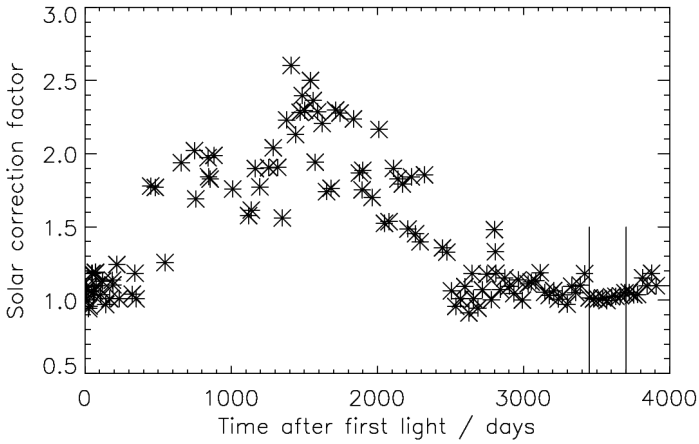
LYRA degradation status after ~ 4000 days

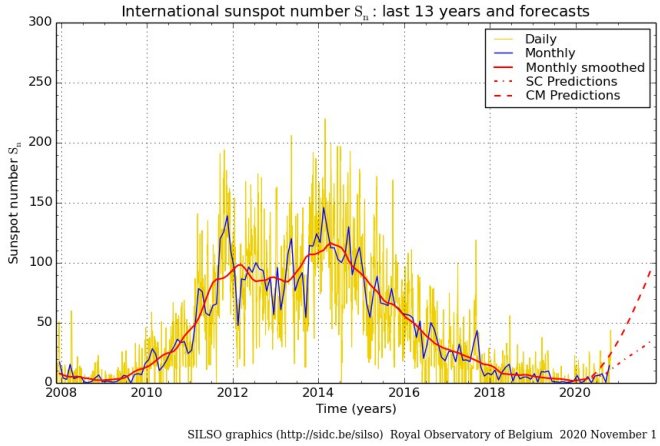
IED 24 Nov 2020

This report is based on an earlier report, some explanation can be found there:
  http://solwww.oma.be/users/dammasch/IED_20180223_LyraStatus3000.pdf
In addition, this report uses the calibration campaigns performed between Mar 2018 and Sep 2020.

The values are based on the latest update of the dark currents, see here:
  http://solwww.oma.be/users/dammasch/IED_20200218_DarkCurrents.pdf

The short-wavelength channels (ch*-3, “Aluminium”, and ch*-4, “Zirconium”) are corrected for solar activity in order to estimate their degradation:
  factor = observed ch1-4 / theoretical ch1-4
This factor is obviously correlated with the sunspot number. Its minimum period, between day #3450 (mid Jun 2019) and day #3700 (mid/end Feb 2020), see vertical bars, is consistent with SILSO's starting point of the new solar cycle in Dec 2019.





Day #1 is in Jan 2010, day #4000 is in Dec 2020. The current estimated degradation status is as follows (values before and after are in counts/ms, percentages describe what is left from the original signal at First Light):

ch1-1	1300.0	->	558.0	43%
ch1-2	613.4	->	296.4	48%
ch1-3	17.2	->	6.3	37%
ch1-4	30.3	->	17.8	59%
ch2-1	492.0	->	(2.5)	<1%
ch2-2	703.5	->	(1.5)	<1%
ch2-3	16.6	->	0.1	<1%
ch2-4	37.5	->	2.9	8%
ch3-1	920.0	->	494.8	54%
ch3-2	545.5	->	4.0	<1%
ch3-3	273.6	->	18.7	7%
ch3-4	30.0	->	11.6	39%

Some assumptions:

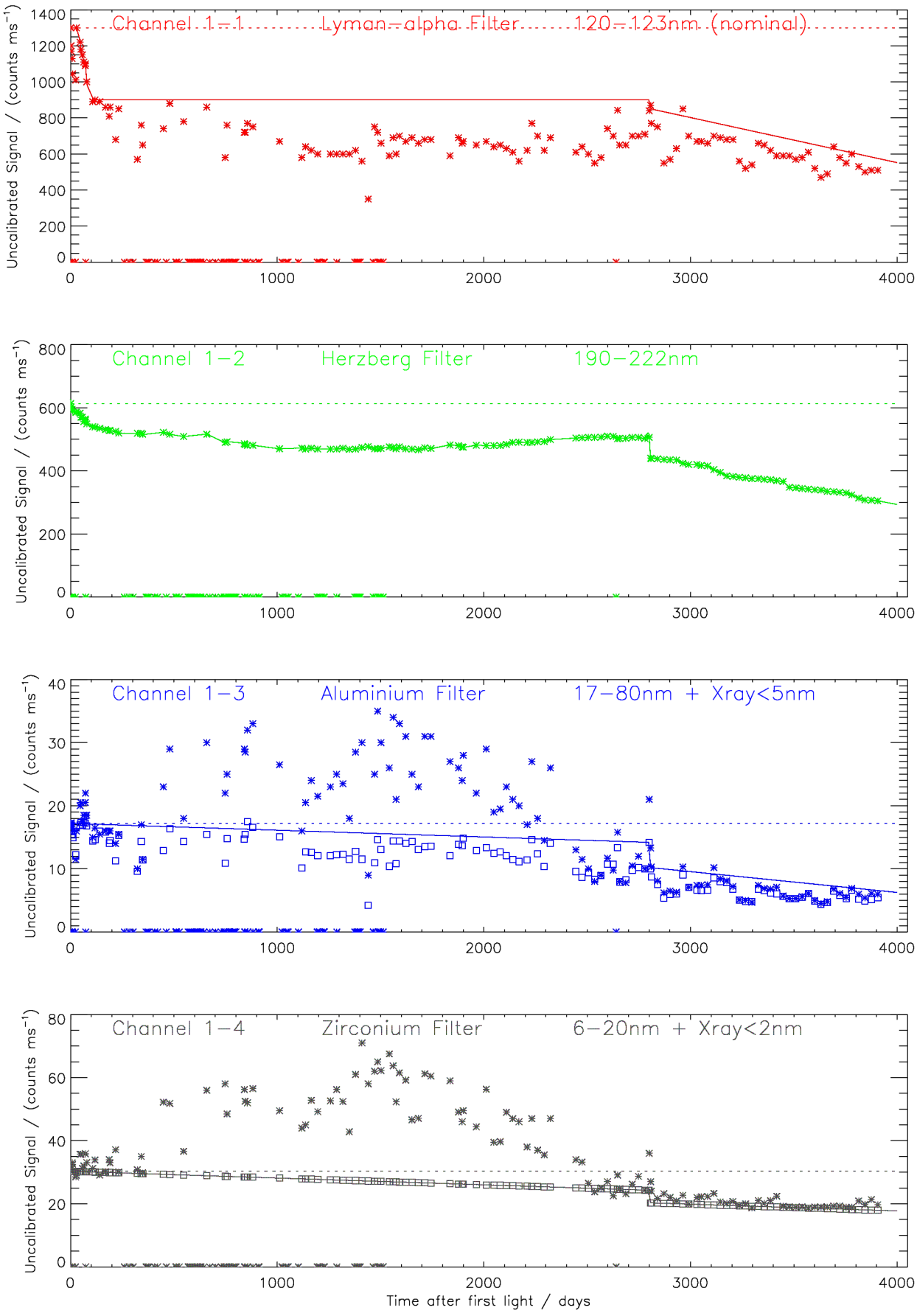
The channels of unit 1 are still degrading, the channels of unit 1 and unit 3 do not significantly degrade any more.

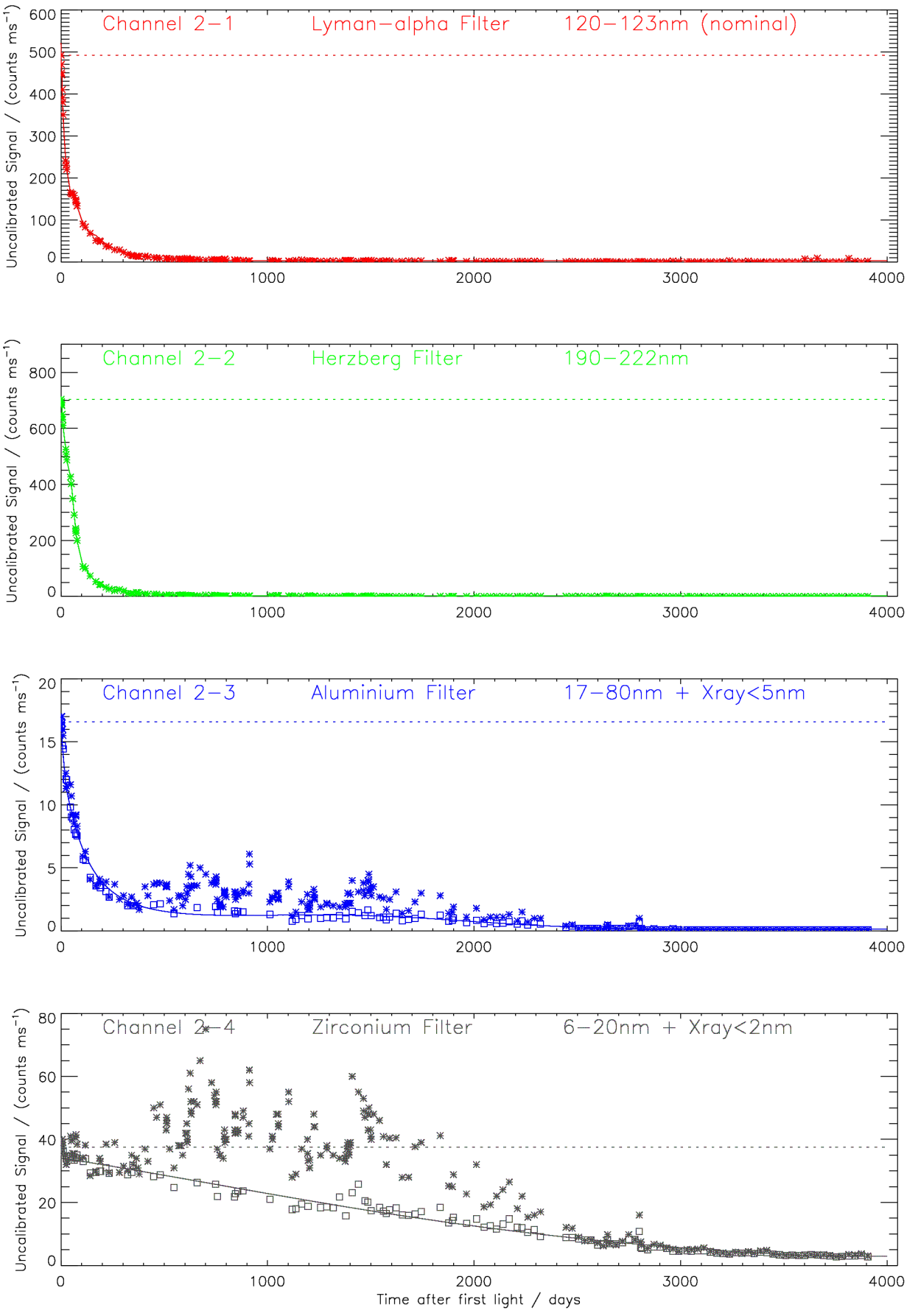
ch1-1: Steep decline in the first weeks, then practically constant until the week-long flare campaign in Sep 2017 (day #2800). Sudden drop due to this campaign, linear decline afterwards. Details hard to tell because of slow saturation, only long exposures taken into account.
ch1-2: Slow decline at first, diminishing later, with even partial recovery. Sudden drop in Sep 2017, linear decline afterwards.
ch1-3: Linear decline until Sep 2017, sudden drop, slightly faster linear decline afterwards. Details hard to tell because of slow saturation, only long exposures taken into account.
ch1-4: Linear decline until Sep 2017, sudden drop, same linear decline afterwards. This "theoretical" degradation is chosen such that the level of the solar correction factor is ~1.0 in begin-2010 as well as in end-2019.

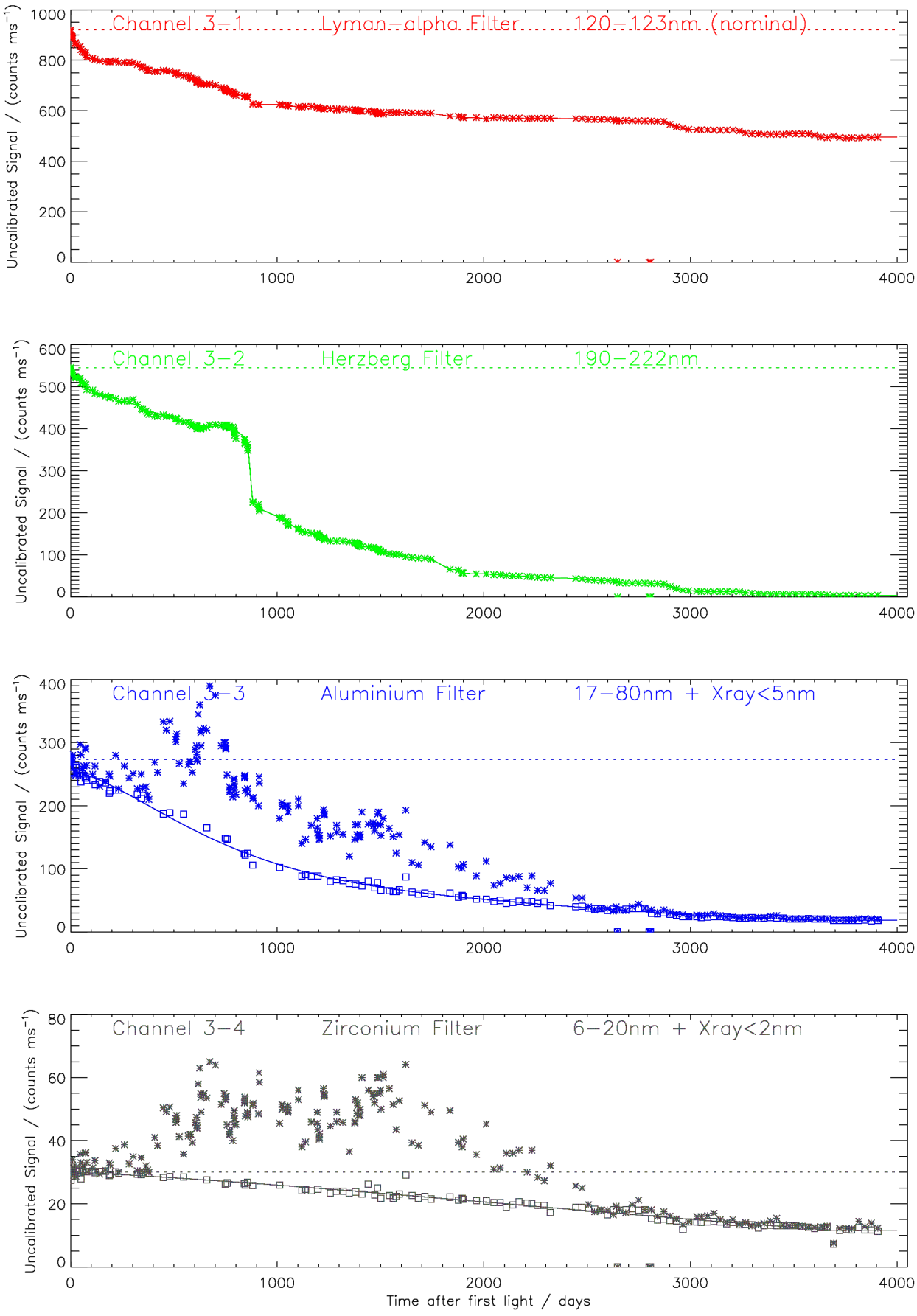
ch2-1: Steep decline in the first weeks, followed by a 5th-order polynomial, until reaching constant "zero" level (set to 2.5) around day #1000 (Oct 2012).
ch2-2: Steep decline in the first weeks, followed by a 5th-order polynomial, until reaching constant "zero" level (set to 1.5) around day #900 (Jun 2012).
ch2-3: Steep decline in the first days, followed by a 5th-order polynomial, until reaching constant "zero" level (0.1) around day #3000 (Mar 2018).
ch2-4: Steep decline in the first days, followed by a 2nd-order polynomial, until reaching constant minimum level above zero (2.9) around day #3700 (Feb 2020).

ch3-1: First faster, then slower decline, until reaching constant minimum level above zero (494.8), probably this high due to infrared influence outside nominal spectral interval, around now.
ch3-2: First faster, then slower decline, interrupted by a steep decline around day #860 (May 2012, due to open window), until reaching constant "zero" level (4.0) around now.
ch3-3: Steep decline in the first days, followed by a 5th-order polynomial, until reaching constant minimum level above zero (18.7) around day #3700 (Feb 2020).
ch3-4: Steep decline in the first days, followed by a 2nd-order polynomial, until reaching constant minimum level above zero (11.6) around day #3700 (Feb 2020).

Whether ch3-3 and especially ch3-4 really stopped degrading now, or just show a compensatory effect of degradation vs. regaining solar activity, has to be confirmed in the future.


Channel 1–1 Lyman–alpha Filter 120–123nm (nominal)
Channel 1–2 Herzberg Filter 190–222nm
Channel 1–3 Aluminium Filter 17–80nm + Xray<5nm
Channel 1–4 Zirconium Filter 6–20nm + Xray<2nm
Uncalibrated Signal / (counts ms^{-1})
Time after first light / days


Channel 2−1 Lyman−alpha Filter 120−123nm (nominal)
Channel 2−2 Herzberg Filter 190−222nm
Channel 2−3 Aluminium Filter 17−80nm + Xray<5nm
Channel 2−4 Zirconium Filter 6−20nm + Xray<2nm
Uncalibrated Signal / (counts ms^{-1})
Time after first light / days


Channel 3-1 Lyman-alpha Filter 120-123nm (nominal)
Channel 3-2 Herzberg Filter 190-222nm
Channel 3-3 Aluminium Filter 17-80nm + Xray<5nm
Channel 3-4 Zirconium Filter 6-20nm + Xray<2nm
Uncalibrated Signal / (counts ms^{-1})
Time after first light / days