EVE/ESP Calibration Details

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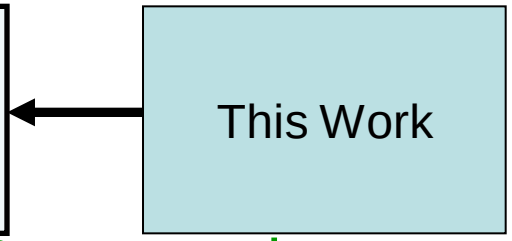
Why ESP Calibration is Needed

- ESP public products (Level 1 and higher) are Absolute Solar Irradiance (ASI) in the ESP pass-bands;
- For accurate determination of the ASI we update the ASI equations for the change of the following parameters, many are functions of temperature, time and/or wavelengths:
- dark counts (++),
- filters transmission, e.g. degradation (+),
- electronics gain (++),

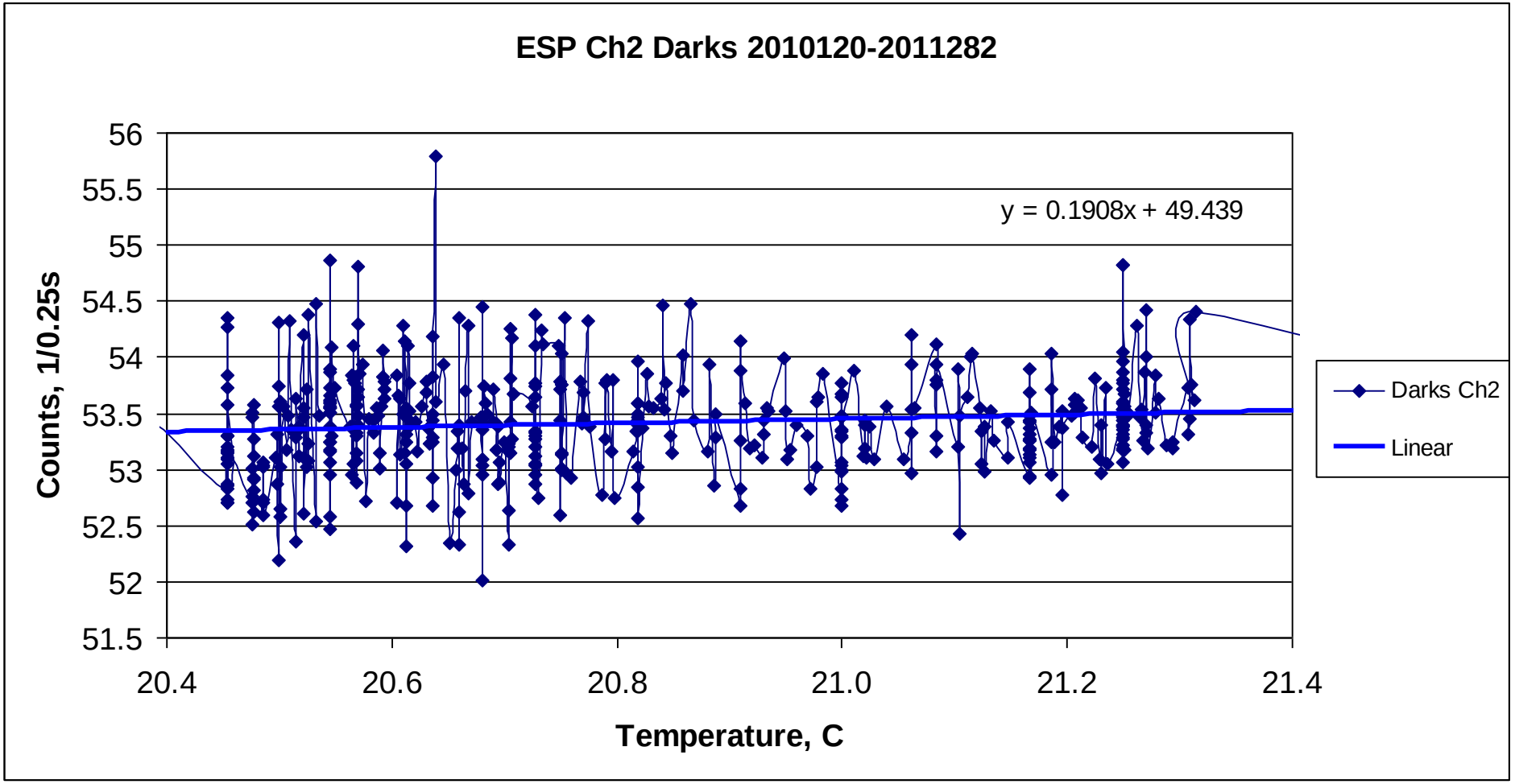


- energetic particle contamination (+) – ESP removed,
- visible light (++) – Not exceed initial level,
- spectral variability, (+) – Will be improved,
- angular offsets (++) – SDO has perfect guiding,
- a distance from s/c to the Sun -- included.
- use Sounding Rocket underflights and intercomparisons

How do we measure/calculate darks

1. Use daily calibration runs to measure dark counts and the temperature with the dark filter in place.
2. Determine the equation (for each channel) to fit the measured dark counts with the dark proxy as a function of temperature.
3. Use the dark proxy to calculate darks for any instant temperature.

An Example of Dark Measurements

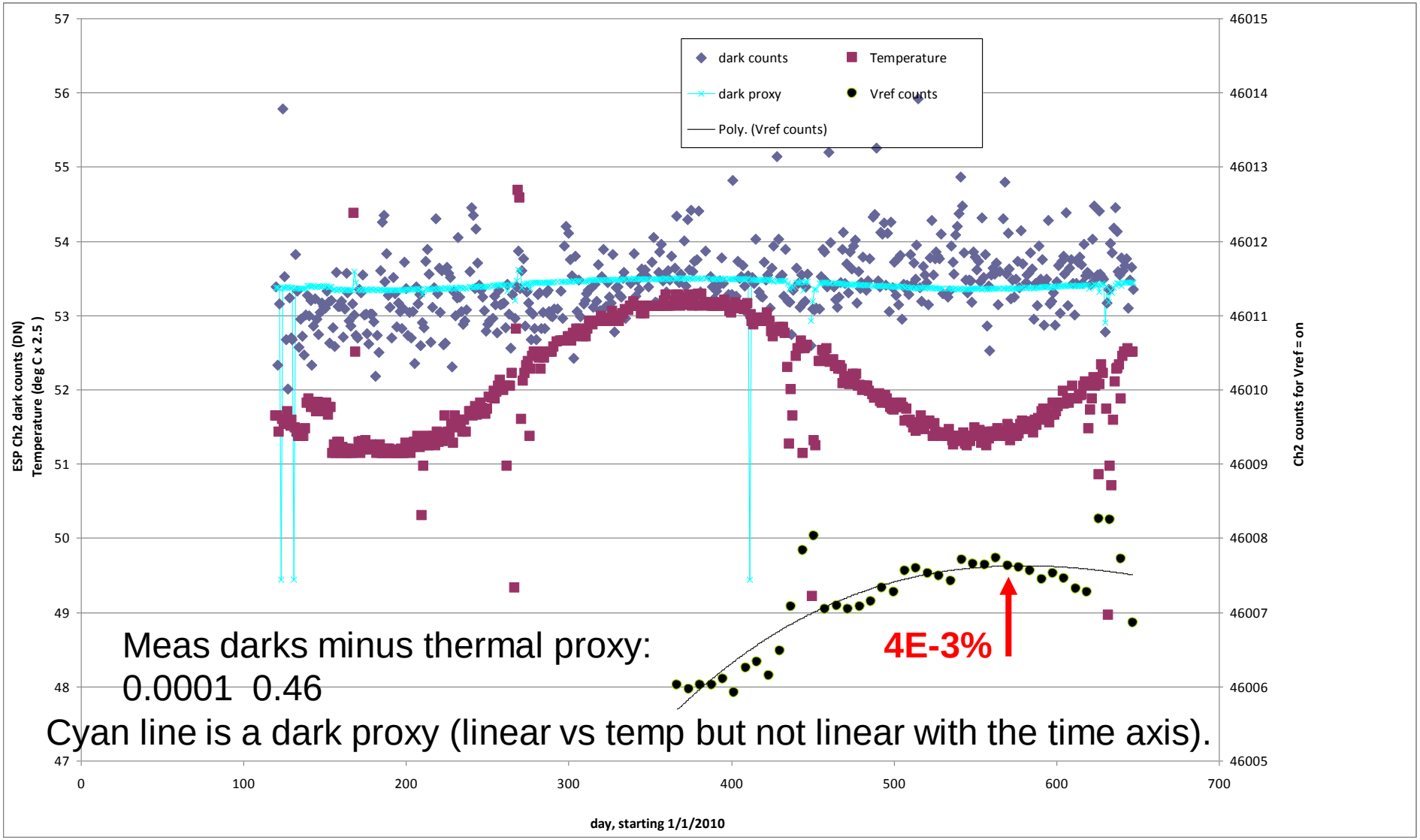


Diamonds: calibration measurements; blue: linear trend (dark thermal proxy)

How accurate is dark thermal proxy

- Very accurate as a function of temperature. Ch2 mean for the residuals (measured darks minus thermal proxy) for 530 days of flight is **0.0001** cnt/0.25s;

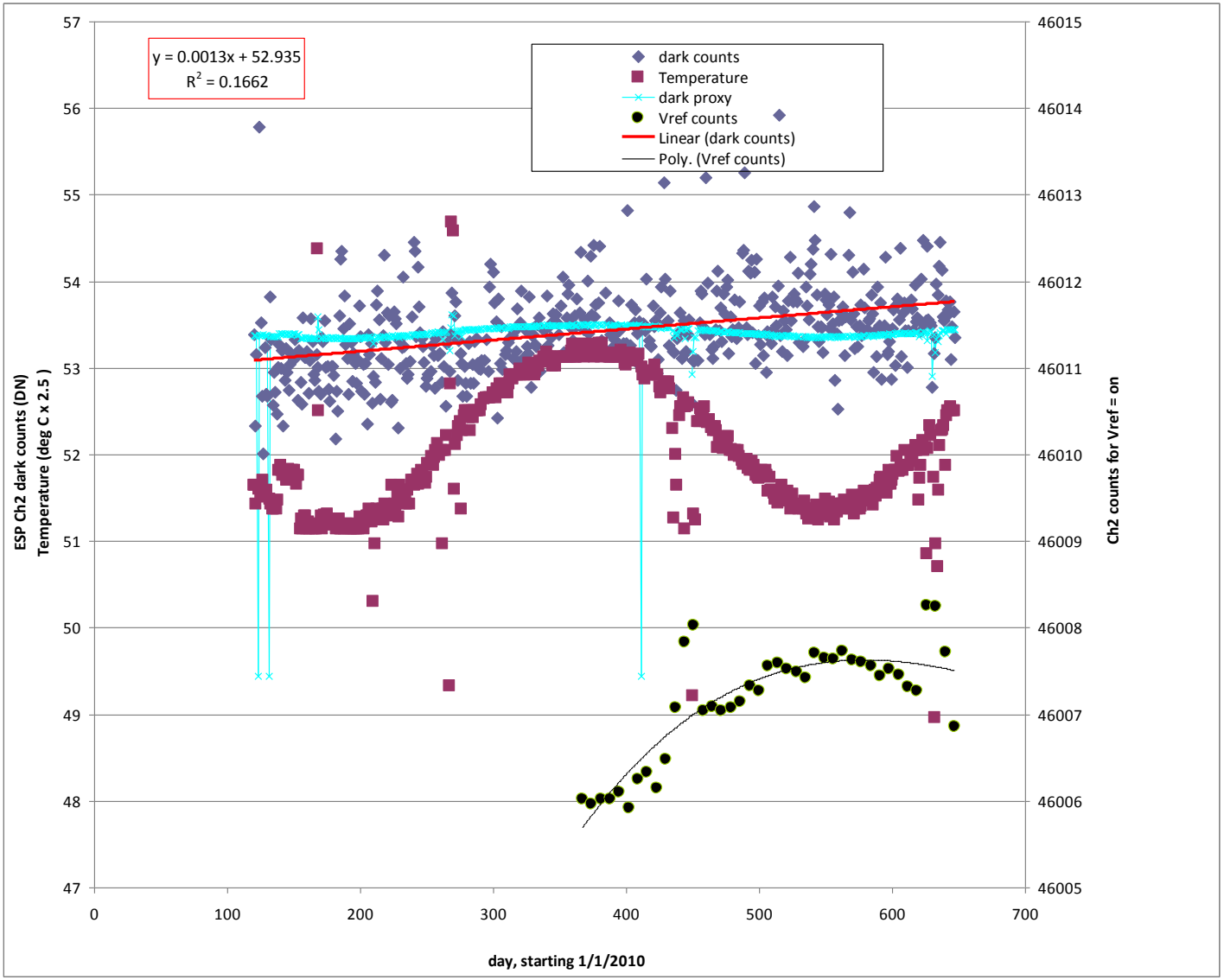
Evolution of dark counts and Vref



Is the Dark Proxy Sufficient?

- We have analyzed whether there are some temporal changes (not related to the temperature). These changes (if exist) may reflect either some ‘aging’ of the detector and change of its characteristics, e.g. shunt resistance OR the change of solar activity.

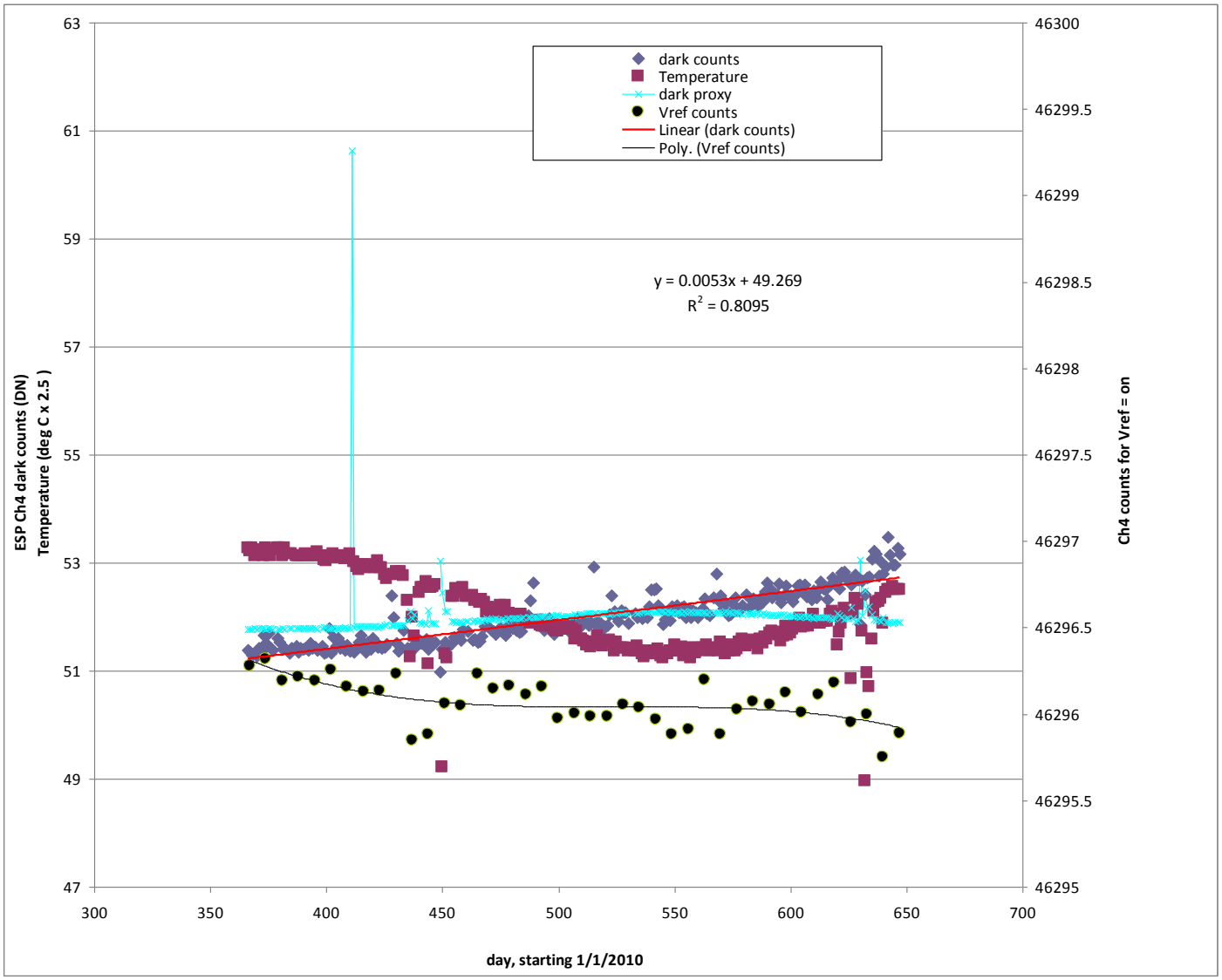
Evolution of Dark Measurements (this work)



Dark Subtraction Will be Improved

- We see that temporal changes of darks are not correlated with the changes of temperature but are some (linear?) function of time. This small but important temporal change was not implemented in the ESP current data product but will be implemented in the next version.

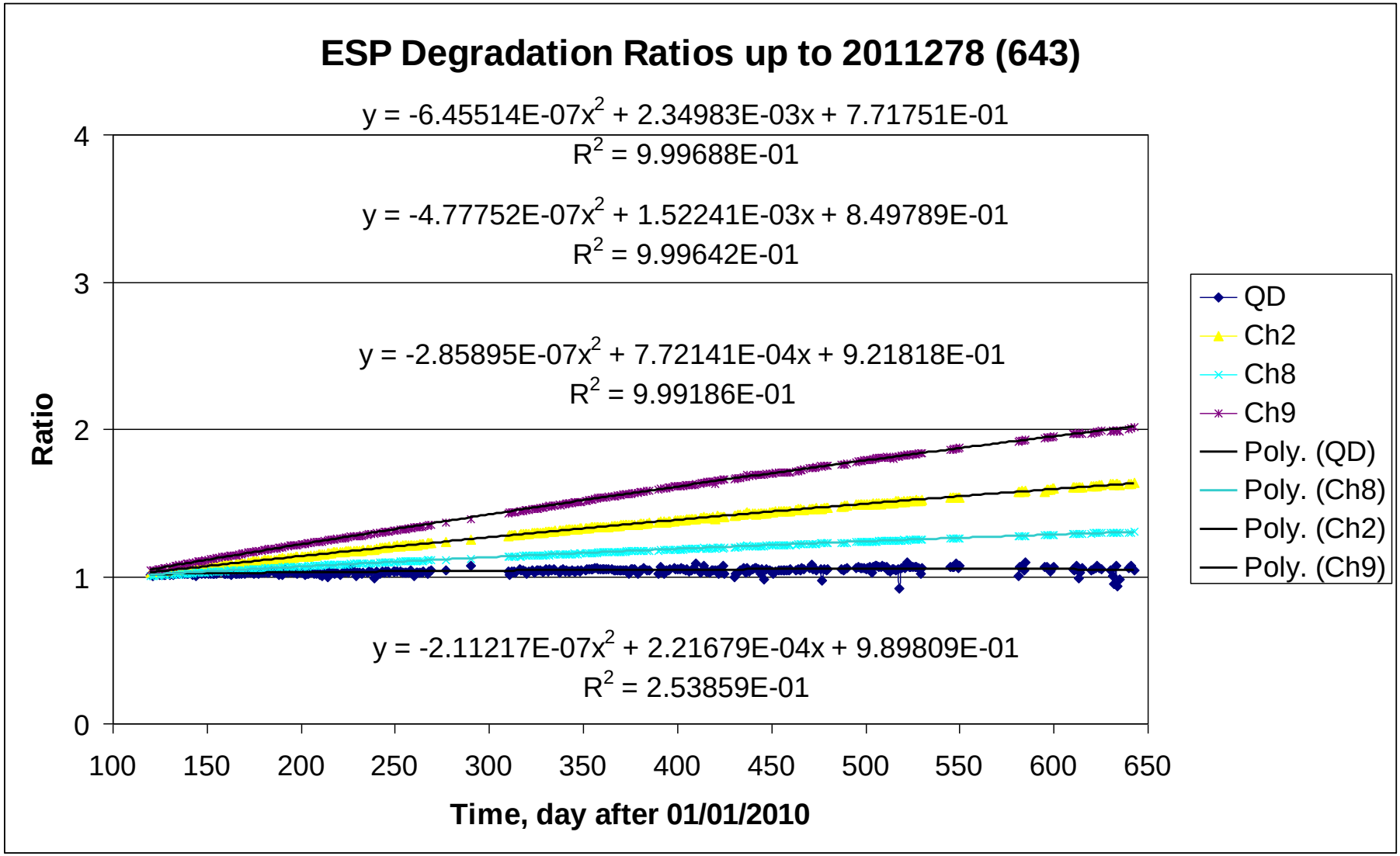
Another Example for a QD Channel



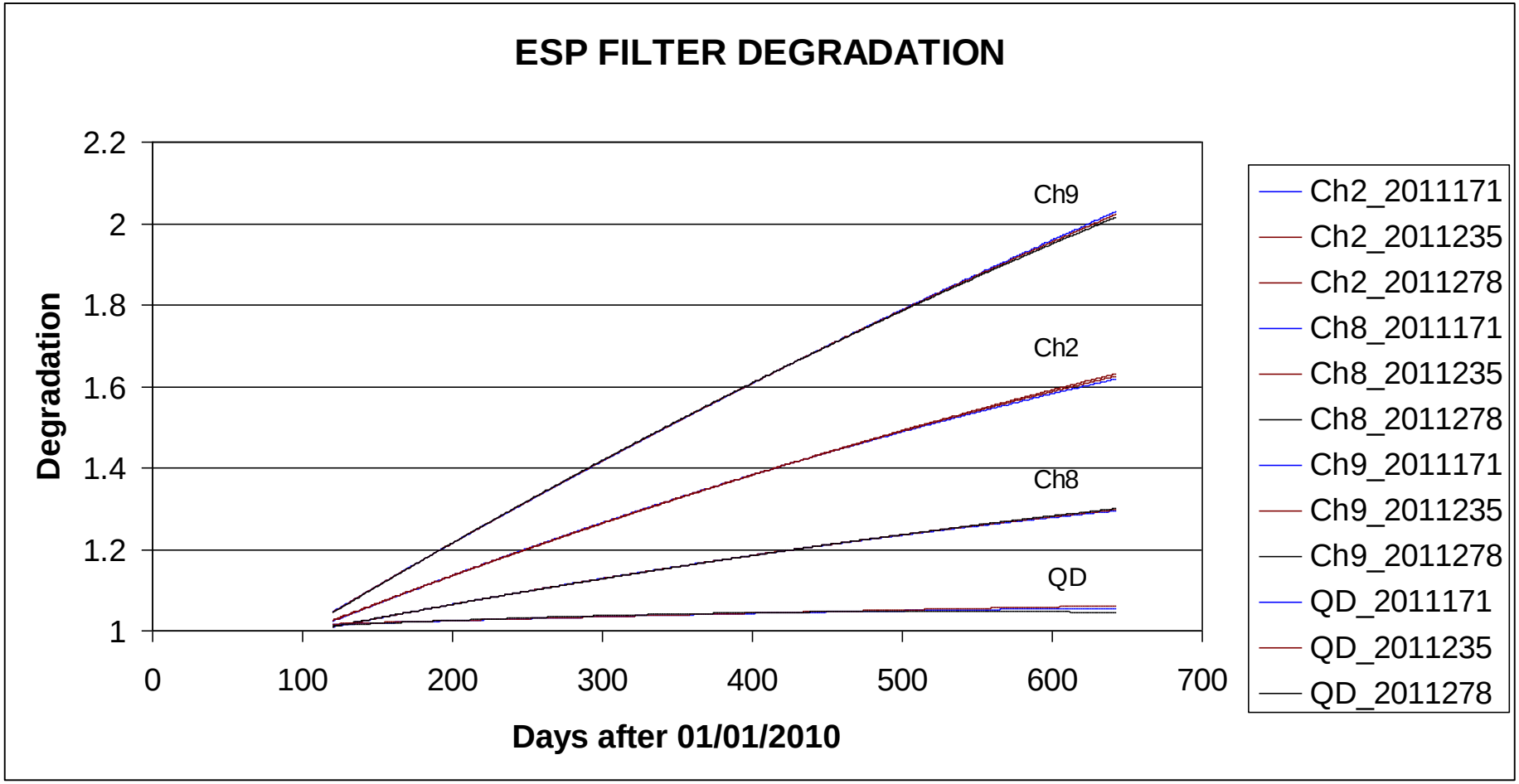
How Degradation of the Filter is Determined

- Use daily calibration runs and compare counts for the primery Al filter (F3) with the counts from one of spare Al filters (F4).
- Most of the mission time F4 is outside of the solar light and it is significantly less degraded than F3.
- The ratio F4/F3 shows F3 degradation (decreased transmission through the filter due to deposition of hydro-carbons).

ESP Filter Degradation Evolution



How Significant are Filter Degradation Changes vs. Updates



How ESP Lev1 is Updated for F3 Degradation. What is accuracy?

- For each channel we determine the degradation rate as a function of time (Day)
- Use the equations with the degradation rate to increase the channel irradiance
- Evolution of the filter degradation shows that existing method of degradation updates is accurate within 0.1% for ‘old’ days and about 0.4% for one_per_two_months update.

ESP Calibration and Underflights

- ESP was calibrated at SURF BL-9 and BL-2 (as an EVE channel).
- After replacement of transmission grating and Ch2 photodiode at USC SSC, both ESP Flight and Rocket instruments showed very similar efficiency profiles (BL-9) and wavelength bands.
- BL2 calibration showed no significant degradation of the rocket instrument.

A Comparison of ESP Flight and Rocket Measurements for SR flight NASA 36.375 (03/23/2011 at about 17.9 UT)

Channel	ESPR Irradiance	ESPF Irradiance	ESPR/ESPF
1	2.15	0.633[1]	3.4[1]
2	4.08	4.17	0.98
QD	6.32	6.28	1.01
8	7.69	7.41	1.04
9	6.83	6.78	1.01

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