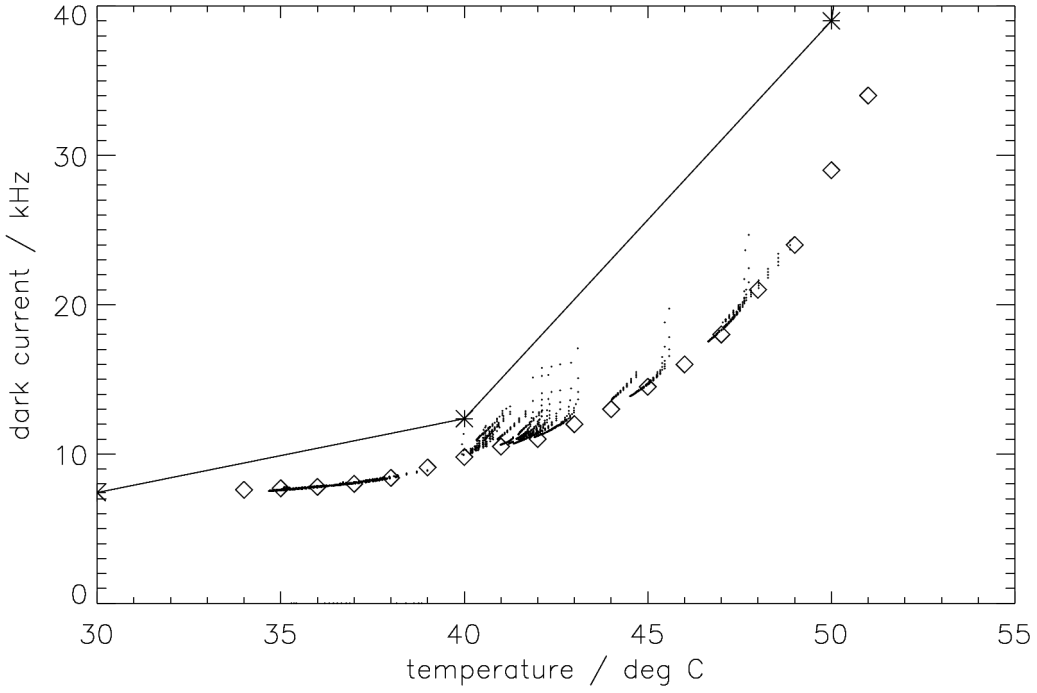
Please remember that it is not possible to simply take the last dark current measured before opening the covers – which was originally planned; see STATUS table in metadata FITS file – because the dark currents vary on a relatively fast time scale, e.g., with each orbit. To correct these variations for calibration purposes, they have to be estimated on this faster time scale. It was suggested to do this with the help of on-board temperatures; to increase the exactness, temperatures for each of the three heads were considered separately, and the HK table in the metadata FITS file was accordingly modified.

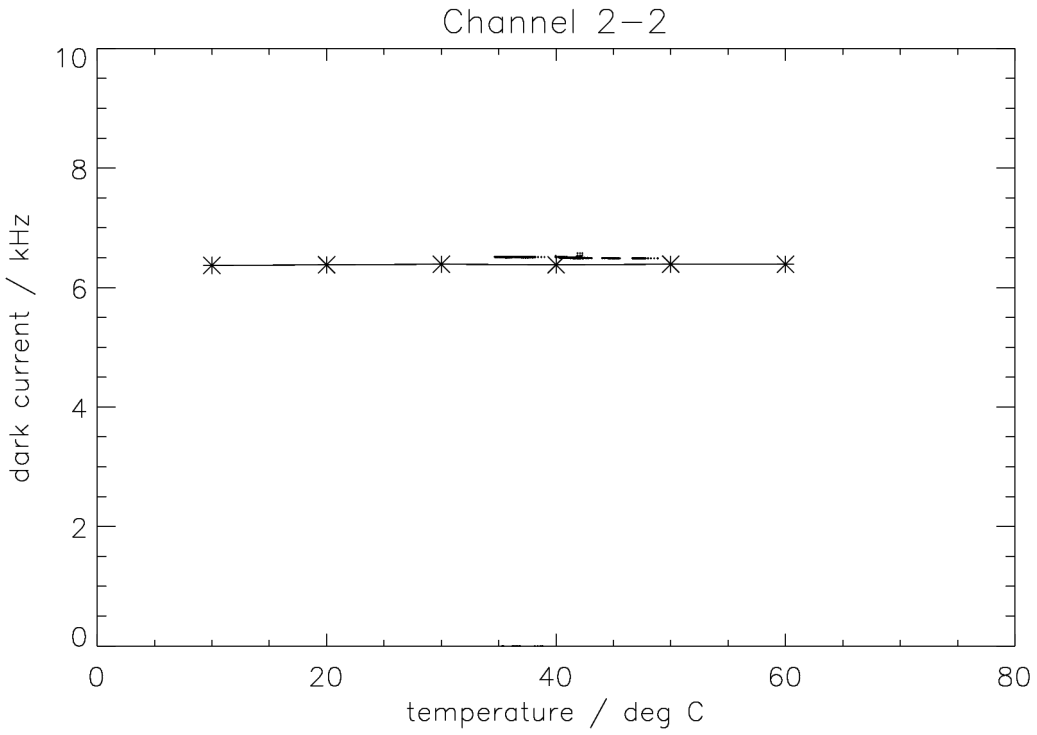
The following eight pages show first the (updated) results for head 2, channels 2-1, 2-2, 2-3, 2-4, and then the (new) results for head 3, channels 3-1, 3-2, 3-3, 3-4. The upper image on each page shows an overview, the lower image shows the situation more detailed.

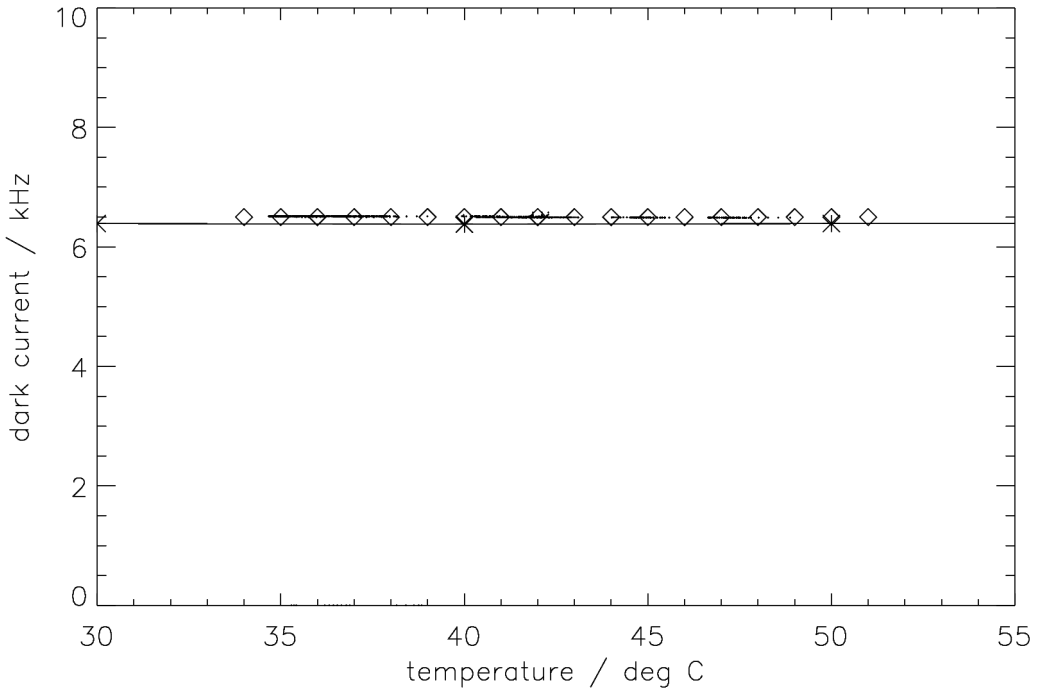
Again, the asterisks denote the values measured in the thermal-vacuum test of 29 Jun 2009, the diamonds denote the values that were selected to substitute the old ones in order to estimate the dark currents from the temperatures as measured (small dots).

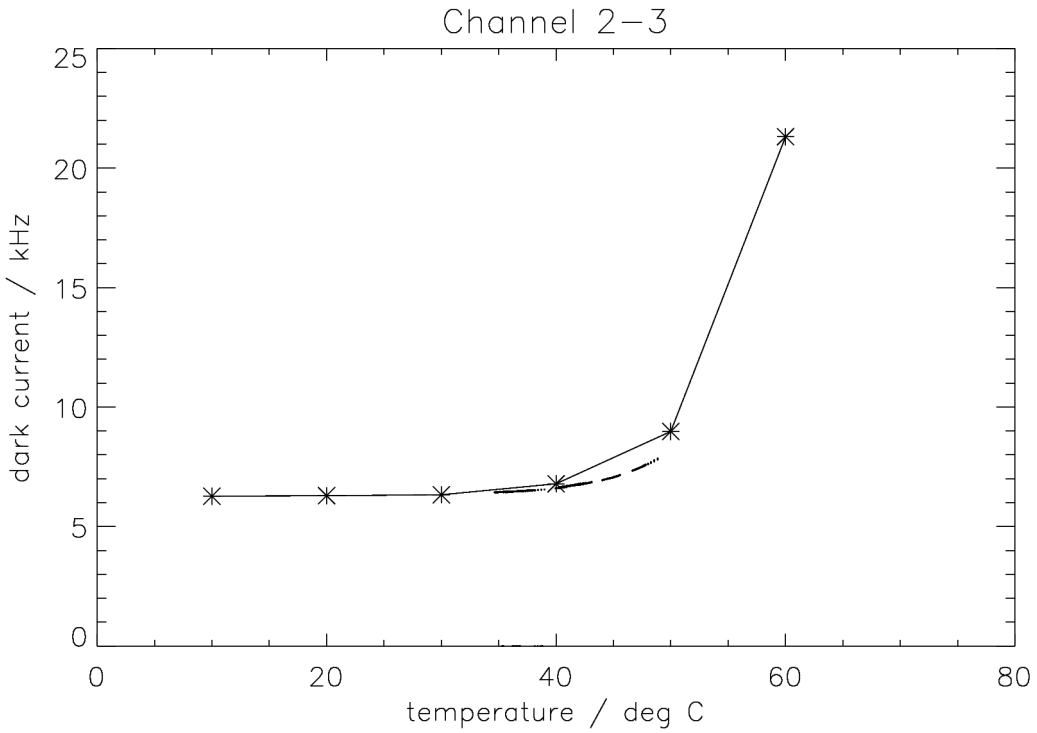
As observed in the earlier report, the dark currents of channels 2-1, 2-3, and 2-4, as well as now channel 3-1 ,were slightly overestimated in the lab tests. The other measurements could be almost exactly confirmed. Especially it could be confirmed that the dark currents of channels 3-3 and 3-4 indeed ***decrease*** with rising temperature.

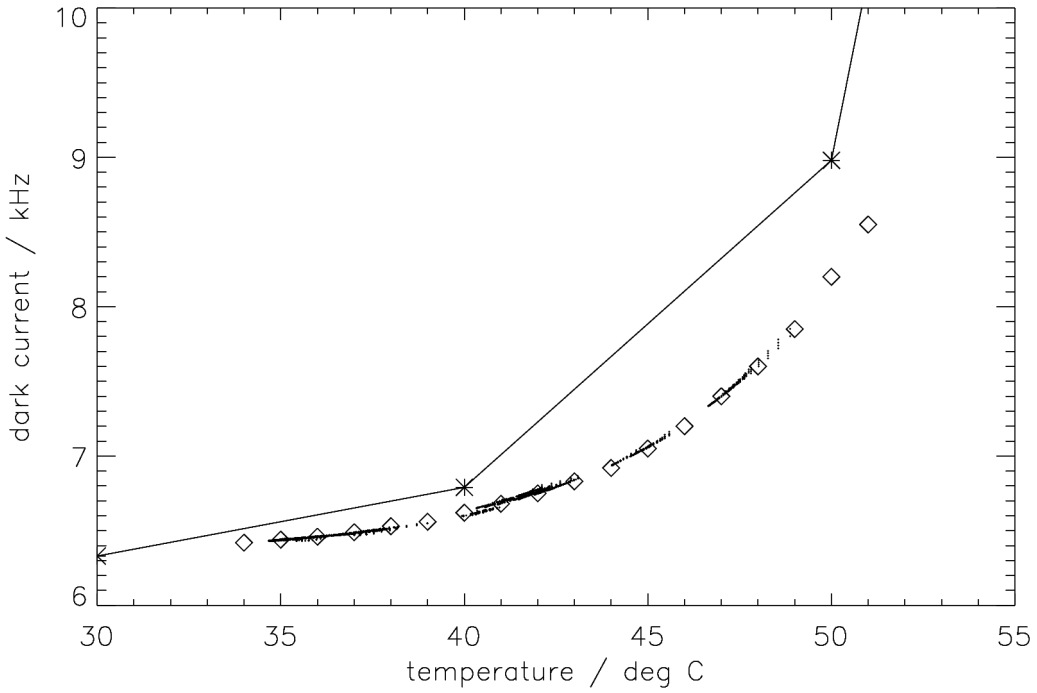

Channel 2−1
dark current / kHz
temperature / deg C
0
50
100
150
200
0
20
40
60
80

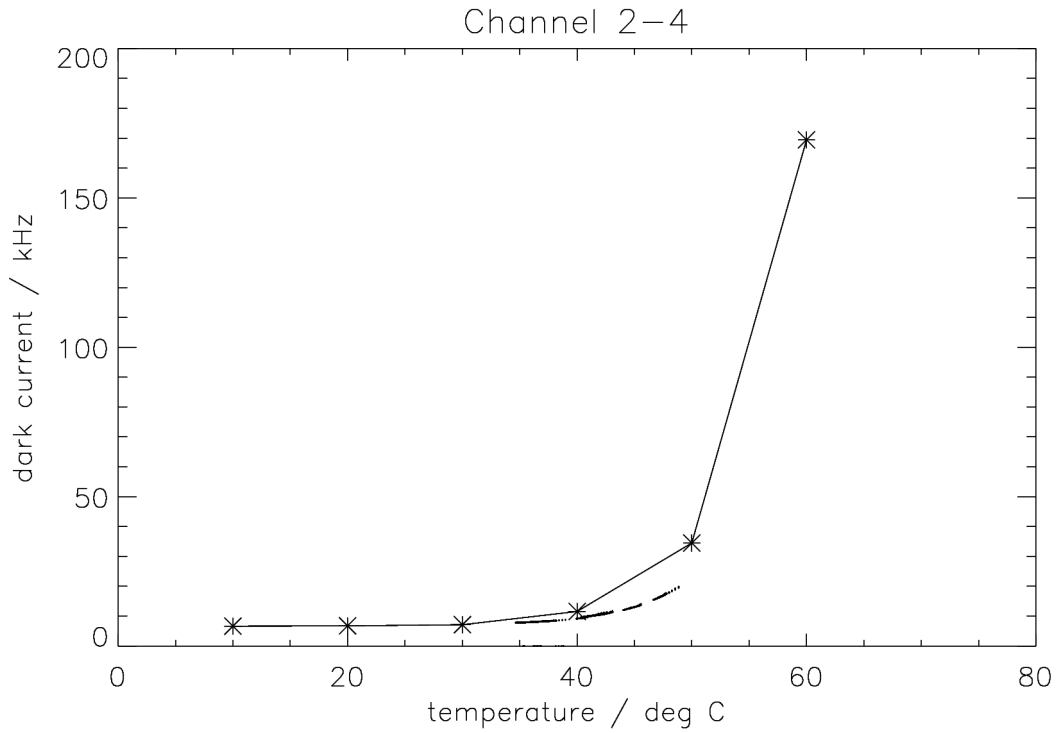

dark current / kHz
temperature / deg C
0
10
20
30
40
30
35
40
45
50
55

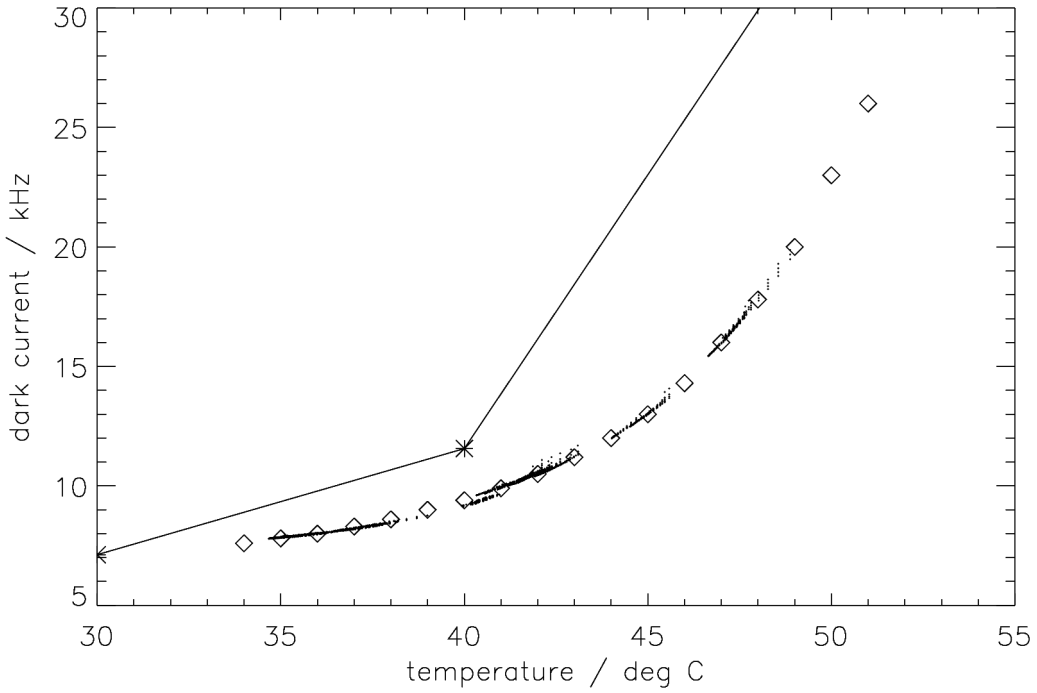

Channel 2−2
dark current / kHz
temperature / deg C
0
2
4
6
8
10
0
20
40
60
80

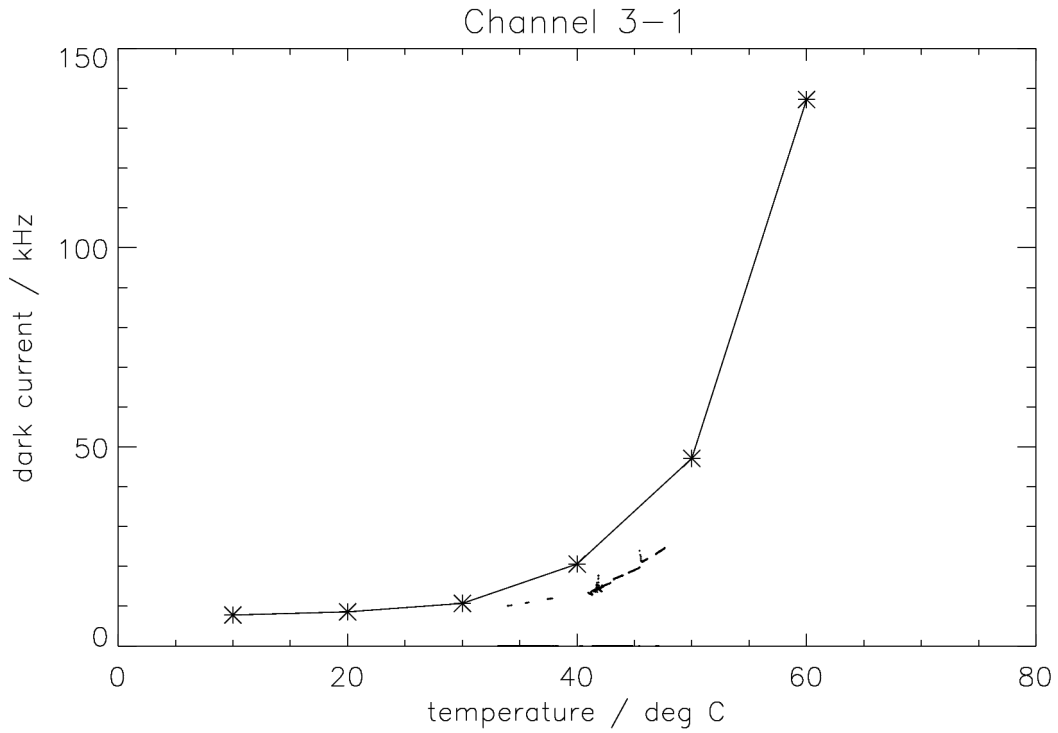

dark current / kHz
temperature / deg C
0
2
4
6
8
10
30
35
40
45
50
55

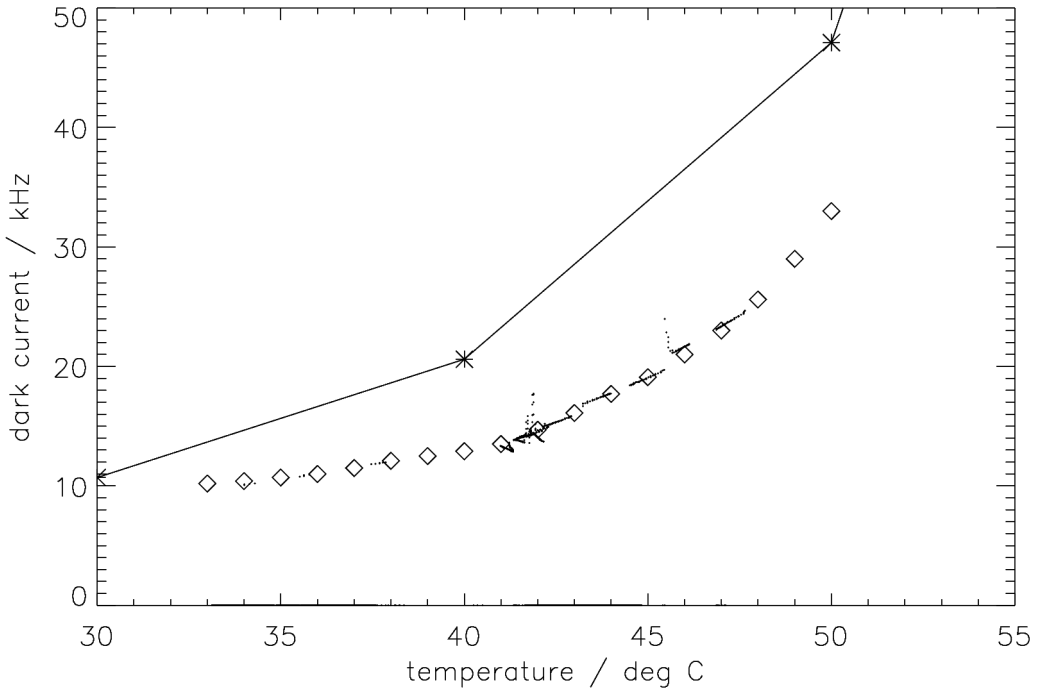

Channel 2−3
dark current / kHz
temperature / deg C
0
5
10
15
20
25
0
20
40
60
80

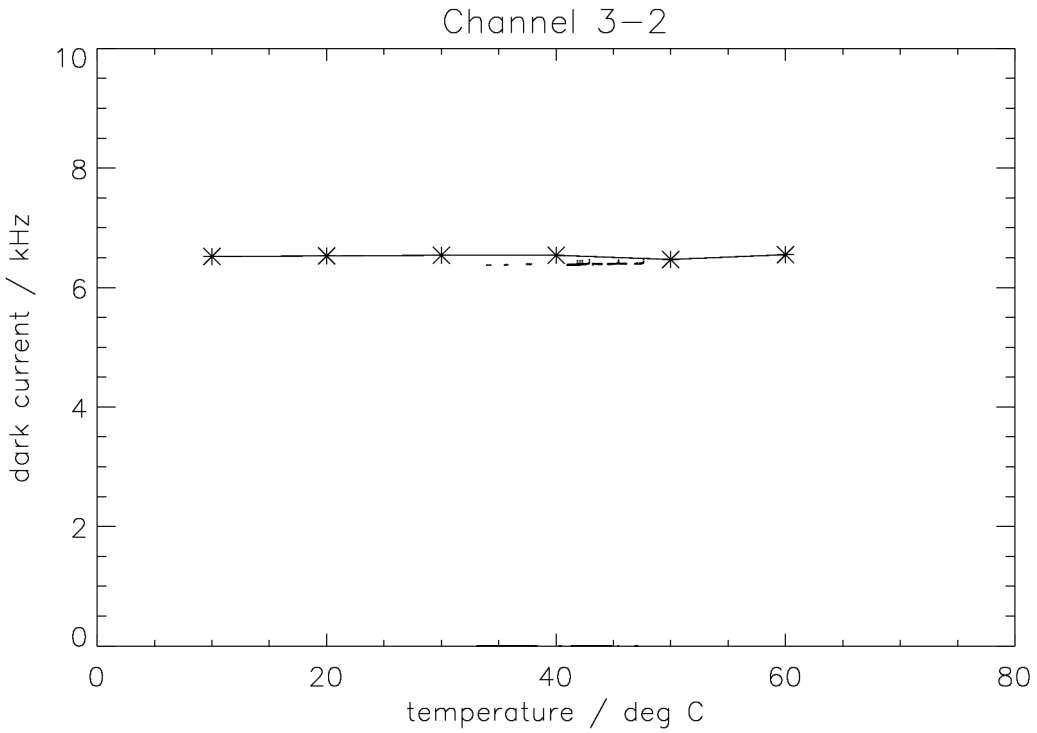

dark current / kHz
temperature / deg C
6
7
8
9
10
30
35
40
45
50
55

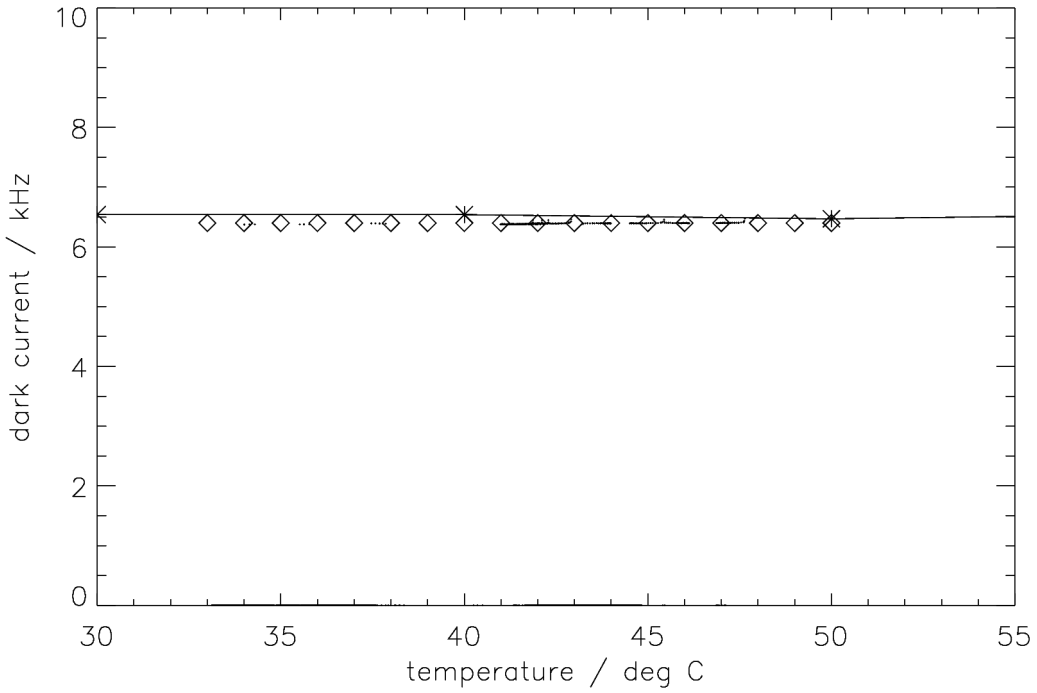

Channel 2−4
dark current / kHz
temperature / deg C
0
50
100
150
200
0
20
40
60
80

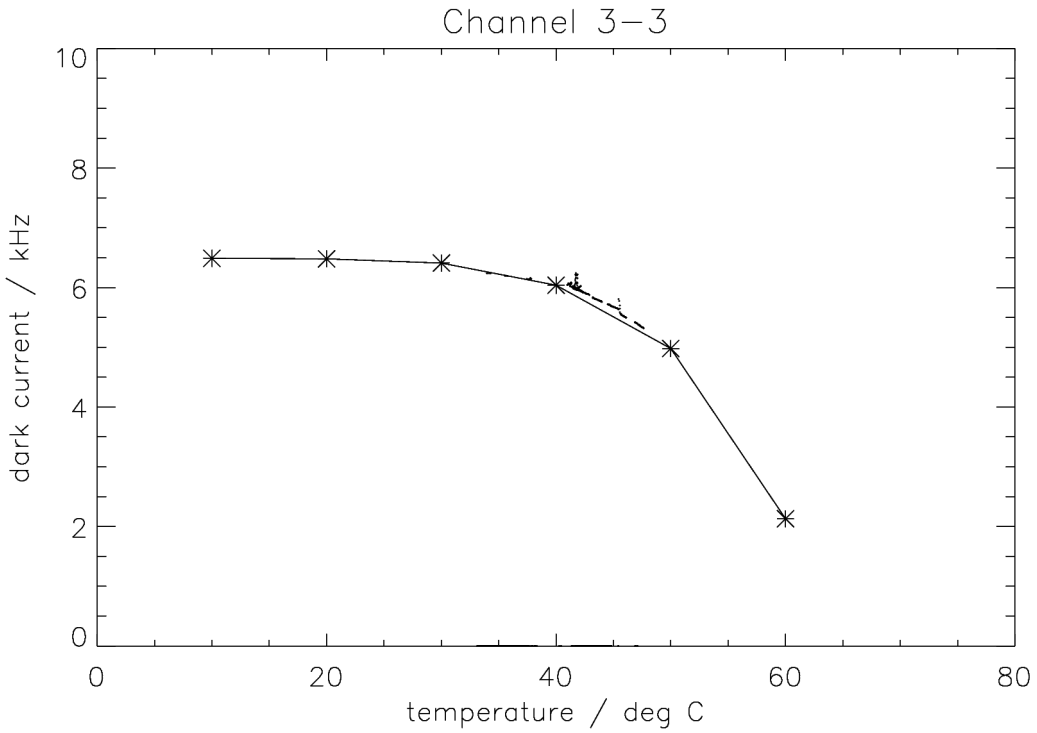

dark current / kHz
temperature / deg C
5
10
15
20
25
30
30
35
40
45
50
55

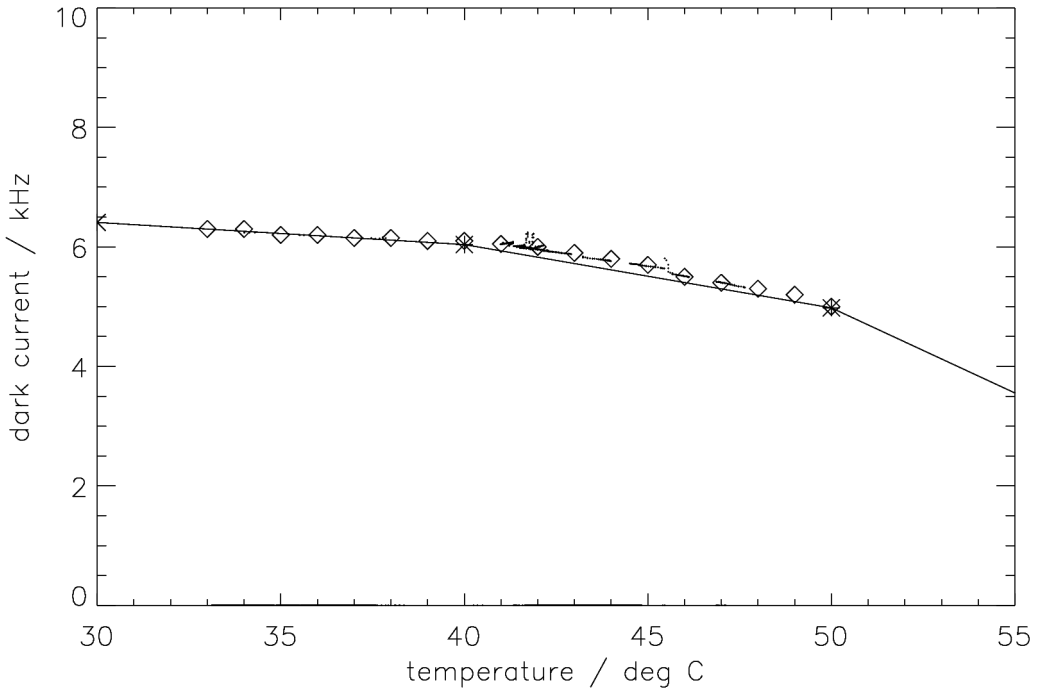

Channel 3−1
dark current / kHz
temperature / deg C
0
50
100
150
0
20
40
60
80

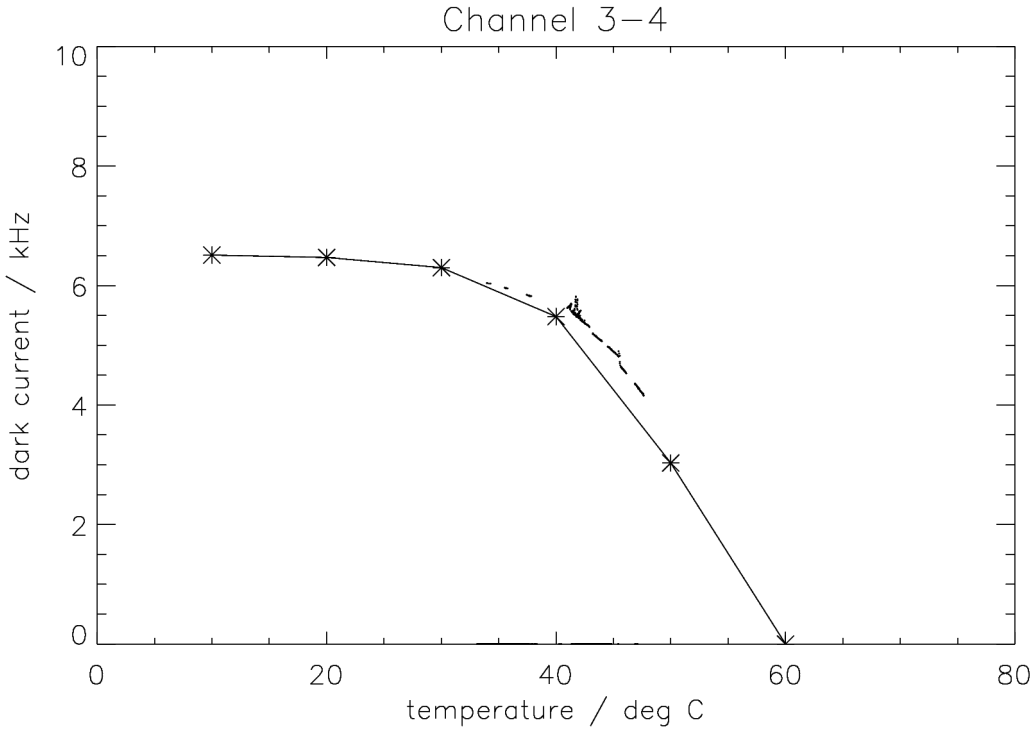

dark current / kHz
temperature / deg C
0
10
20
30
40
50
30
35
40
45
50
55

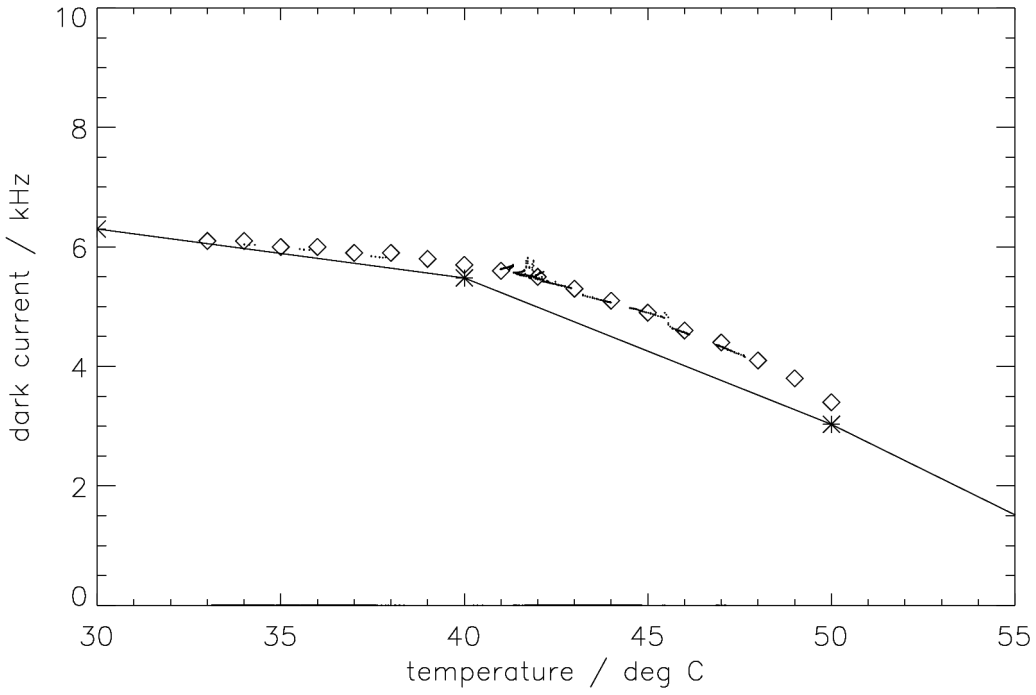

Channel 3−2
dark current / kHz
temperature / deg C
0
2
4
6
8
10
0
20
40
60
80


dark current / kHz
temperature / deg C
0
2
4
6
8
10
30
35
40
45
50
55


Channel 3−3
dark current / kHz
temperature / deg C
0
2
4
6
8
10
0
20
40
60
80


dark current / kHz
temperature / deg C
0
2
4
6
8
10
30
35
40
45
50
55


Channel 3−4
dark current / kHz
temperature / deg C
0
2
4
6
8
10
0
20
40
60
80


dark current / kHz
temperature / deg C
0
2
4
6
8
10
30
35
40
45
50
55

LYRA Dark Currents

IED 18 Oct 2010

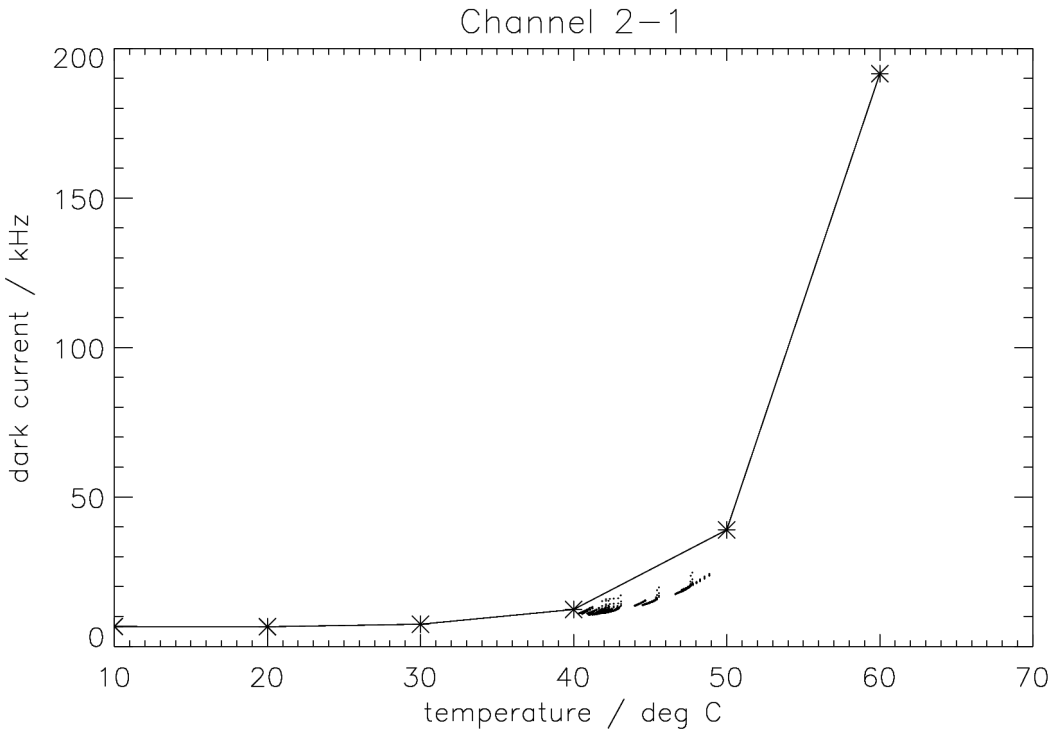
The task is to solve the problem of estimating the dark currents from the temperatures, at least for Head2. (Maybe I was the only one having a “problem” with this.) As a first approach, I took the values measured in the lab during the "Functional Tests Thermal Vacuum", see here:
http://solwww.oma.be/users/dammasch/FT_TV_General.xls
I simply took the values from the second table, temperature vs. dark currents in kHz. For low temperature values, like in Dec 2009 and Jan 2010, this worked fine. For the values after April (above 40 deg C) I had my difficulties, especially for high temperature above 45 or even 50 degrees, I had to use a different correction formula for almost each day. This obviously could not be the way.

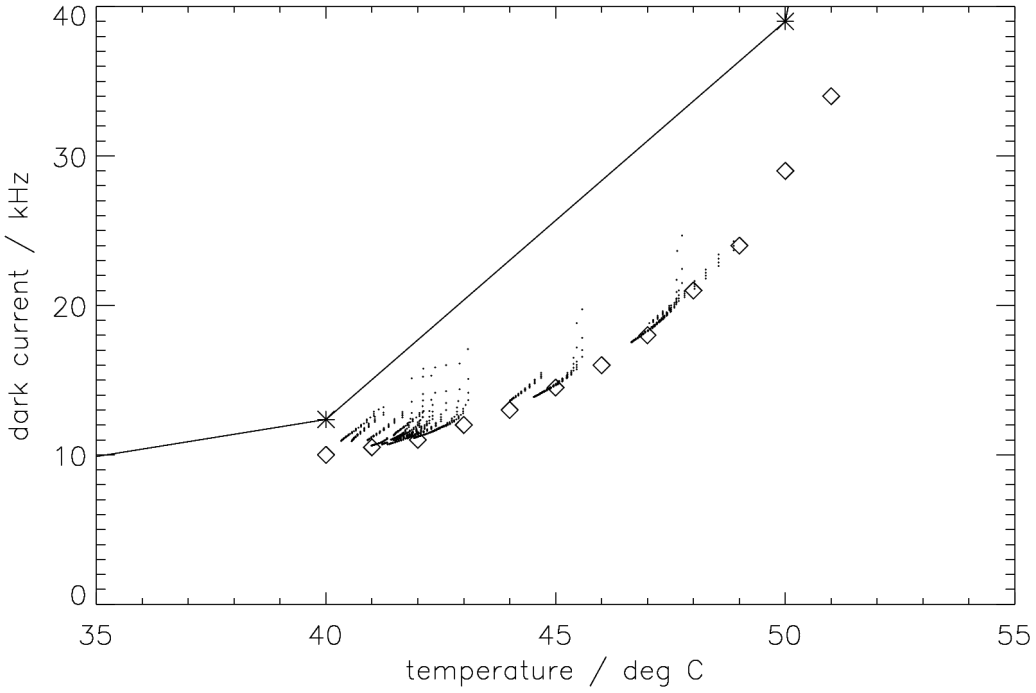
My first mistake was that I used a linear interpolation between 40 and 50 degrees. As you can see in the first images of the attached report (see below), the relationship between temperature and dark currents is not at all linear between 40 and 50 degrees, quite the opposite, this is probably the interval where it is the most nonlinear.

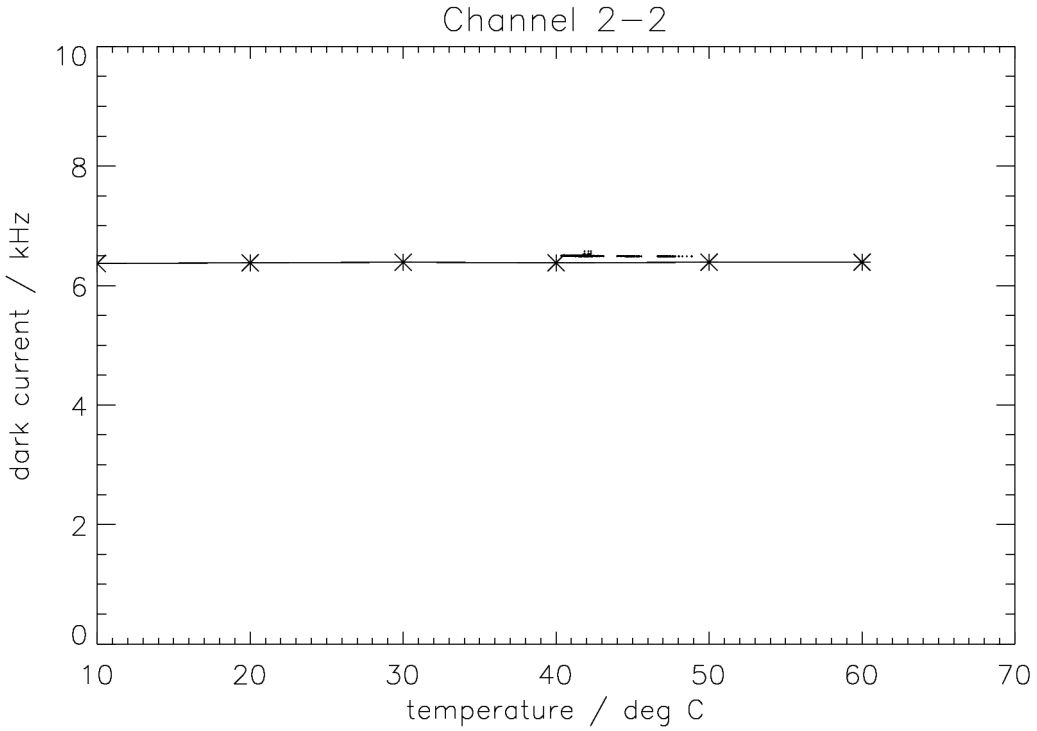
So I collected data from calibration tests: 26 May, 23 Jun, 14 Jul, 11 Aug, 29 Sep, 14 Oct 2010. These tests cover temperatures between 40 and 49 degrees. The results can be seen on the first four pages (see below): The upper image shows the overall situation of a channel, the straight line connects the values from the FT_TV lab. The dots are the dark current measurements from the calibration tests. The lower image shows the specific situation between 40 and 50 degrees. The diamonds are the values that I selected (manually) for the interpolation. This means, I kept the lab measurements for all values below 30 degrees and for the last one at 60 degrees. For the temperatures 40, 41, 42, ..., 49, 50, 51 degrees, I inserted the new points (the 50 and 51 points being guesses that coincide with the observed fluctuations on days where 50-51 degrees are actually reached). Obviously, the dark currents for ch2-1, ch2-3, ch2-4 were slightly over-estimated in the FT_TV lab.

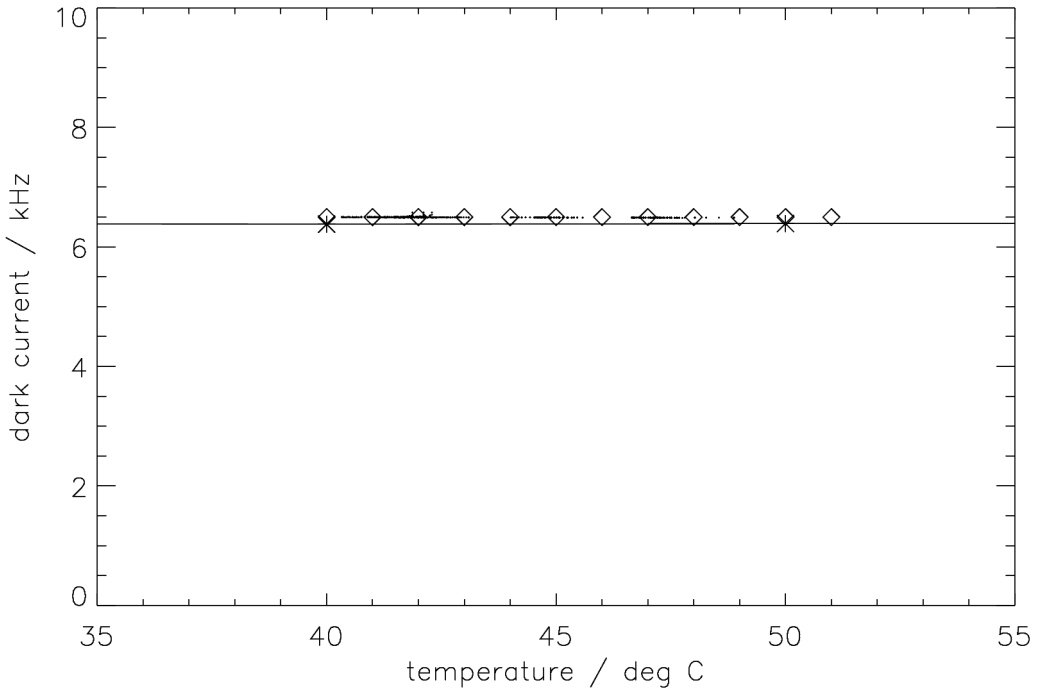
The results show that this works well. The next two images (see below) show as an example the day 17 Oct 2010 before/after subtraction of dark currents as estimated from the temperatures in the metadata FITS file. The main difference is the vanishing sinus and other temperature effects in channel 2-1. The other effects are not so obvious, but on other days they are.

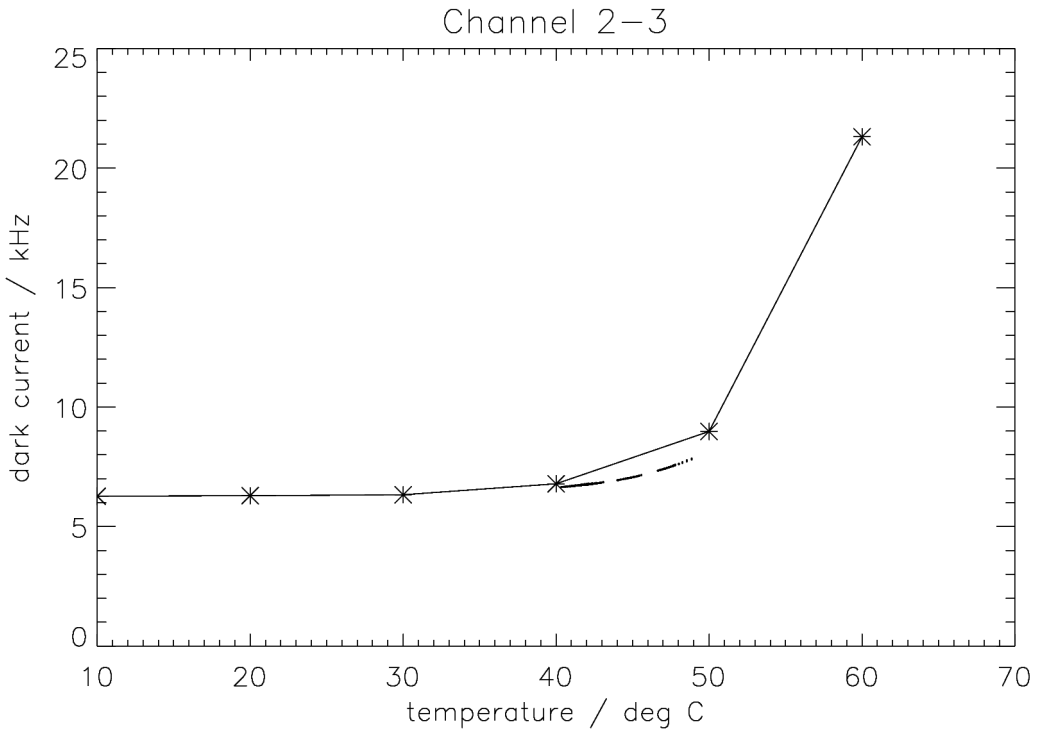
The last two images show the month of October before/after dark current subtraction. As you can see, the bump around the 12-15 Oct is gone.

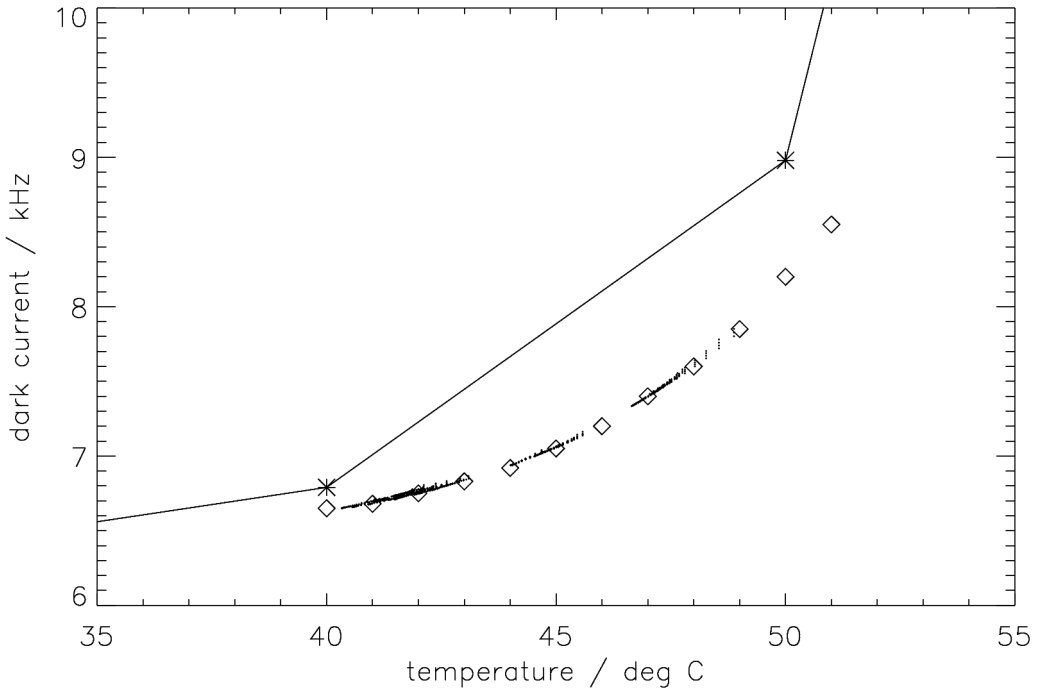

Channel 2−1
dark current / kHz
temperature / deg C
0
50
100
150
200
10
20
30
40
50
60
70

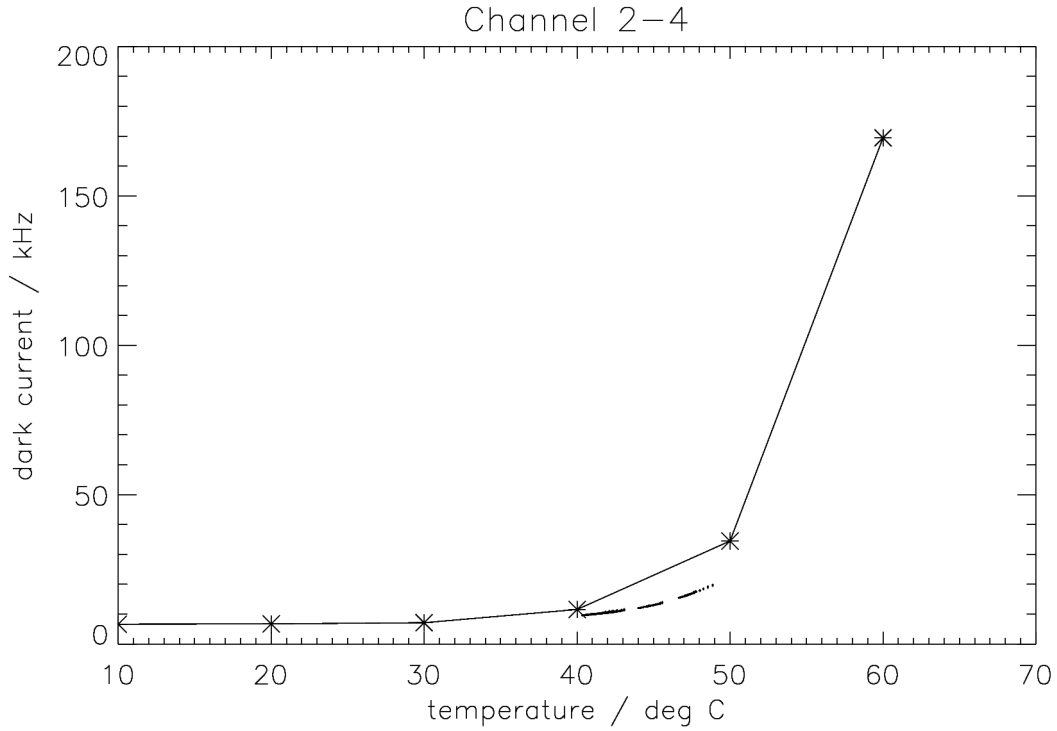

dark current / kHz
temperature / deg C
0
10
20
30
40
35
40
45
50
55

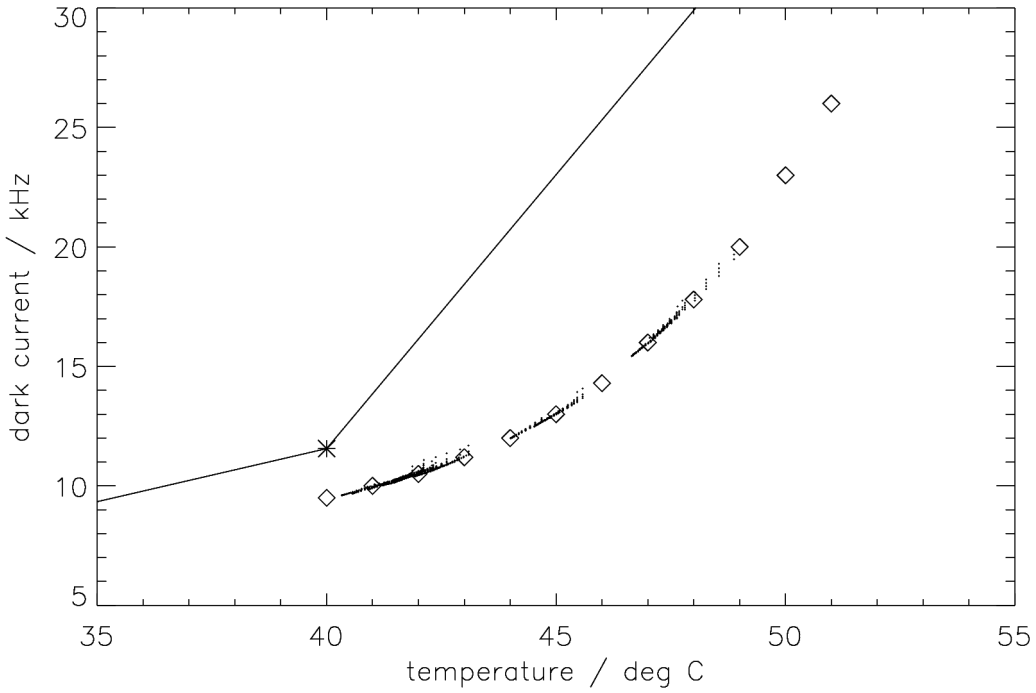

Channel 2−2
dark current / kHz
temperature / deg C
0
2
4
6
8
10
10
20
30
40
50
60
70

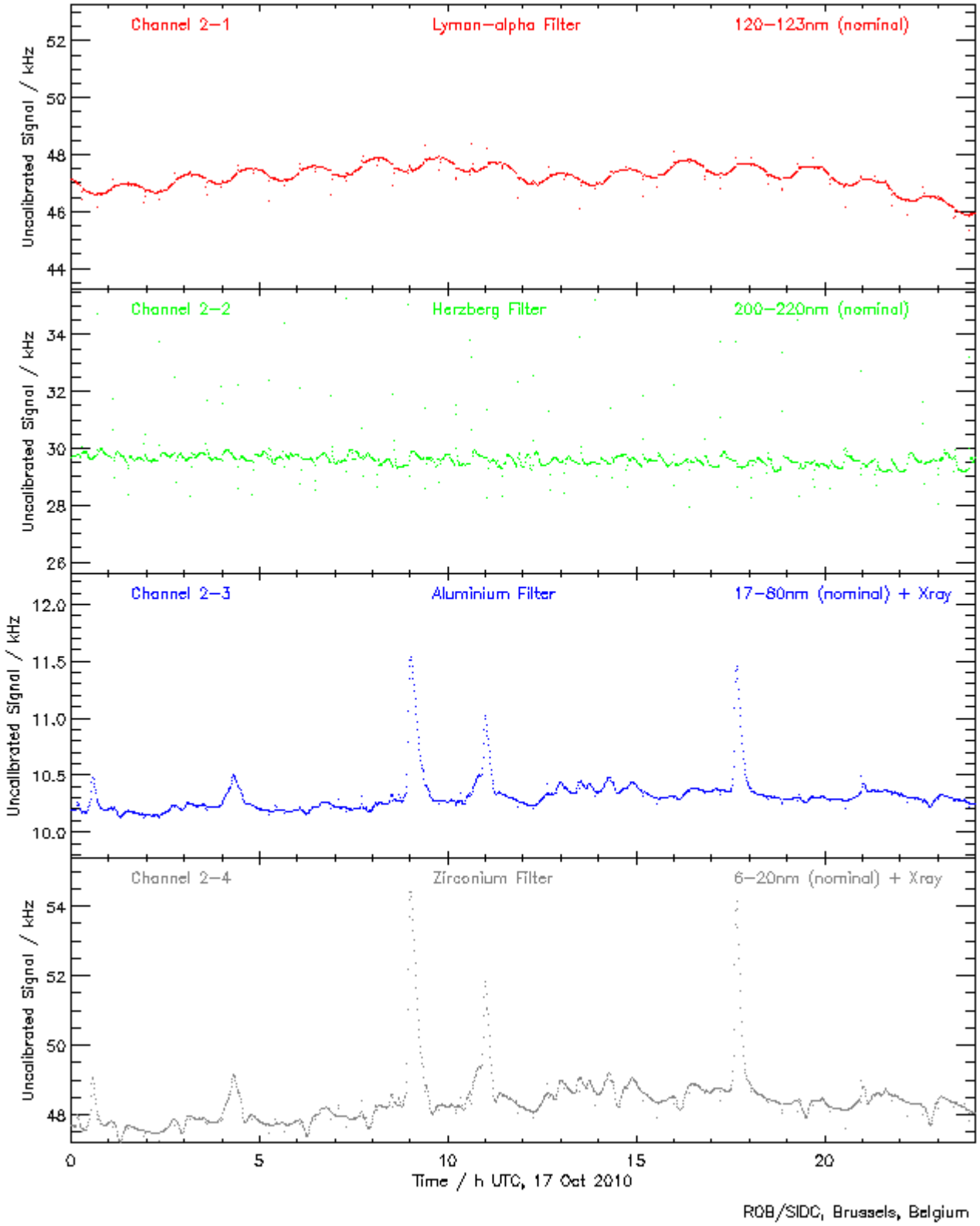

dark current / kHz
temperature / deg C
0
2
4
6
8
10
35
40
45
50
55


Channel 2−3
dark current / kHz
temperature / deg C
0
5
10
15
20
25
10
20
30
40
50
60
70

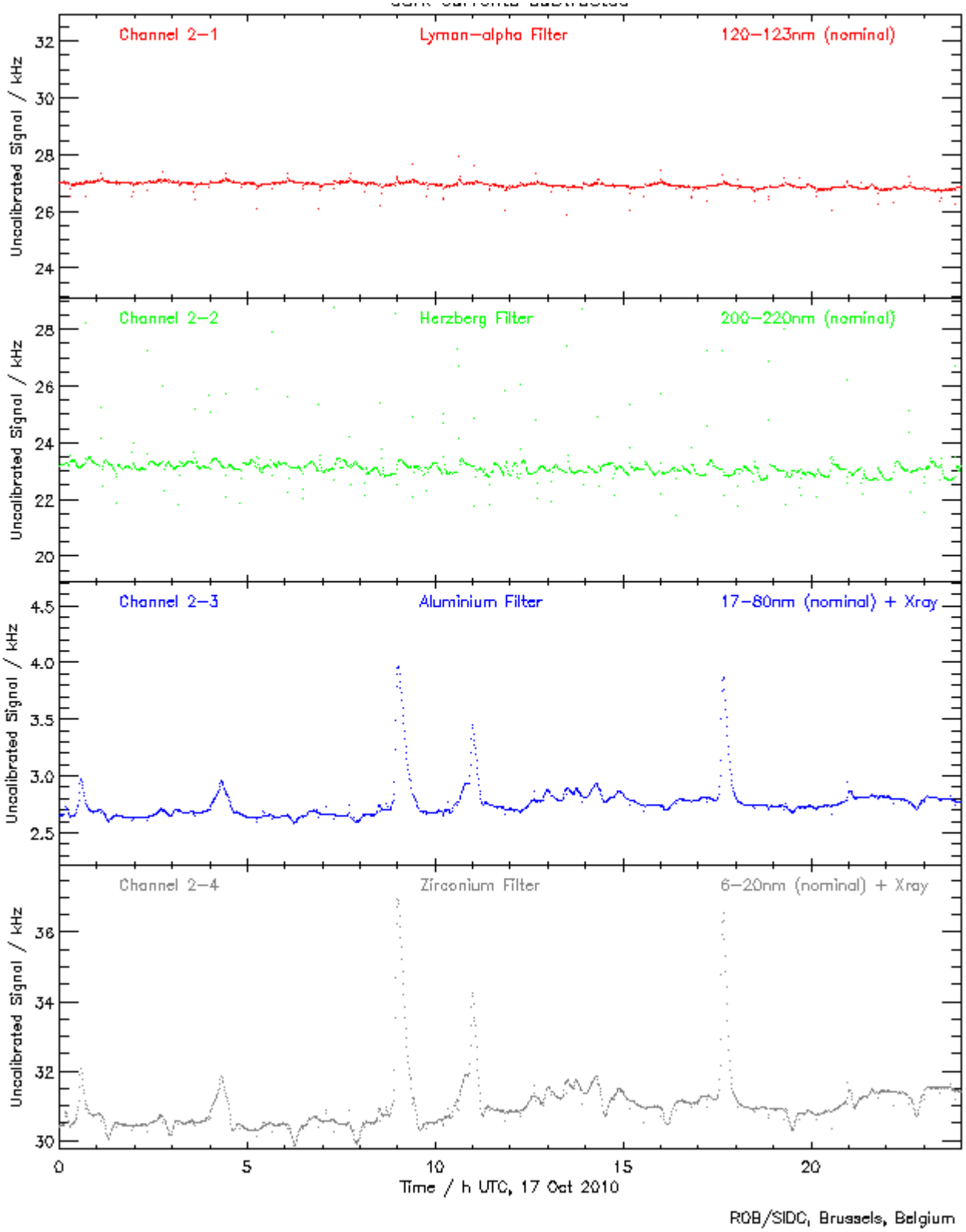

dark current / kHz
temperature / deg C
6
7
8
9
10
35
40
45
50
55

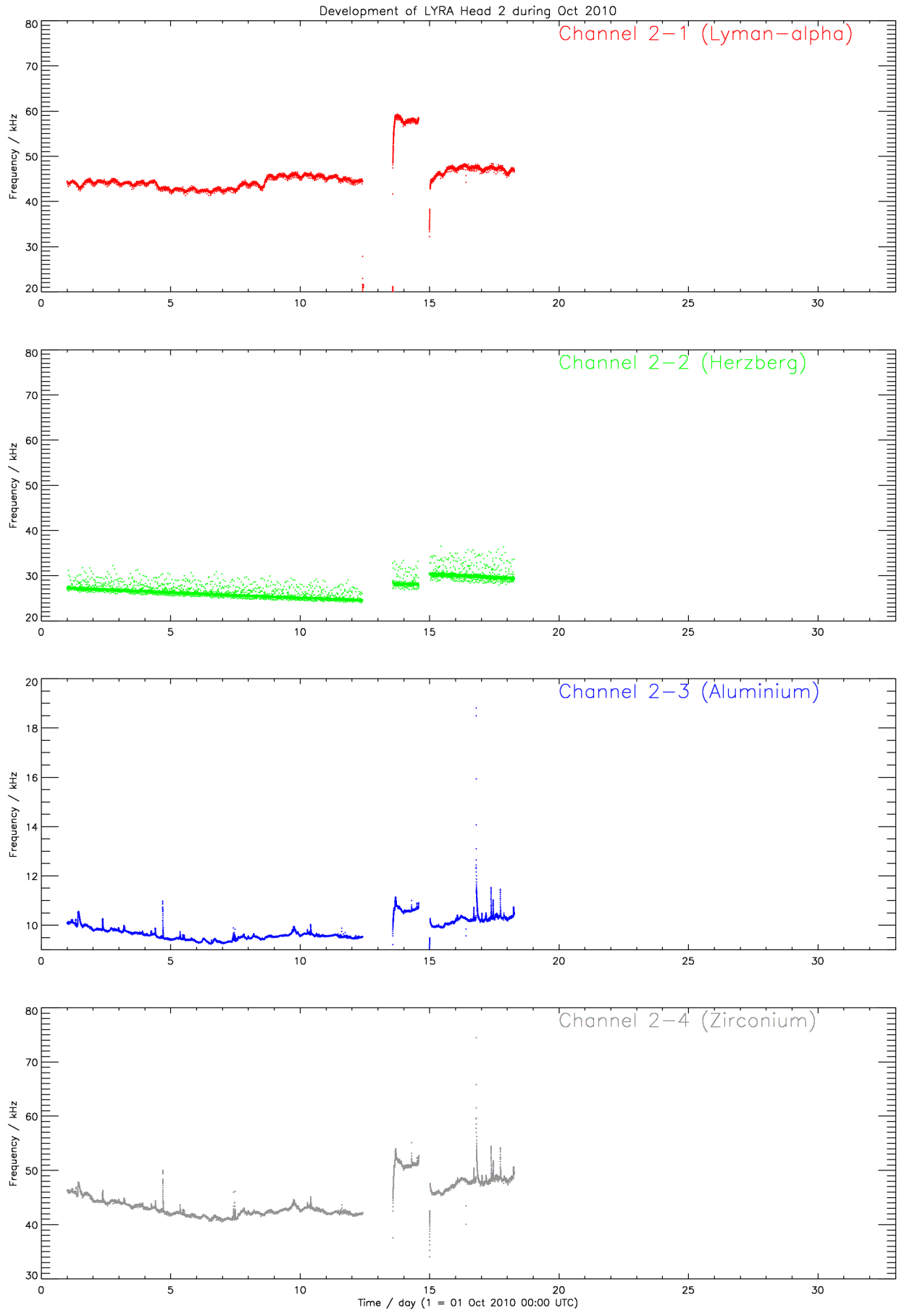

Channel 2−4
dark current / kHz
temperature / deg C
0
50
100
150
200
10
20
30
40
50
60
70

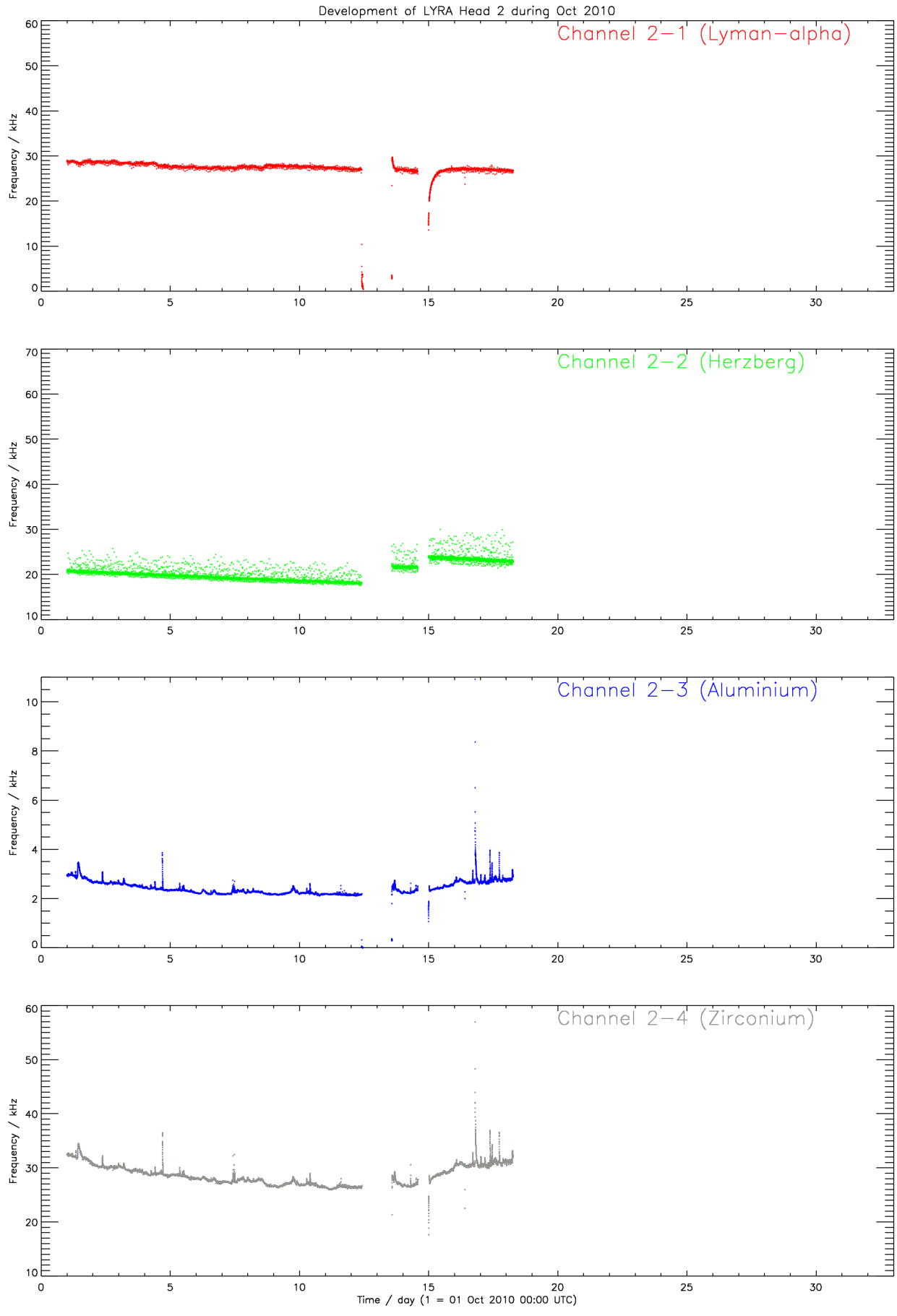

dark current / kHz
temperature / deg C
5
10
15
20
25
30
35
40
45
50
55



ROB/SIDC, Brussels, Belgium


Channel 2–1
Lyman–alpha Filter
120–123nm (nominal)
Channel 2–2
Herzberg Filter
200–220nm (nominal)
Channel 2–3
Aluminium Filter
17–80nm (nominal) + Xray
Channel 2–4
Zirconium Filter
6–20nm (nominal) + Xray
Uncalibrated Signal / kHz
Time / h UTC, 17 Oct 2010
ROB/SIDC, Brussels, Belgium


Development of LYRA Head 2 during Oct 2010
Channel 2-1 (Lyman-alpha)
Channel 2-2 (Herzberg)
Channel 2-3 (Aluminium)
Channel 2-4 (Zirconium)
Frequency / kHz
Time / day (1 = 01 Oct 2010 00:00 UTC)


Development of LYRA Head 2 during Oct 2010
Channel 2-1 (Lyman-alpha)
Channel 2-2 (Herzberg)
Channel 2-3 (Aluminium)
Channel 2-4 (Zirconium)
Frequency / kHz
Time / day (1 = 01 Oct 2010 00:00 UTC)