LYRA

the **L**arge-**Y**ield **Ra**diometer onboard PROBA2

LYRA calibration considering the evolution of dark currents

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Inter-Calibration and Degradation of EUV Instruments
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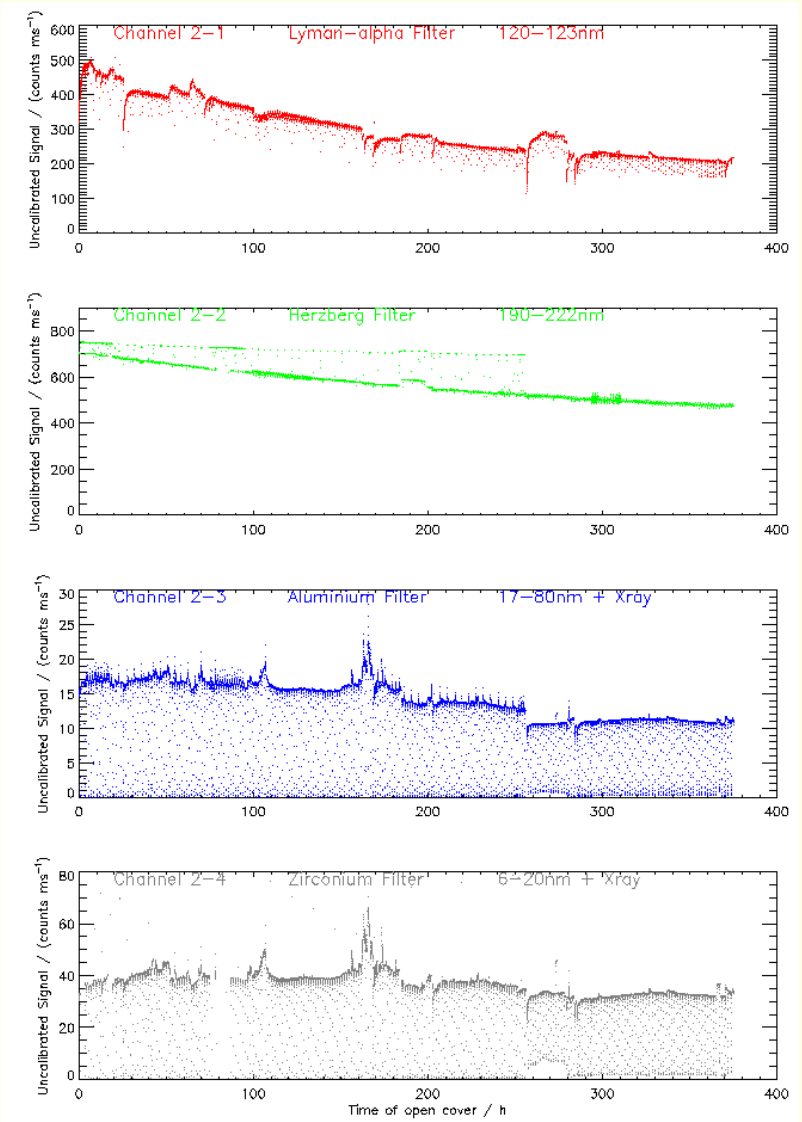
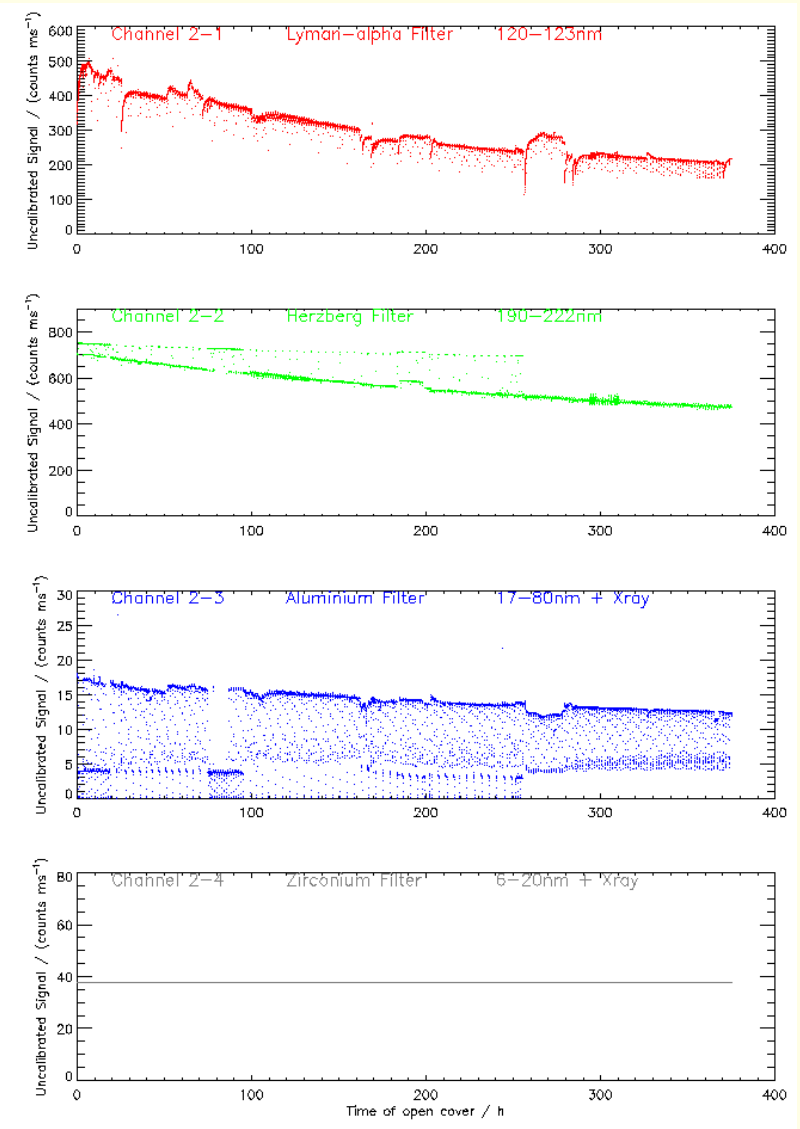
Calibration: How do we do it?

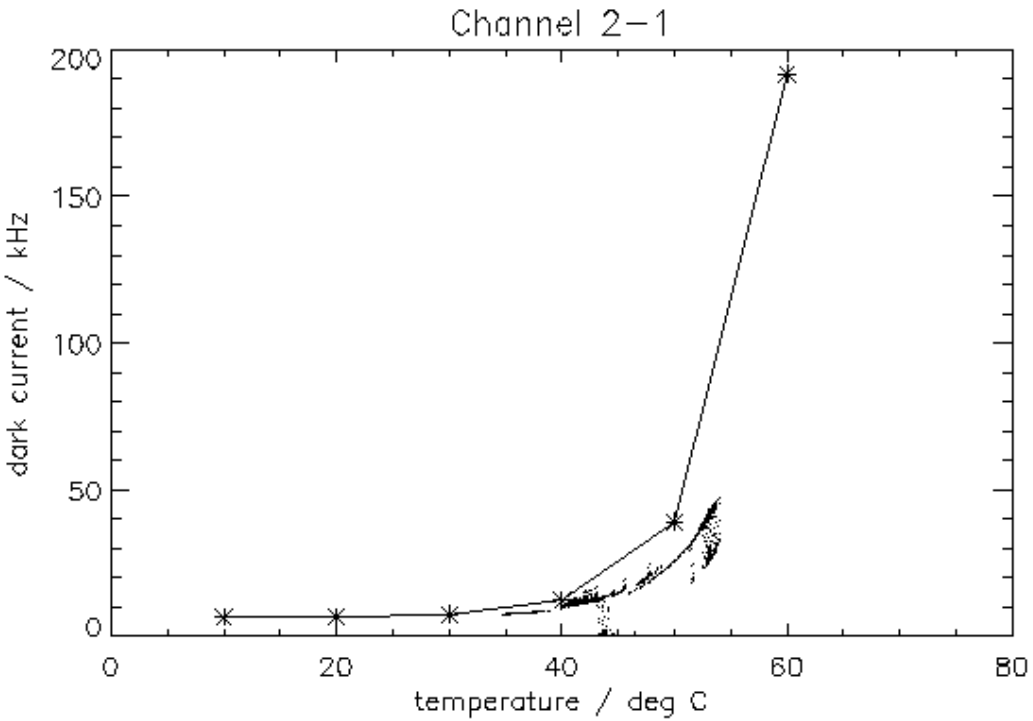
- Just as a reminder, here are some slides from an earlier presentation:

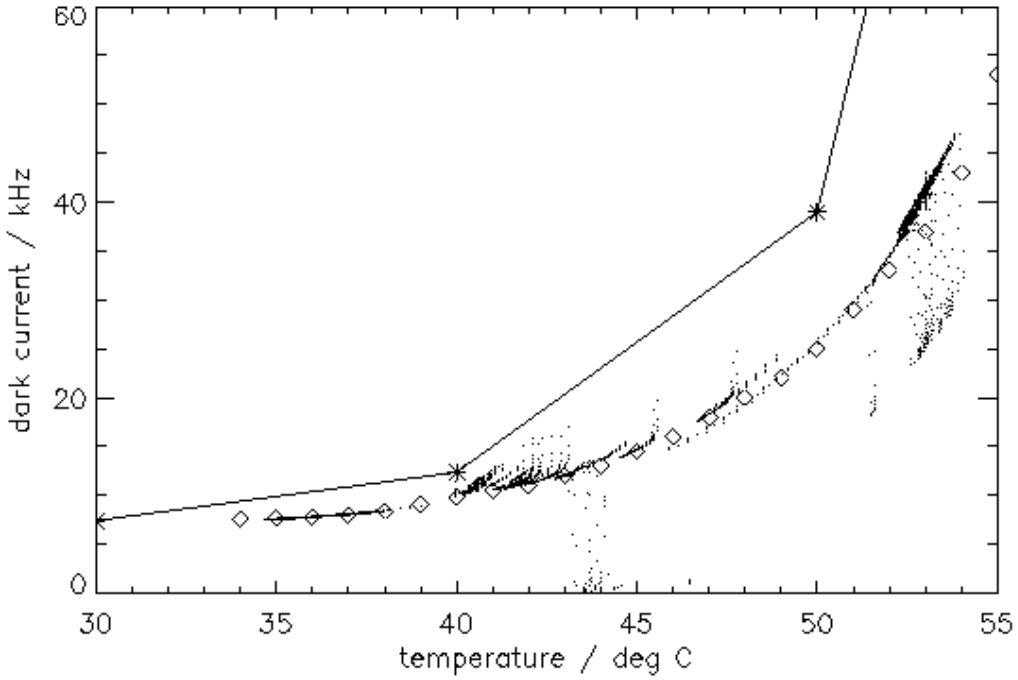
Start with “First Light”…



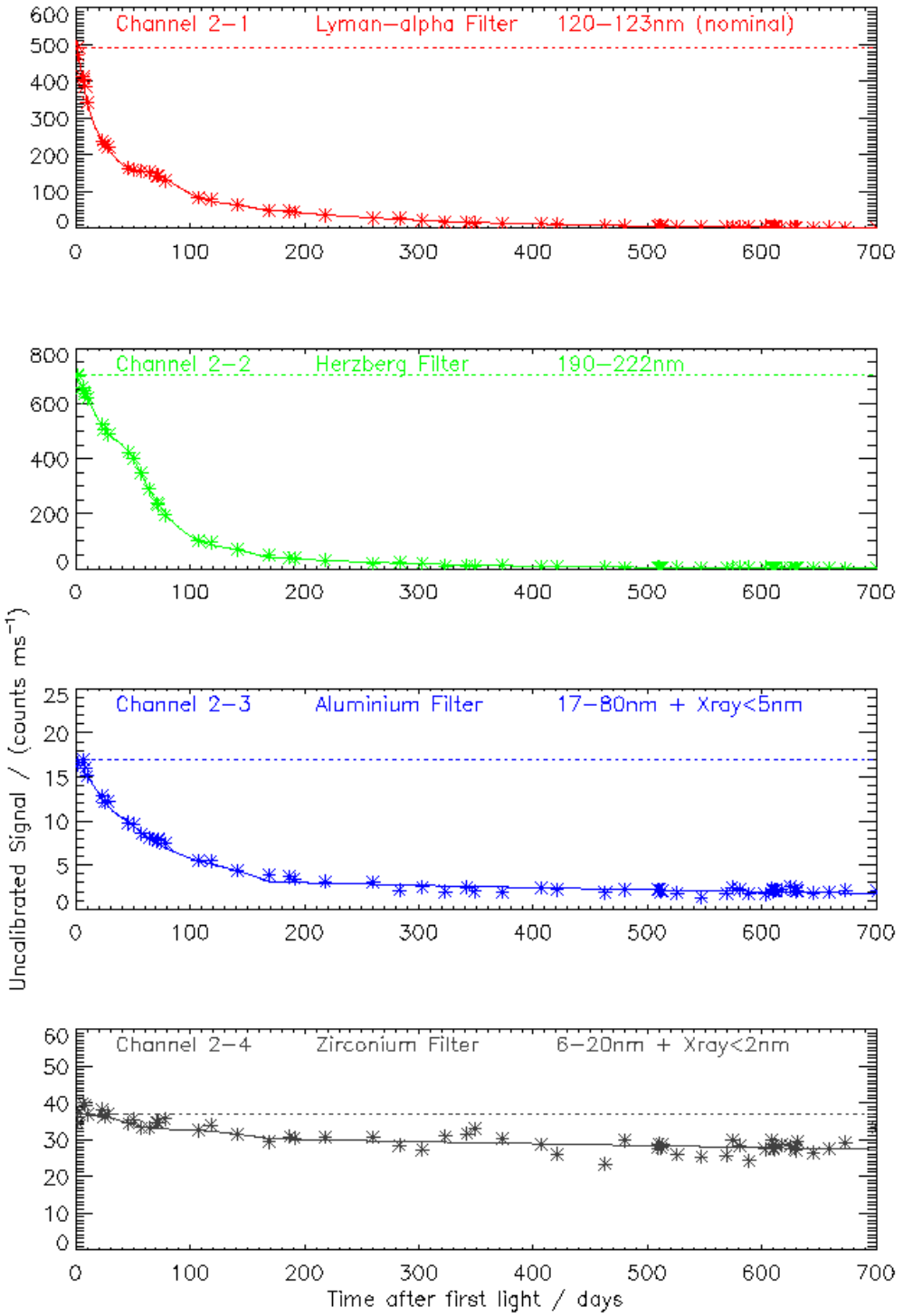


…estimate and subtract dark currents…





… fit the degradation …



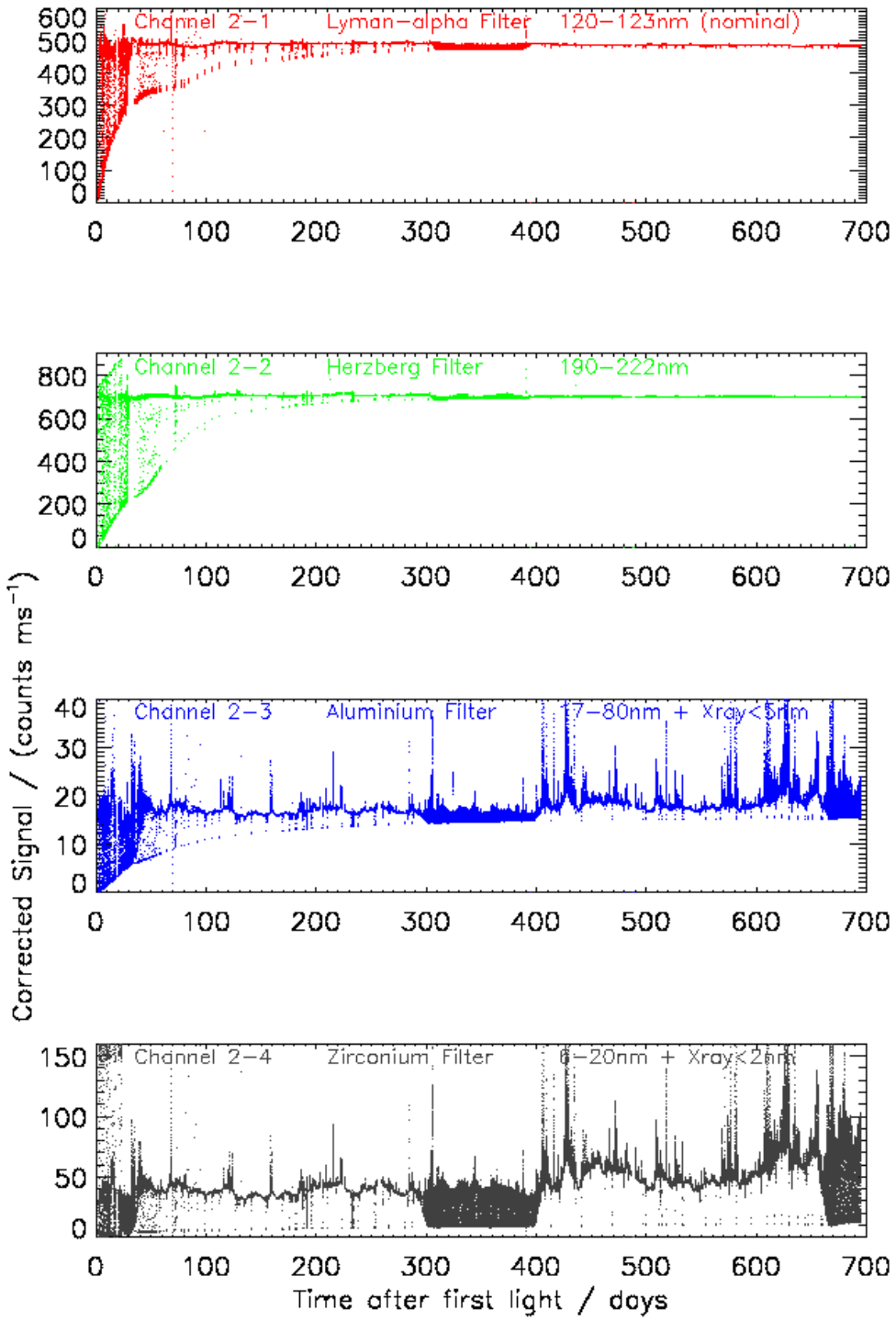
… and add it

Plausibility:

- Artifacts in channels 1 and 2
- Non-degraded SXR in channels 3 and 4

Disadvantages:

- Underestimate EUV in channels 3 (and 4)
- Distortion of occultations



Formal:

i = is + id

i=measured photocurrent

is=solar photocurrent

id=dark current

is = (i – id)*corr1AU + degrad

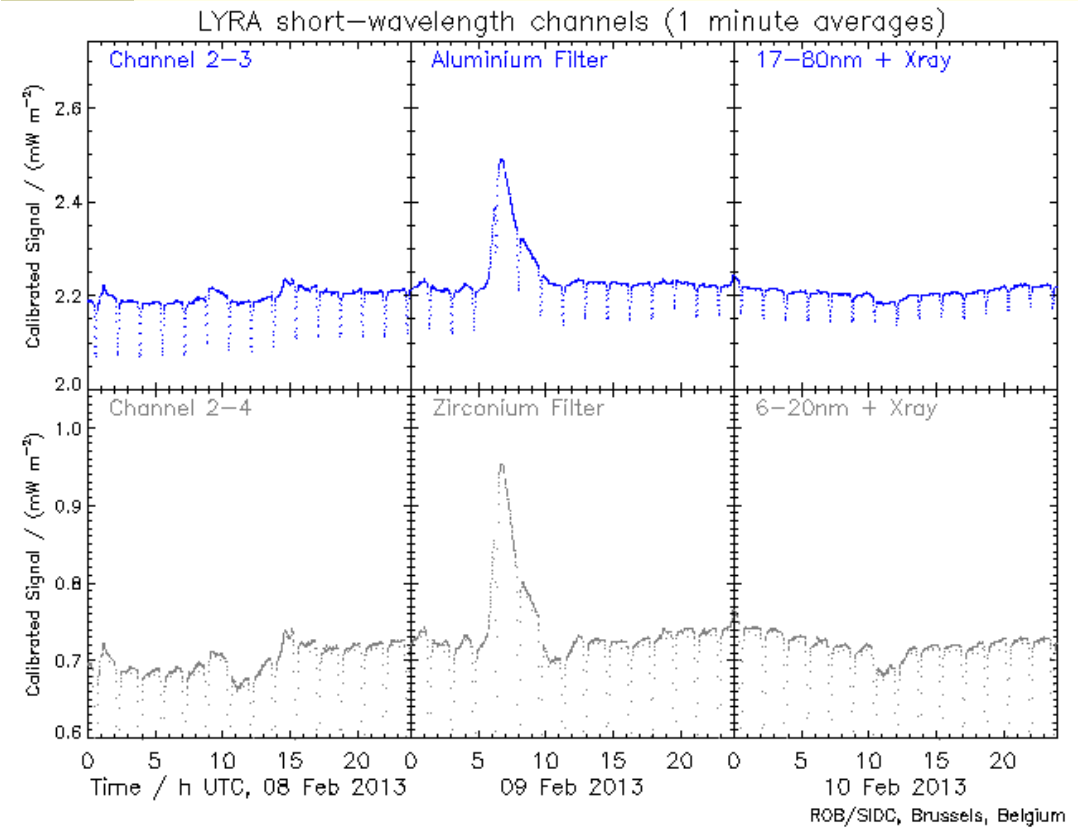
id=function(T)

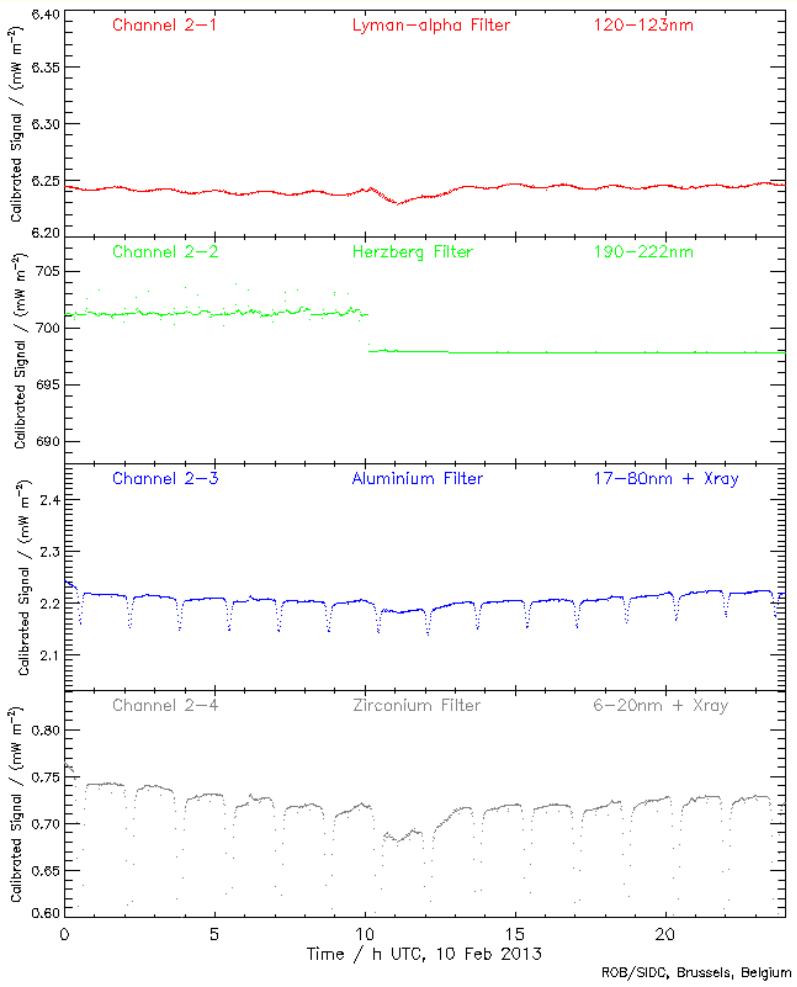
degrad=function(day)

Ecal = conversion(is)

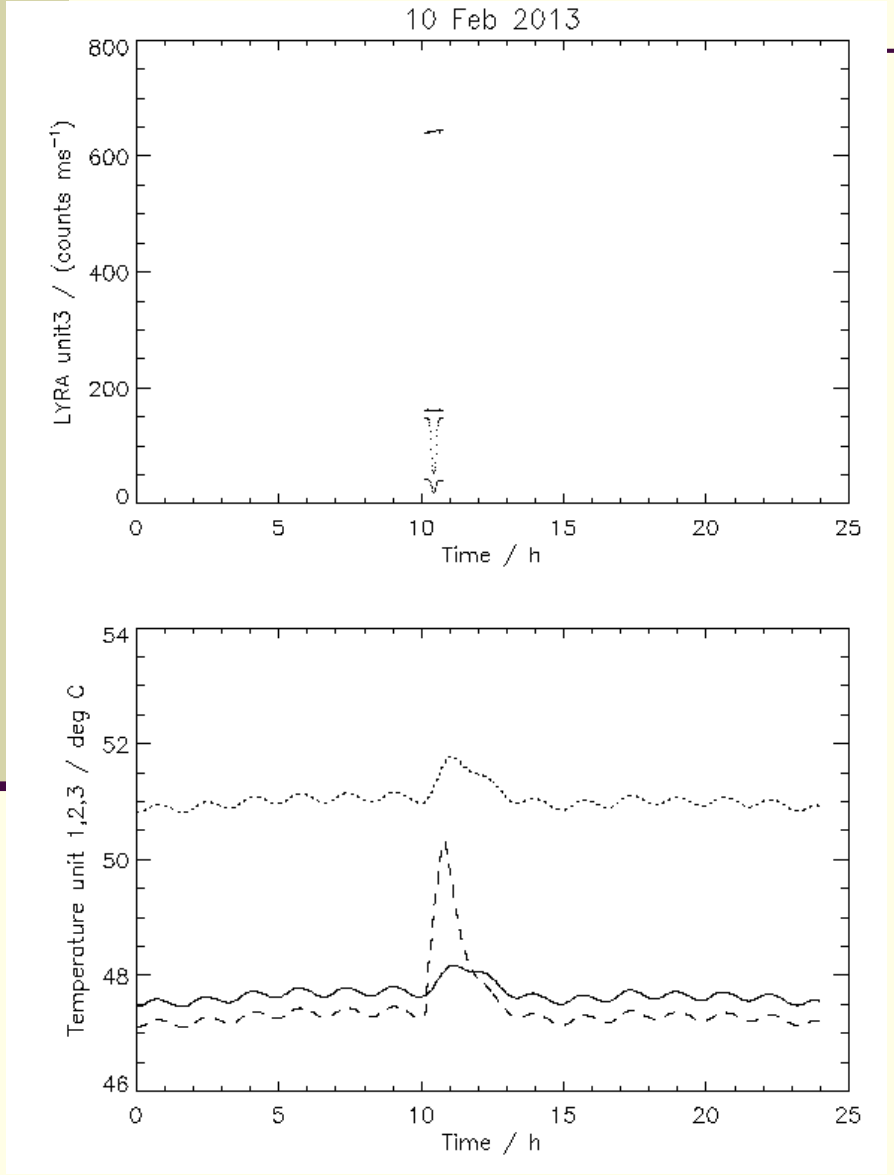
according to comparison with TIMED and SORCE at First Light (06 Jan 2010)

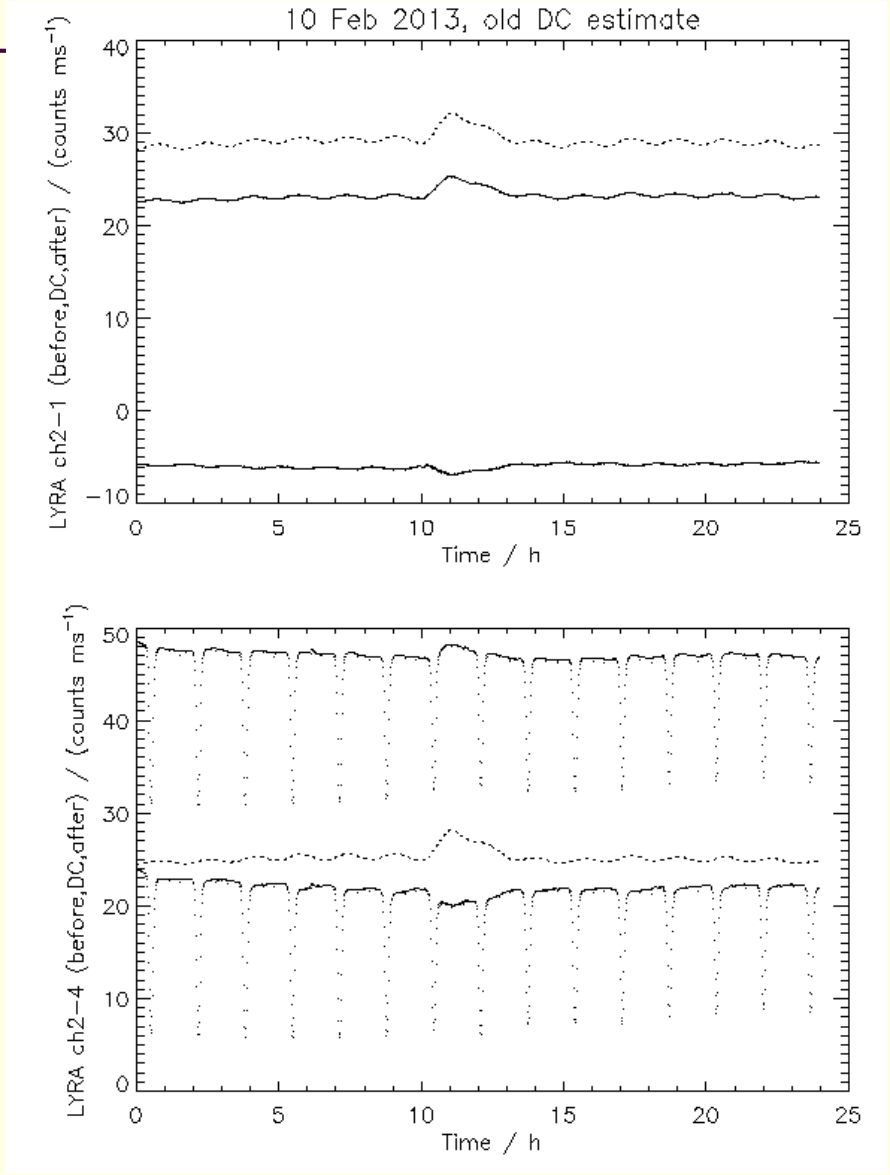
Problems with regular “dips”





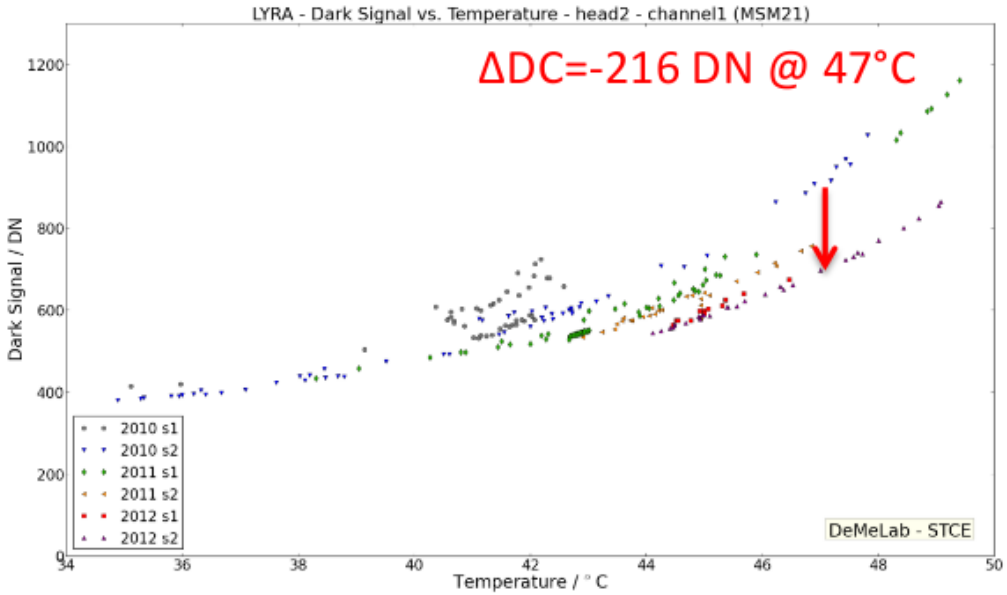
Problems with unrealistic DC



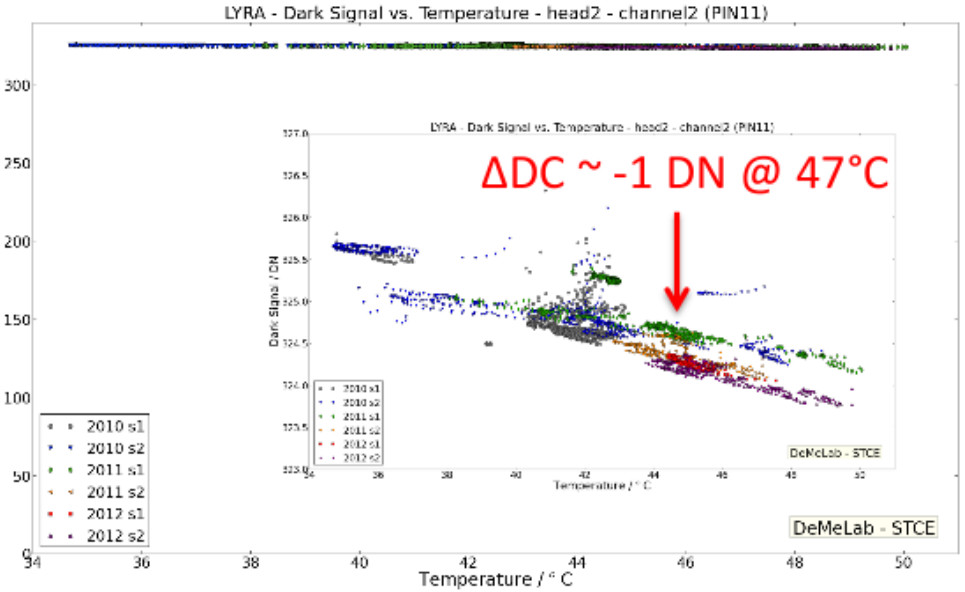


-1- dark current vs temperature (unit 2, diamond)

MSM diamond



PIN diamond



Legend:

- grey : 1st sem. 2010
- blue: 2nd sem. 2010
- green: 1st sem. 2011
- orange: 2nd sem. 2011
- red: 1st sem. 2012
- purple: 2nd sem. 2012

IT = 50ms (20 Hz)

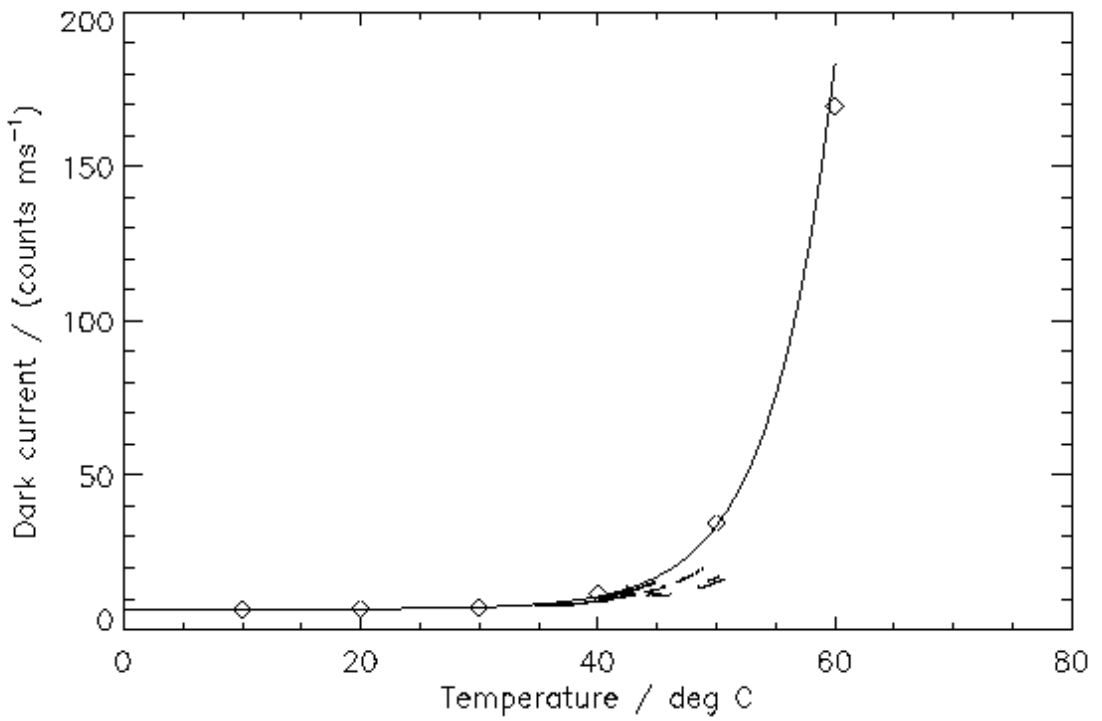
- Diamond MSM dark current increases vs temperature as expected, but decreases with time
  - ΔDC ~ -27% of the mean @ 47°C → recovery of the diamond MSM ?
  → cleaner diamond surface (TBC with ch2-3 and ch2-4),
- Diamond PIN dark current remains stable in orbit
  - ΔDC = -0.3% of the mean @ 47°C (=noise) → no PIN diamond detector degradation

DC as function of temperature (step 1)

Pre-launch laboratory measurements (-40, … ,+60 deg C) can be fitted with

DC(T) = a+ exp(b*T +c)

Chose a = 6.63, which corresponds to DC < 20 deg C.

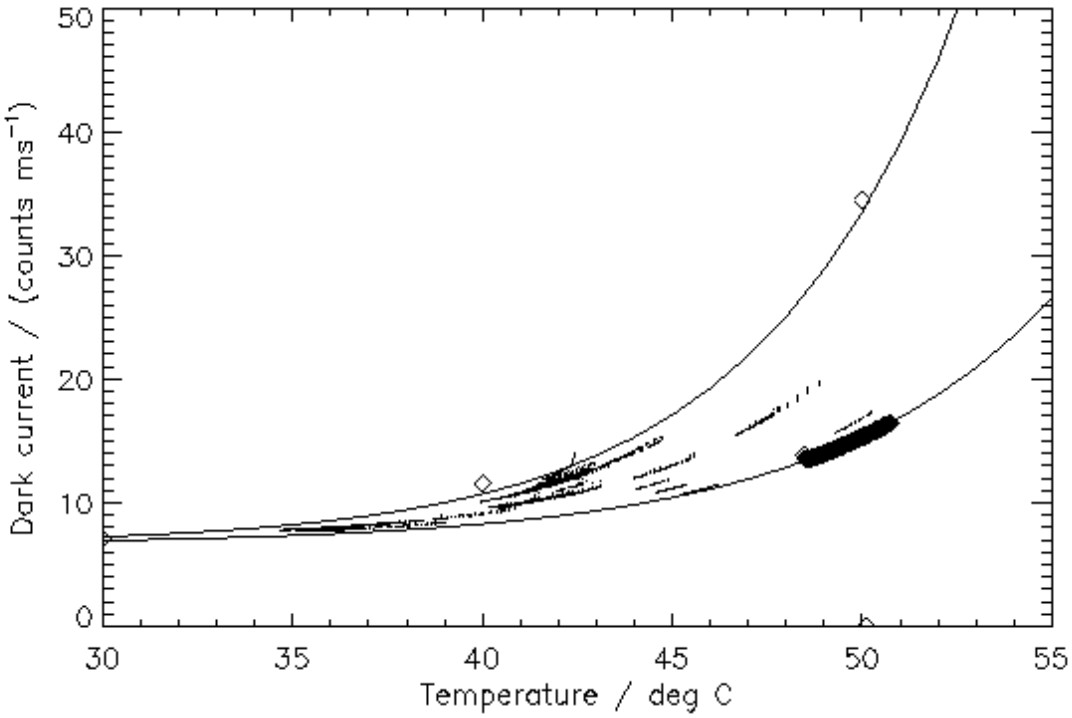


DC as function of temperature (step 2)

Then try to fit
the on-board
measurements
2010-2014 with

DC(T) = 6.63+exp(b*T+c)

Chose c = -6.13,
which corresponds to
the lab fit from step 1.

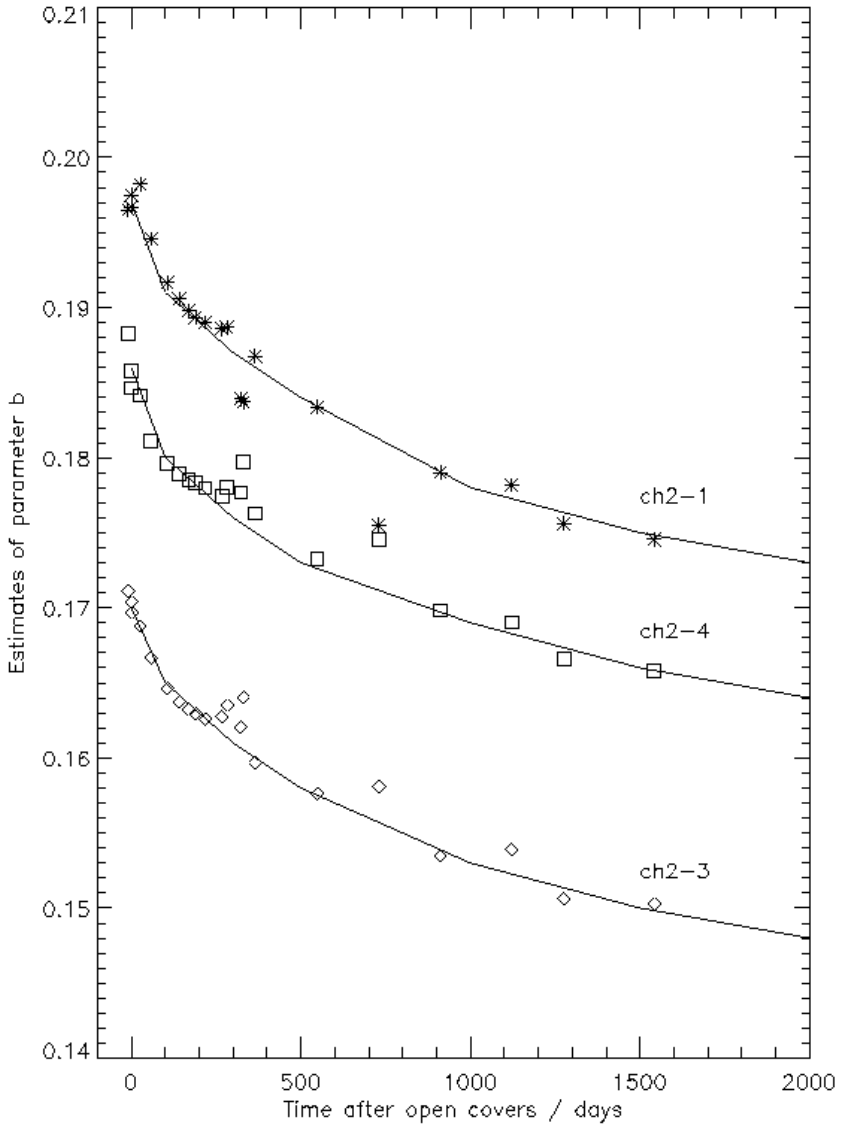


DC as function of temperature (step 3)

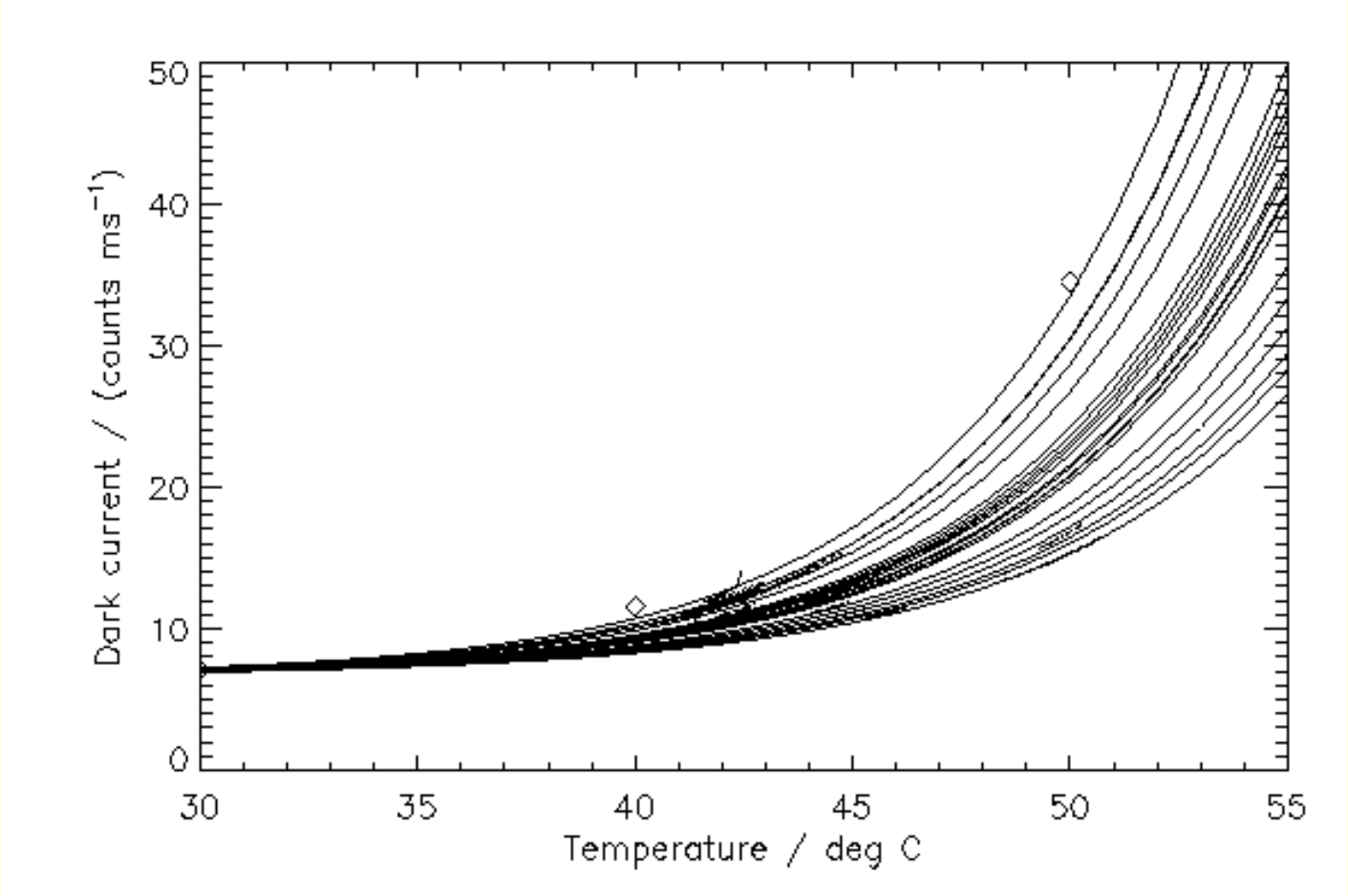
Parameter b can be fitted to time (d) for channels ch2-1, ch2-3, ch2-4:

DC(T,d) = a+exp(b(d)*T+c)

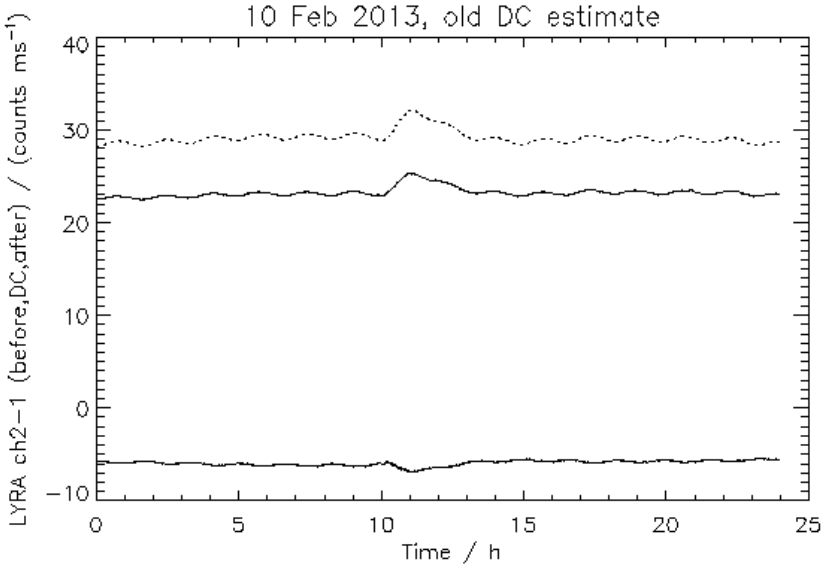
with individual constants a and c,
and individual table b, per channel.

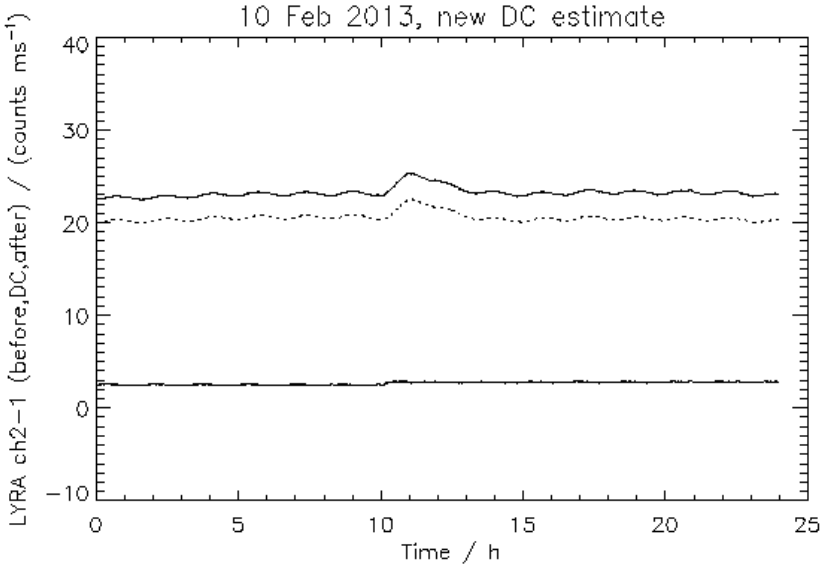


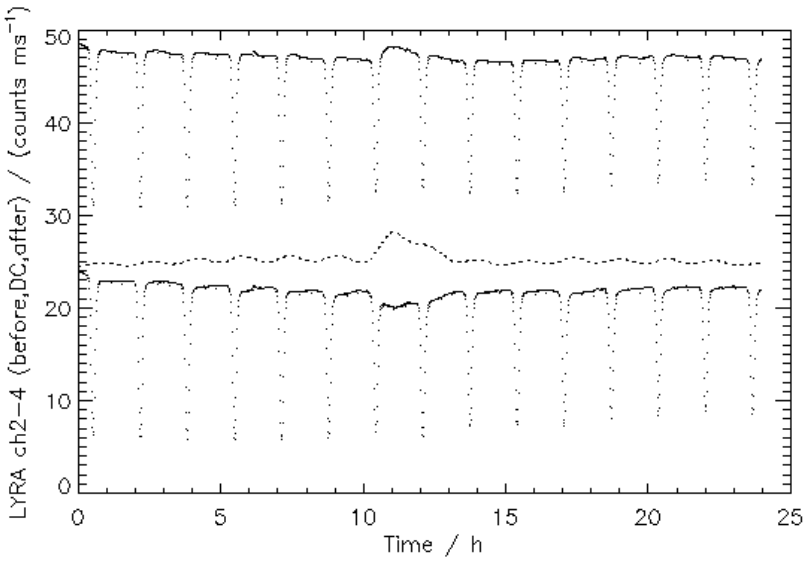
Result: DC as function of T and d

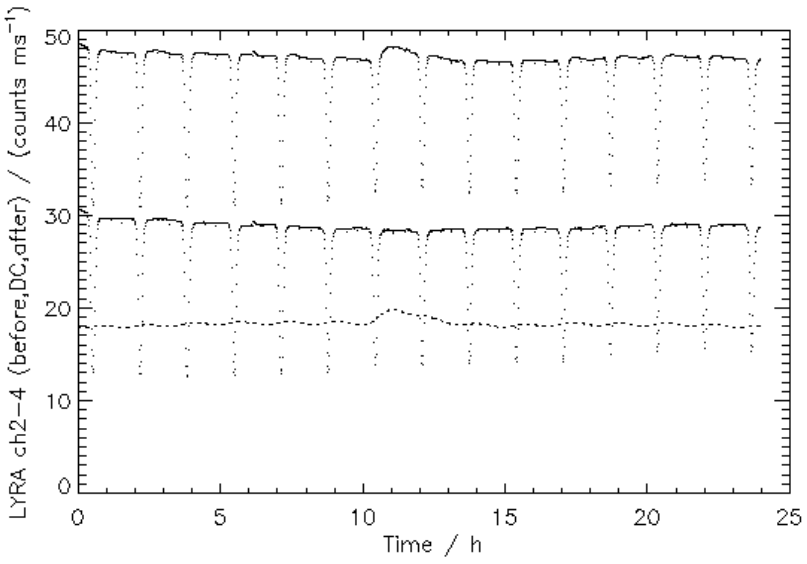


Some problems are solved…









…some problems remain a mystery to me

- Why does the dark current for ch2-1 sometimes behave as if the temperature was several degrees higher? (But only for ch2-1, not for ch2-3 or ch2-4.)
- Why does the dark current for some Si channels (e.g. ch3-3 and ch3-4) decrease with temperature?
- Why does the dark current for MSM channels ch2-1, ch2-3, and ch2-4 decrease over time? (But it remains constant for PIN channel 2-2.)

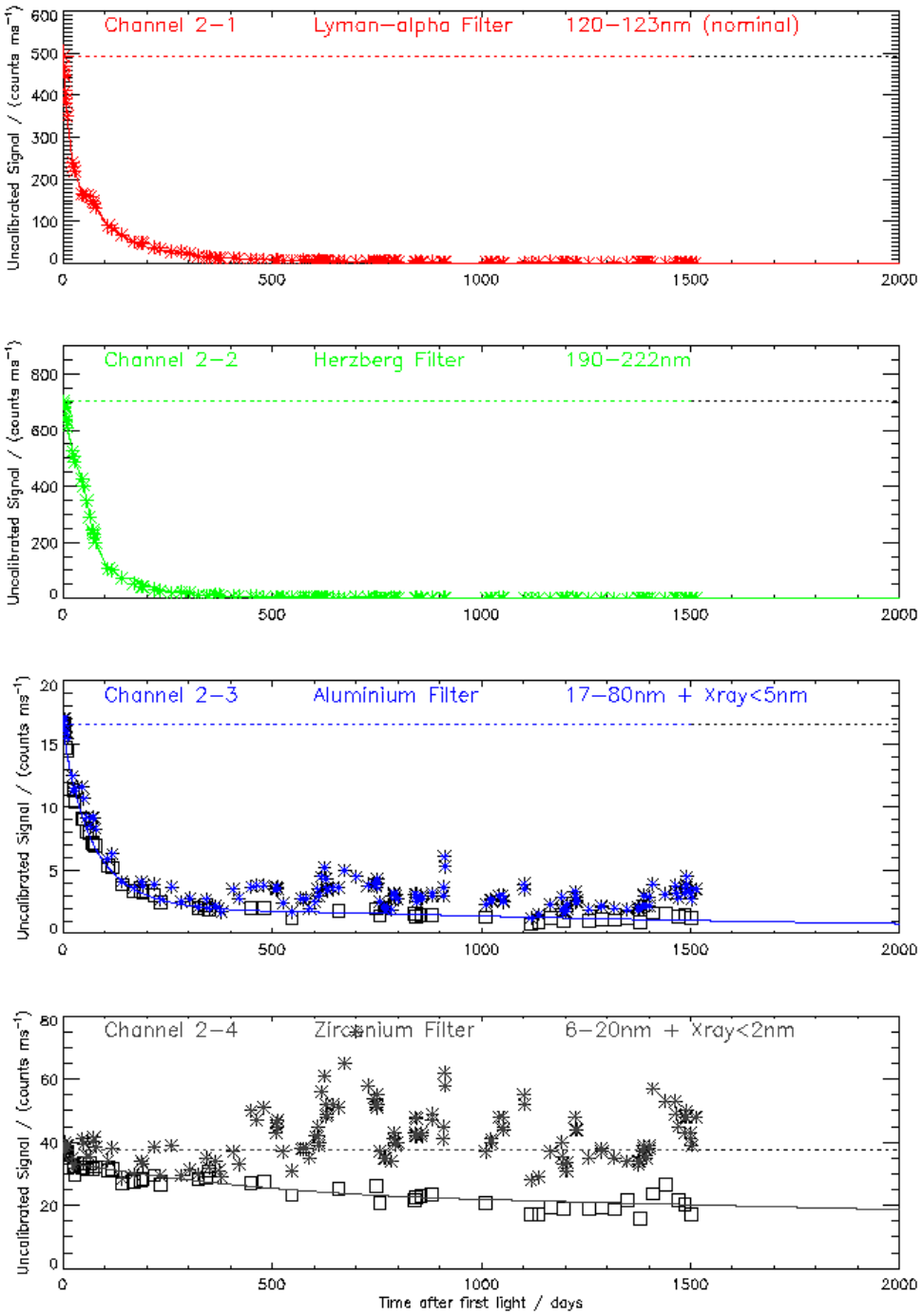
So, here we go again:

Estimate and subtract
dark currents
(now as a function of T and d)

Correct for 1AU

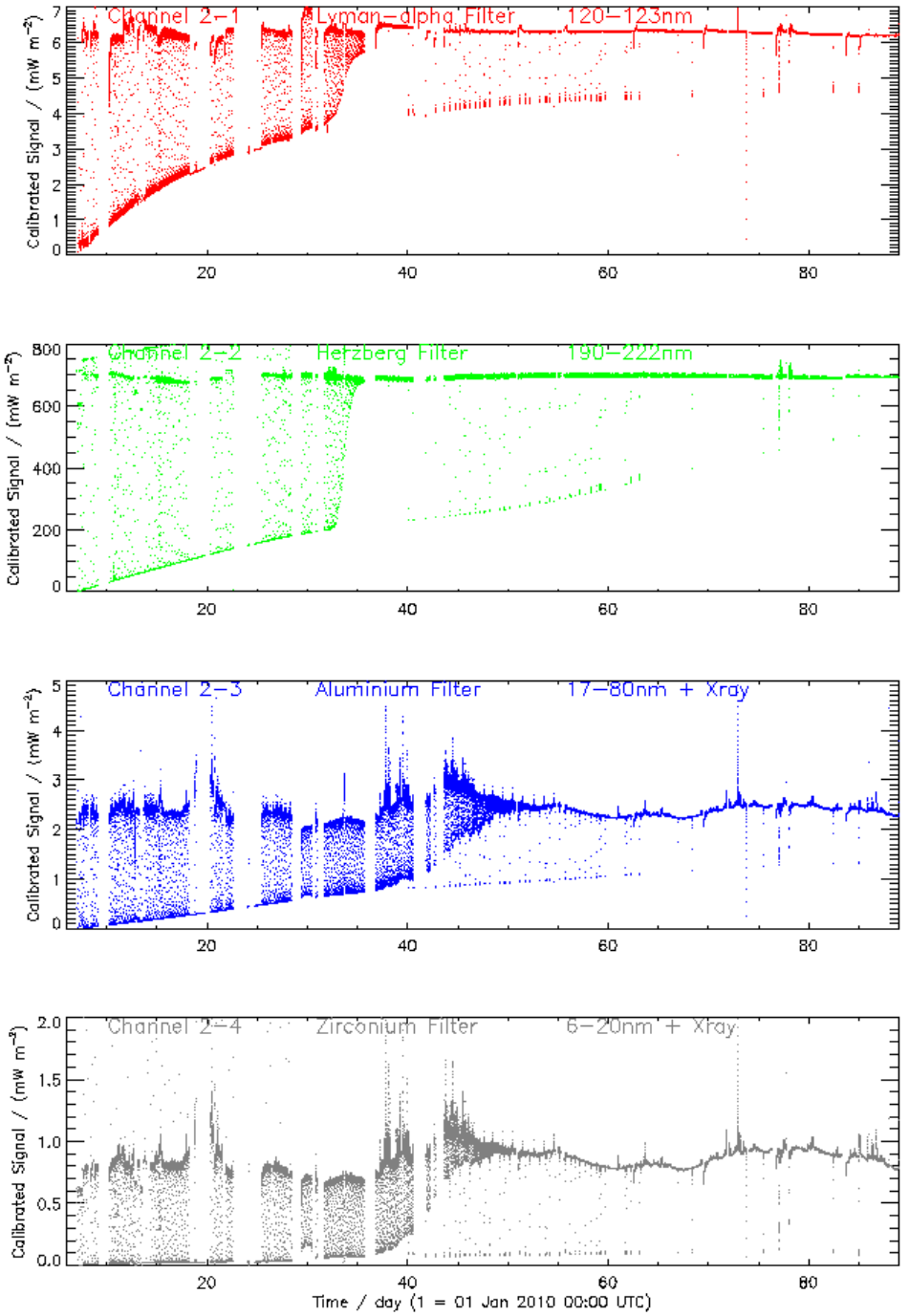
Fit the degradation
(now based on campaigns
up to 2014, and comparison
with non-degraded ch1-4)
ch2-1 <0.5%, ch2-2 <0.5%
ch2-3 7%, ch2-4 53%

Add degradation and convert
according to First Light
calibration…

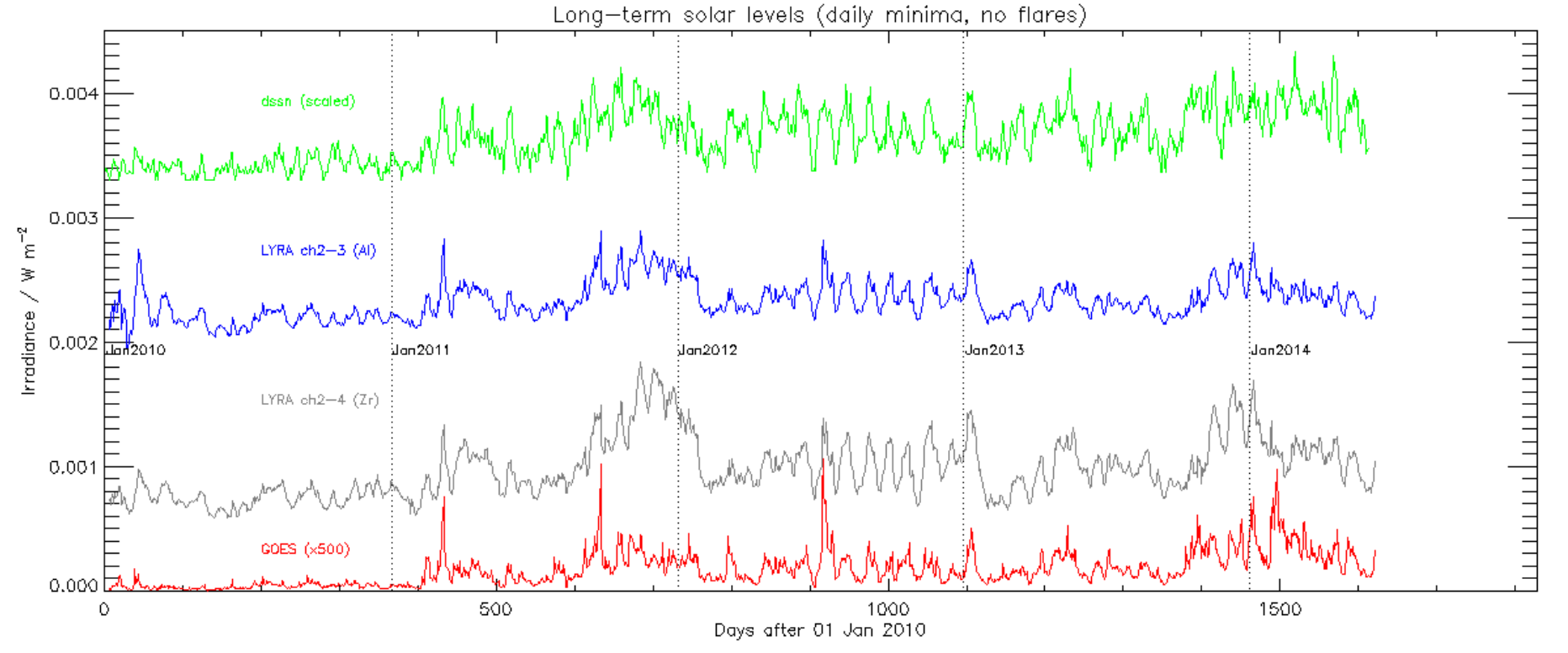


…to get these results:

- Example: The first three months of 2010, calibrated



And, in the long range:



(small changes possible after the next re-processing)

Lessons learned?

- Never take anything for granted.
- Even the most self-evident things may change.