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**Super-luminescent LED 21 and 50 day trend analysis**

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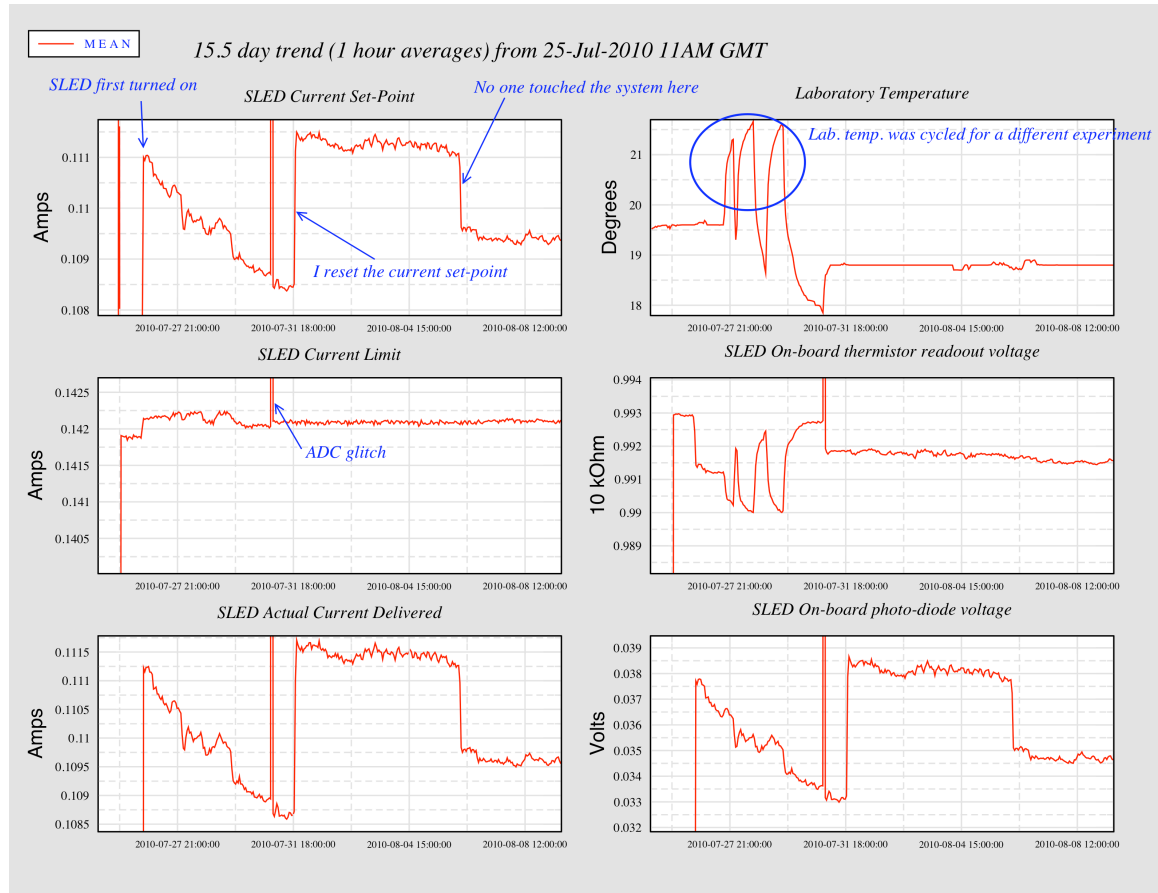
**LIGO Hanford Observatory**  
**P.O. Box 1970**  
**Richland WA 99352**  
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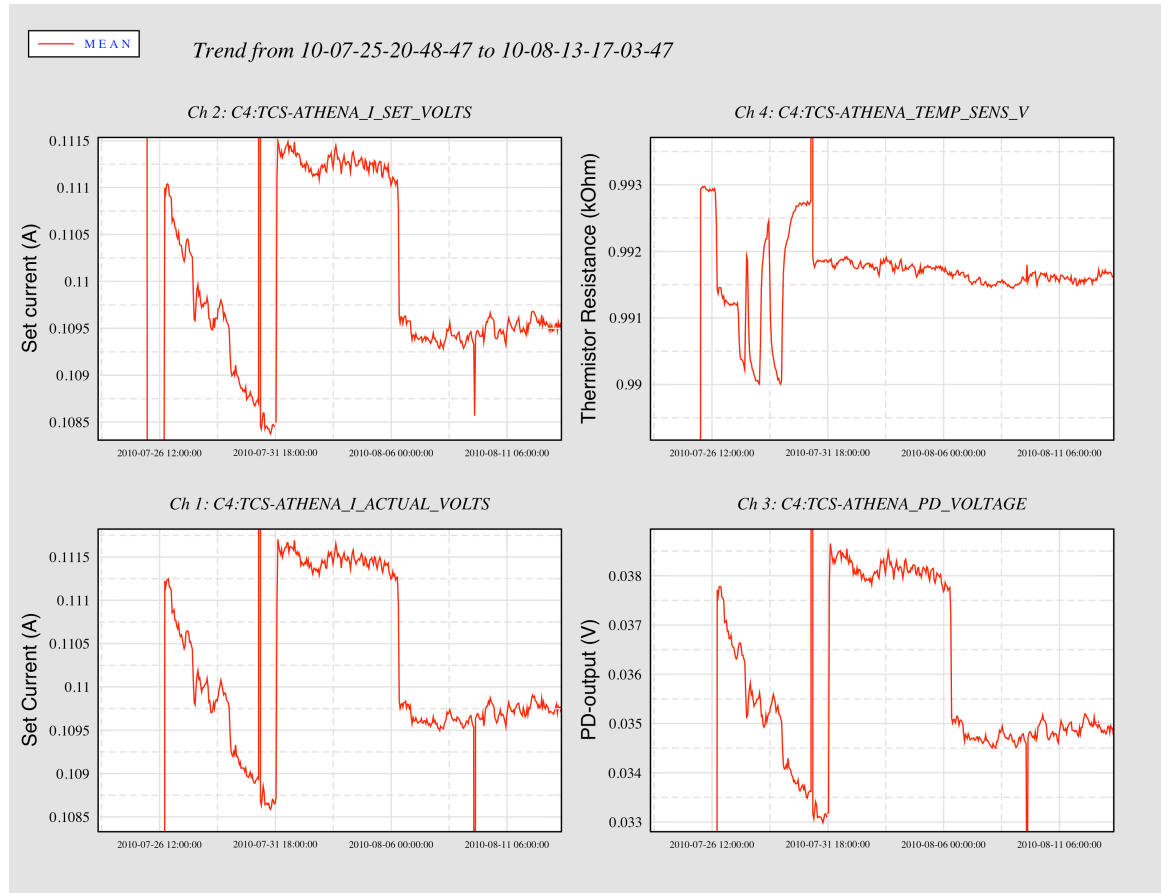
**LIGO Livingston Observatory**  
**P.O. Box 940**  
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We analyzed the 21 day trend data of the Superlum SLED.

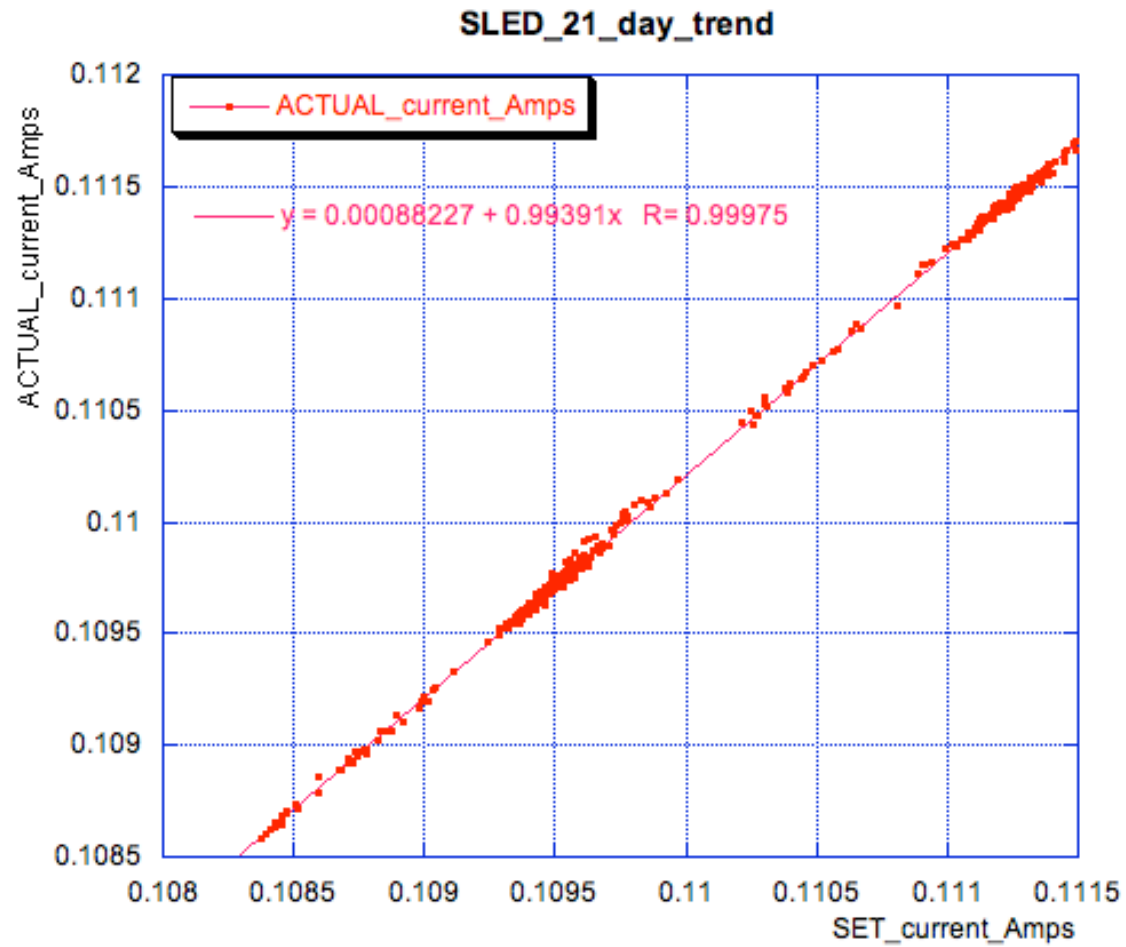
The timeline data indicates a problem with the set point stability.





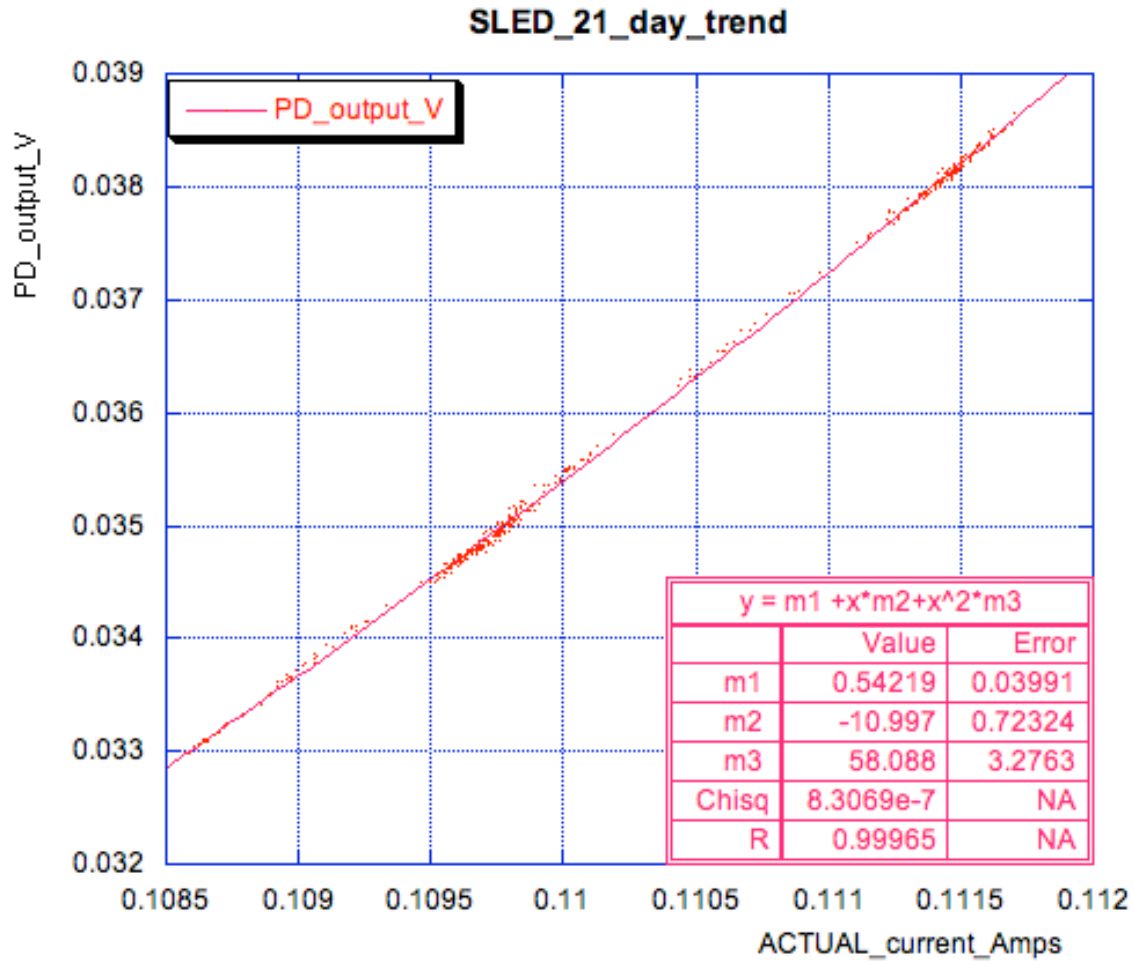
The following analysis confirms that the problem derives from the set point fluctuations.

The monitor of the actual current to the SLED tracks precisely the set point

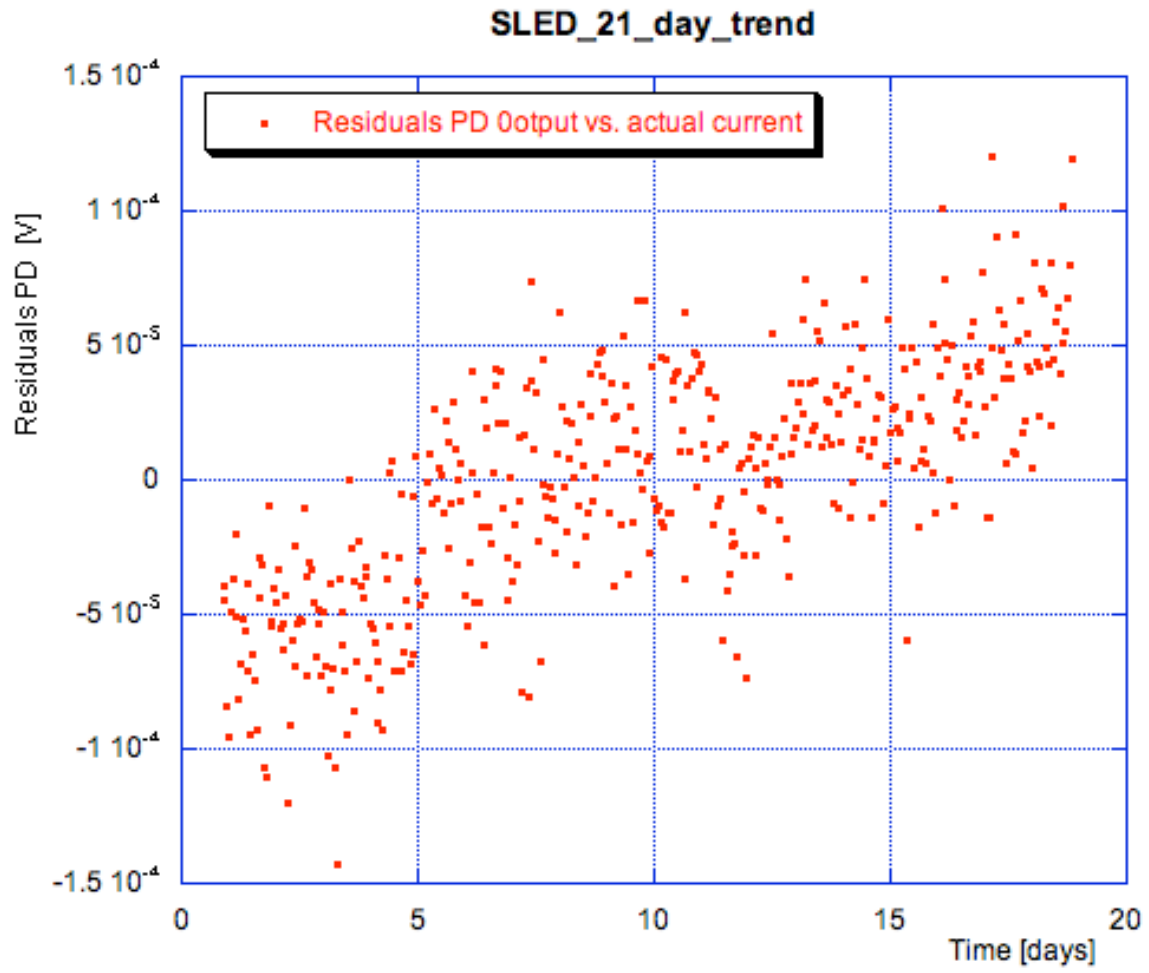


Similarly the photodiode output tracks the actual current.

We applied a quadratic fit, to take into account the non linear response of the SLED, which seems to fit well.



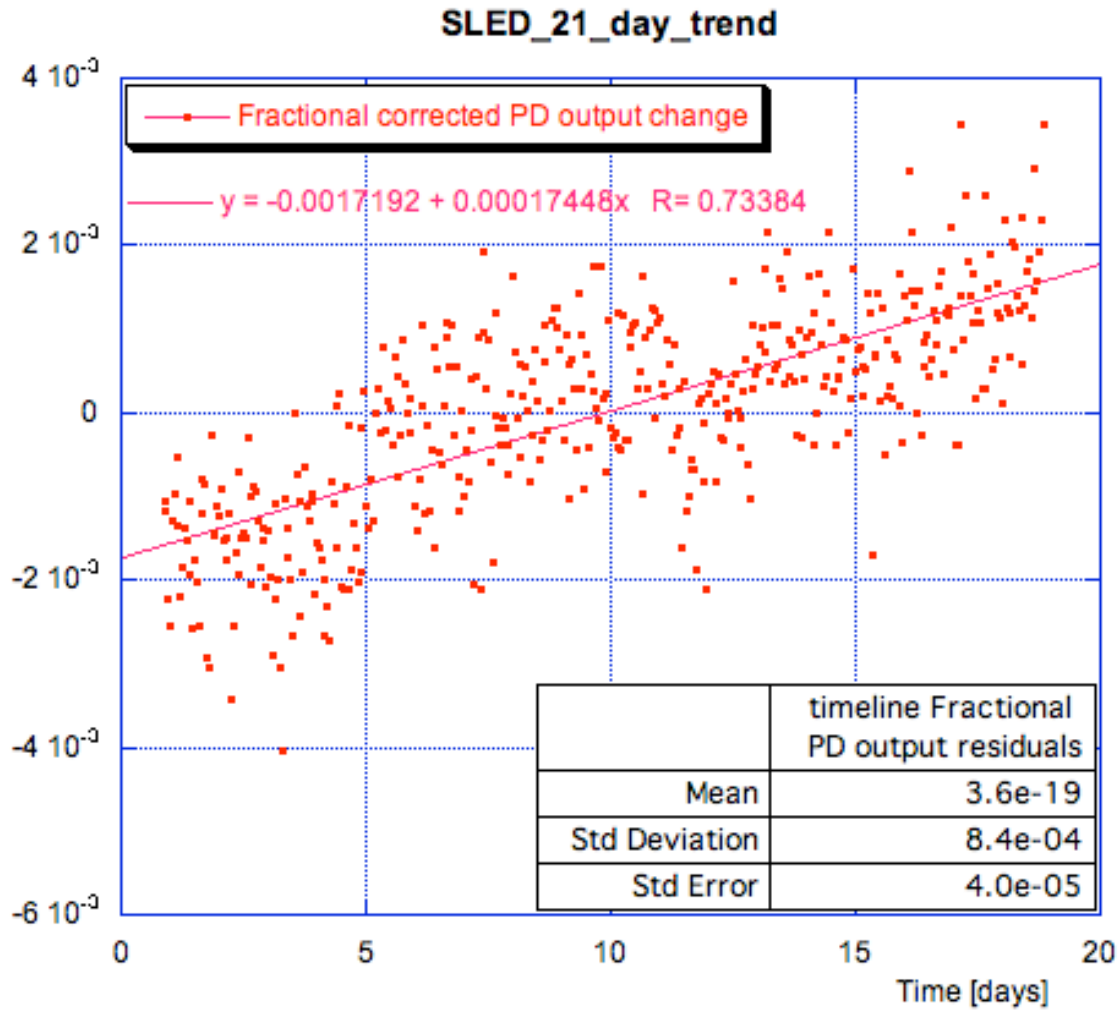
And the residuals of the fit do not show any time trend.

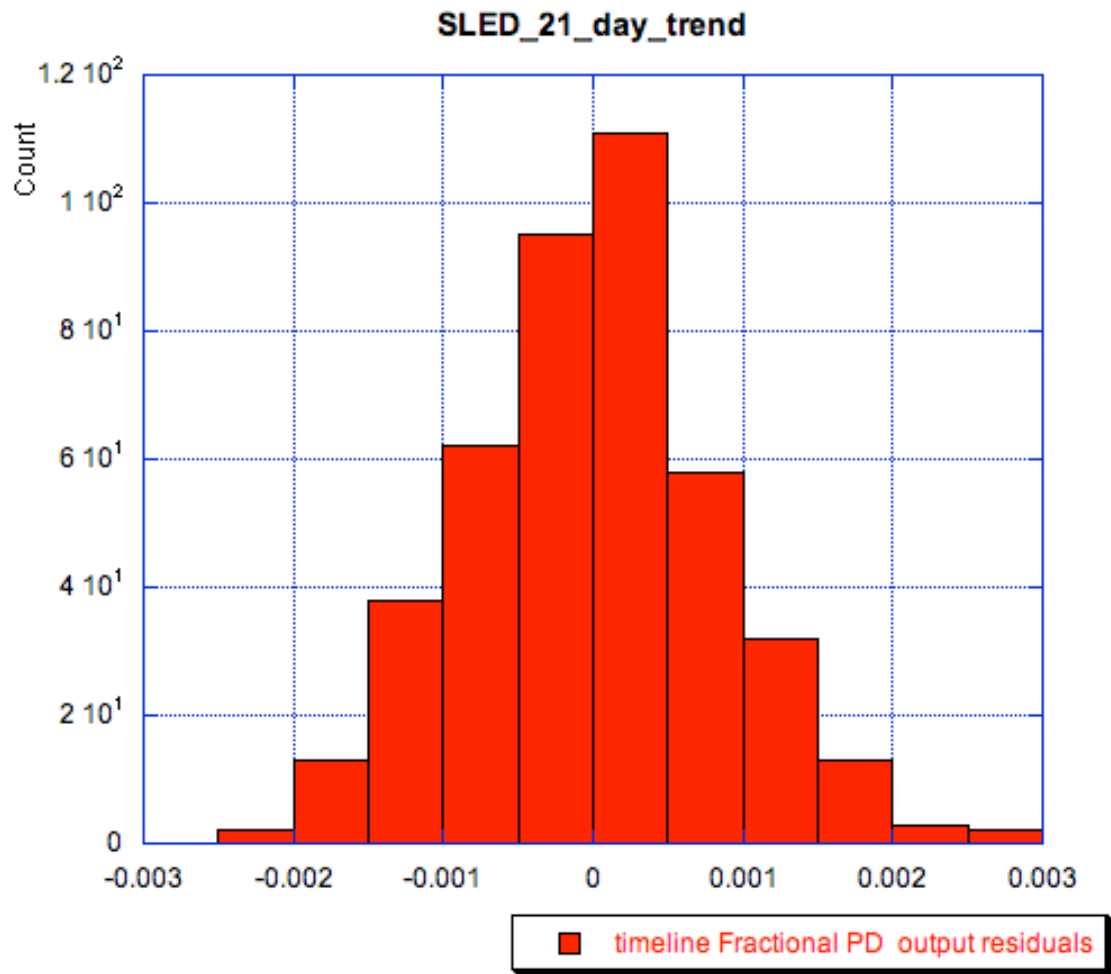


Note that the subtracted fit function was obtained from a current to light output plot, independent of time.

Dividing the residuals by the light output, we conclude that at fixed drive current the SLED has shown a slow and smooth 0.4% increase light output over a 19 day period.

Once subtracted this upward trend, the power fluctuation is 0.084%.

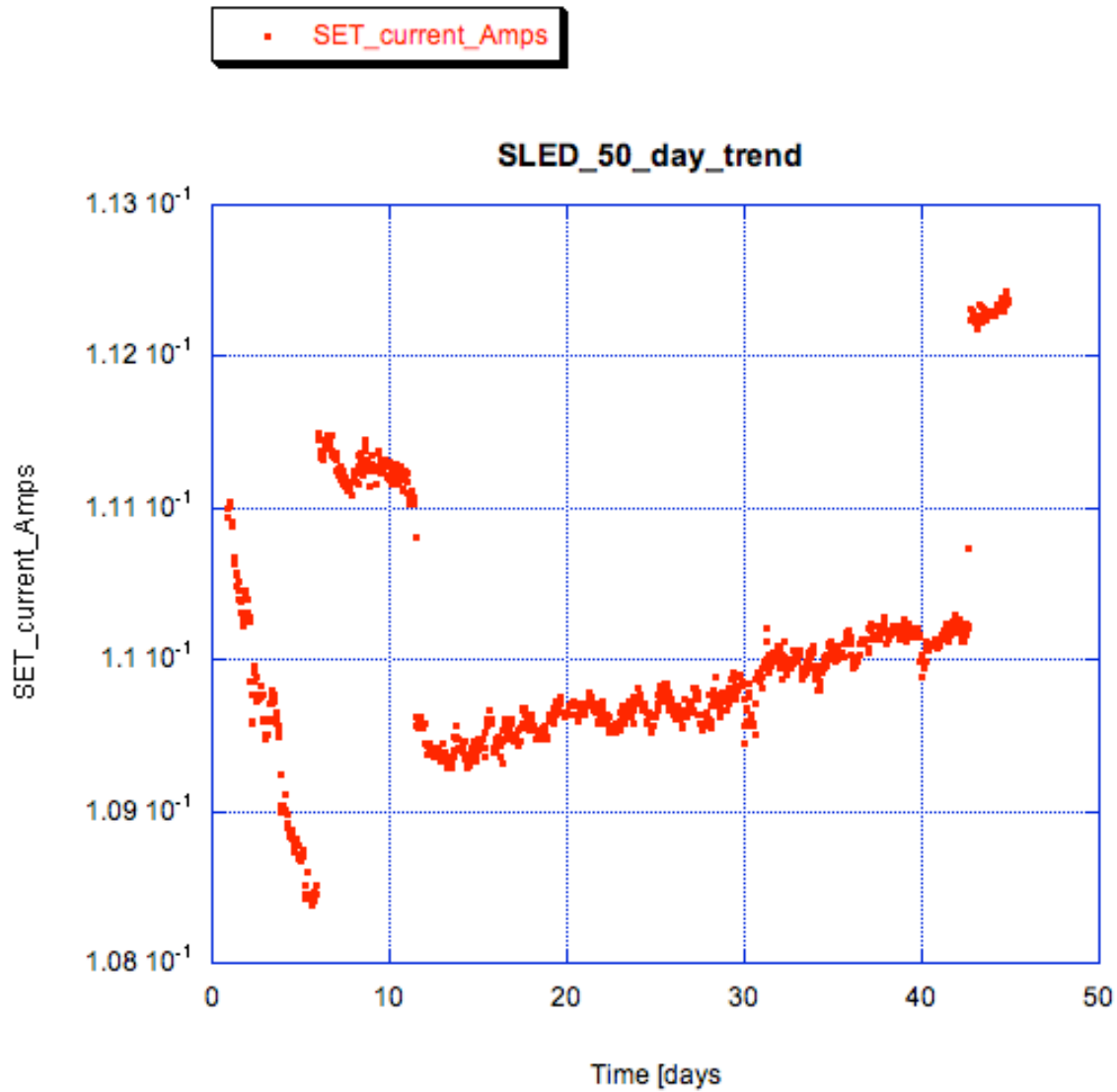


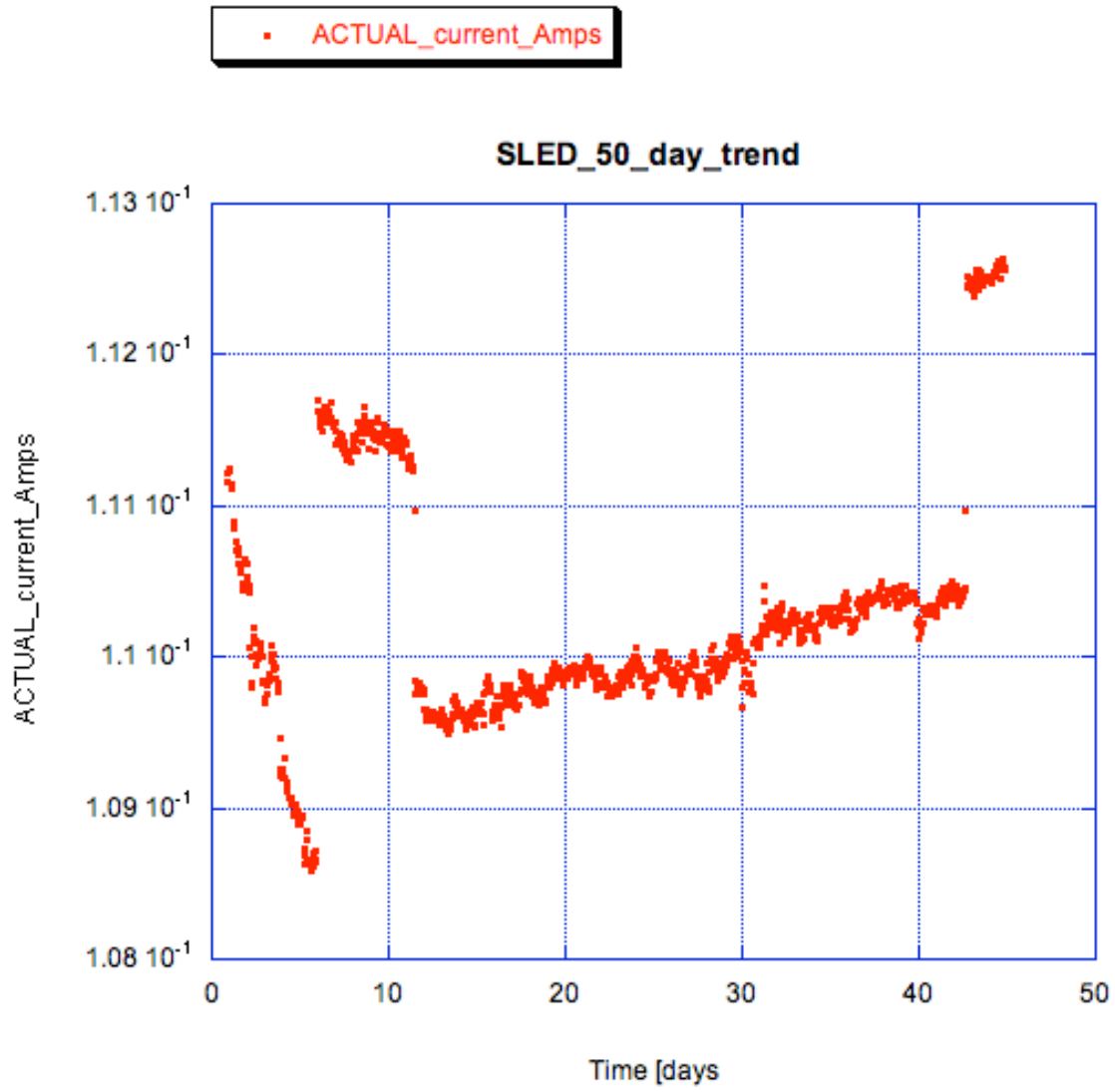


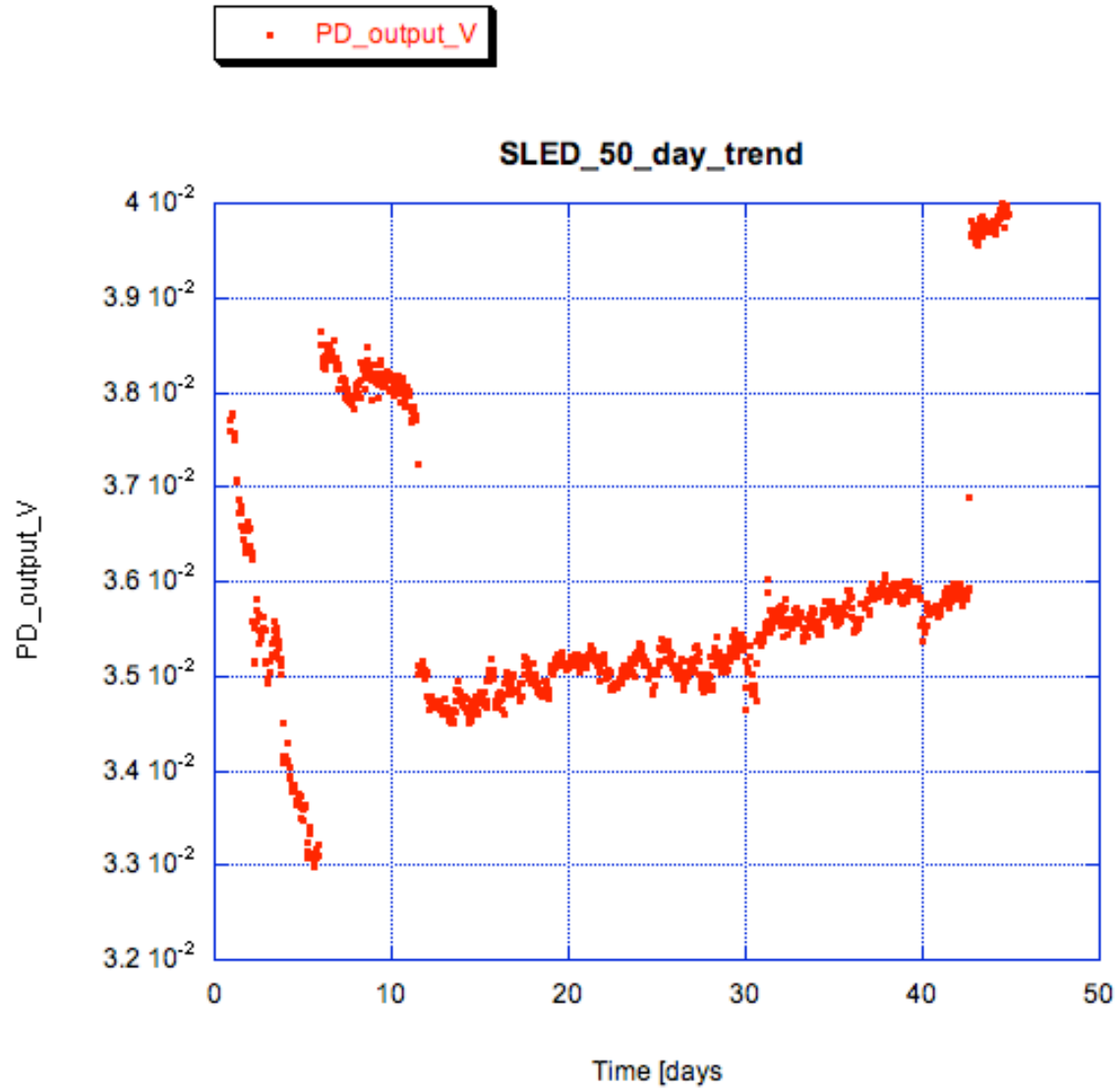


We repeated the data analysis after one month, over 50 days timescale.

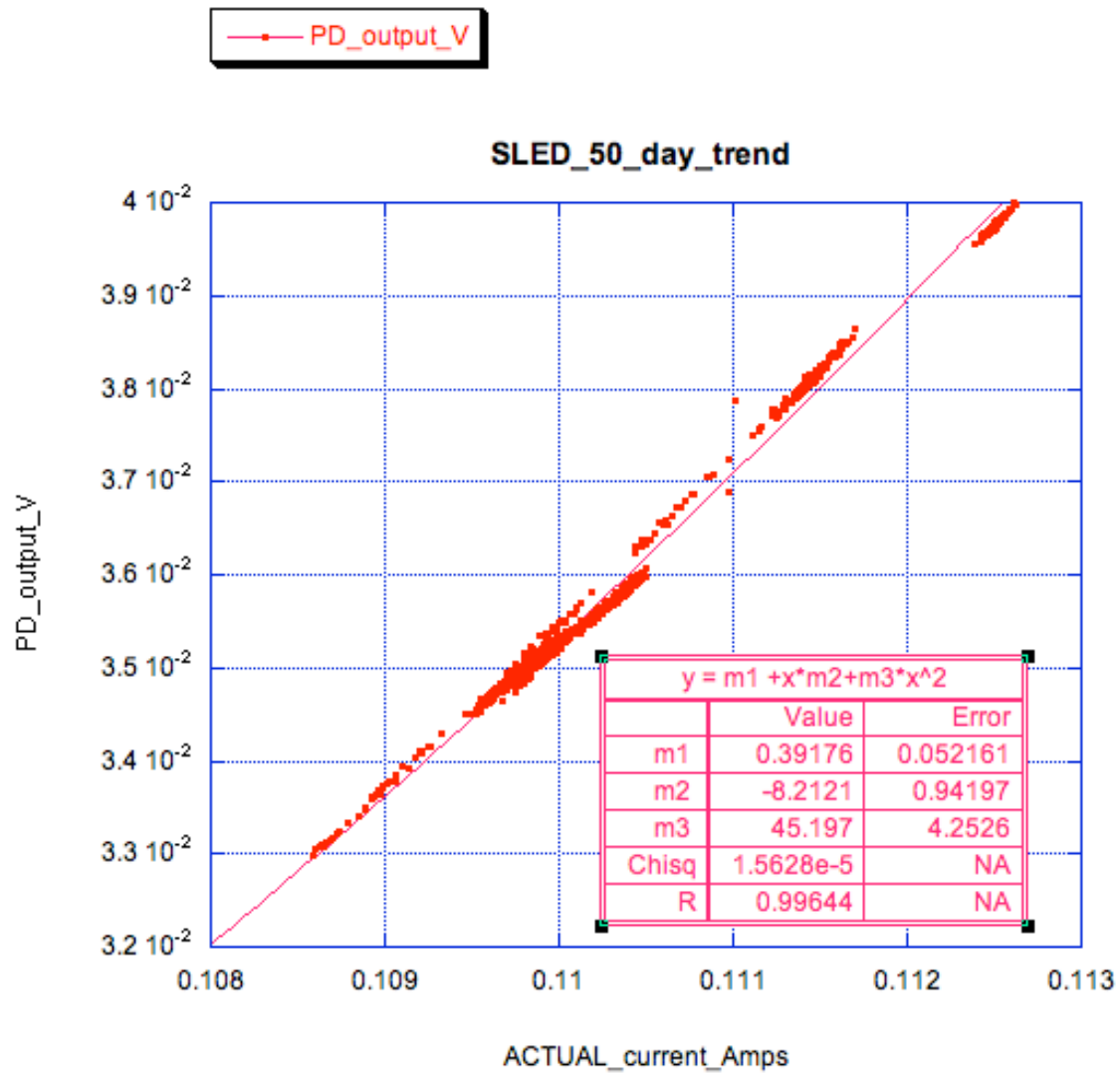
Again the set point jumps, and the actual current in the SLED and the monitor photodiode output current follow.







We made the same plot of actual current in the SLED vs. current in the PD, fit with a second order function, and plotted the residuals

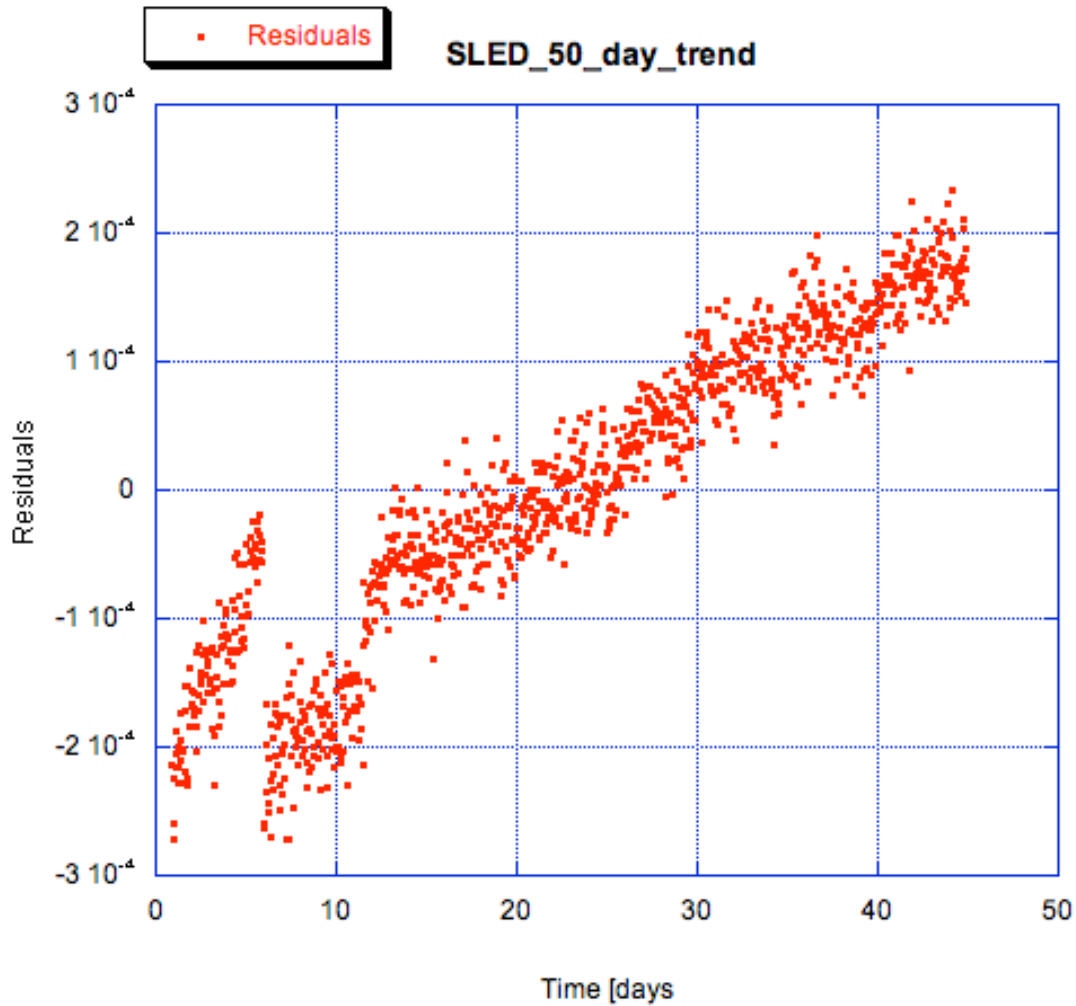


The residuals are then plotted as a function of time and show a small trend up, and a couple of discontinuities.

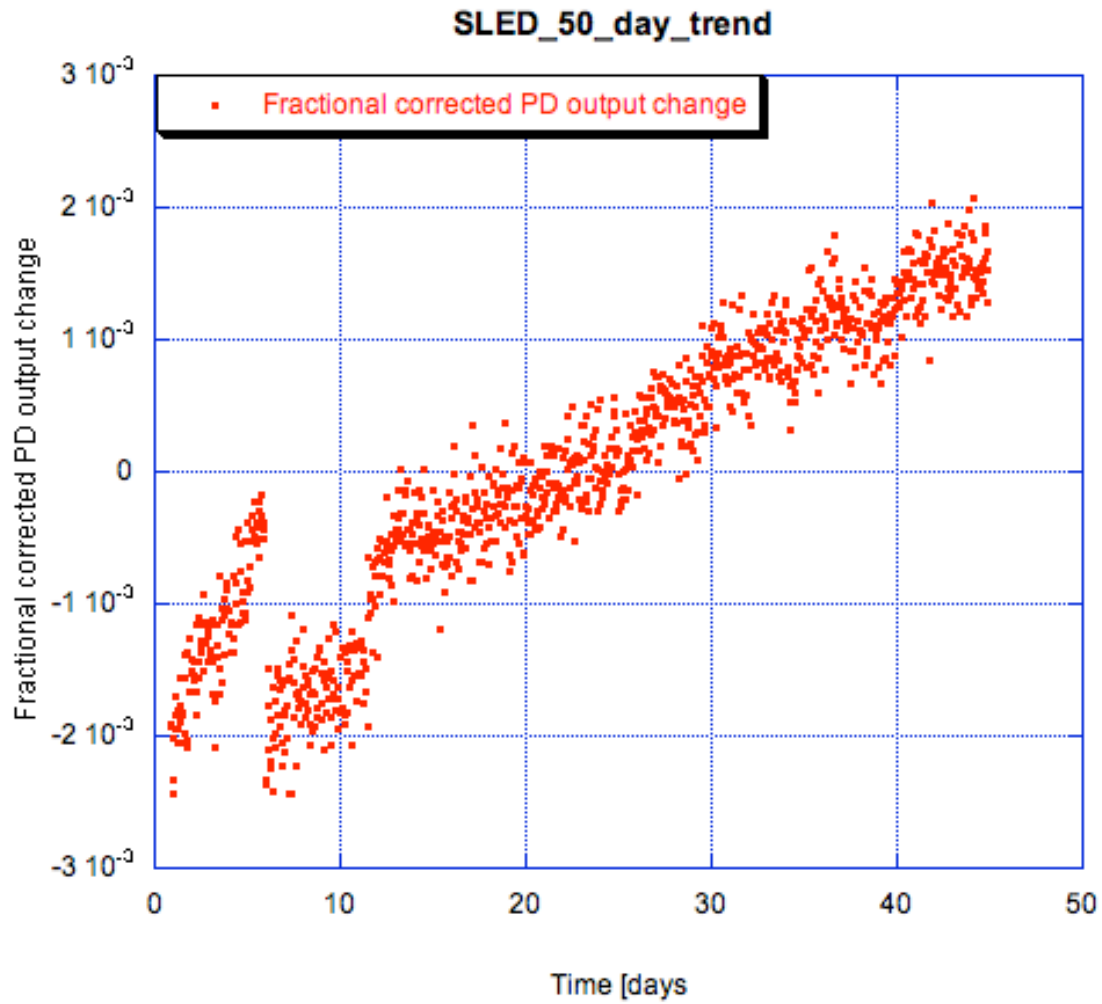
Strangely these discontinuities are in the first 15 days, that were studied in the 21 day's study, and no discontinuity was present even if it is the same data.

Some problem must be present in the data storage or analysis.

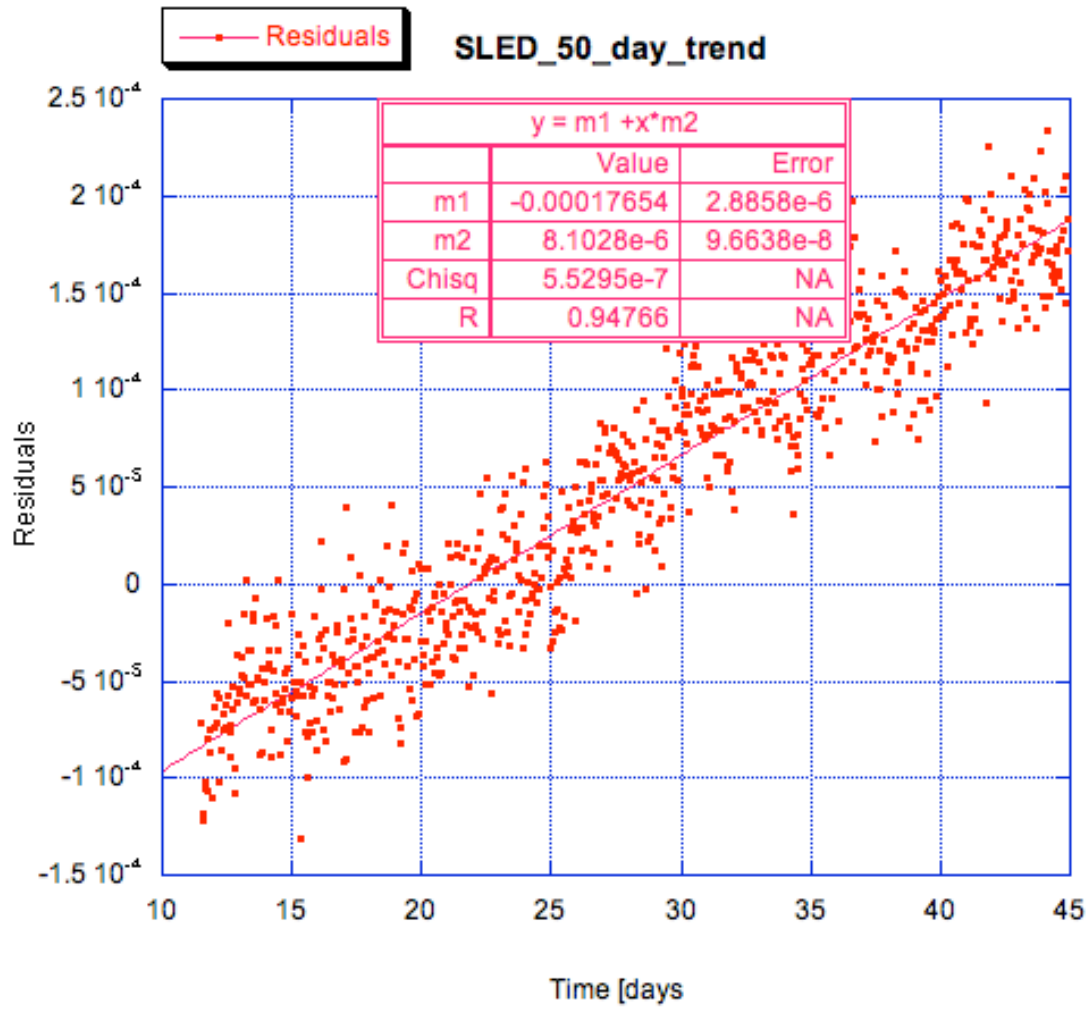
Anyways no decay vs. time is visible



dividing by the PD output we obtain the percent stability, which is of the order of few per thousand, in slow growth.



if we restrict the data to the last 30 days (cutting off the two discontinuities)



we fit the plot with a straight line and we plot the residuals (divided by the average monitor PD voltage) we get an r.m.s. of  $2.4 \times 10^{-4}$

