Degradation sources in the SolACES instrument – and how to correct them

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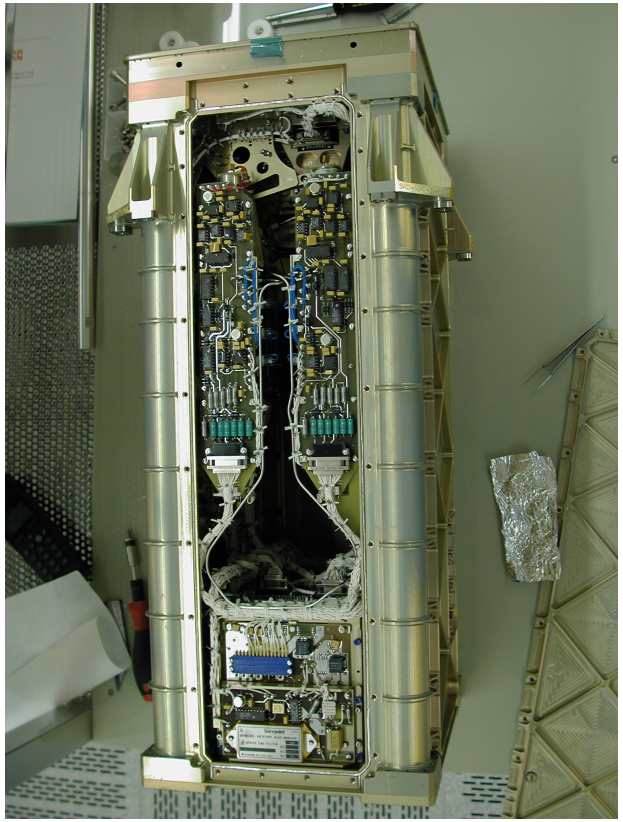
SolACES

- degradation sources
- measurement systems in SolACES
- Level 3 data product
- differential degradation
- changes in the overall evaluation
- double calibration method and results
- conclussion



SolACES – degradation sources

- in 1972 Dr. Gerhard Schmidtke used a Ni63 source to calibrate an EUV-detector
- in the figure the changes in the countrate at constant flux are shown.

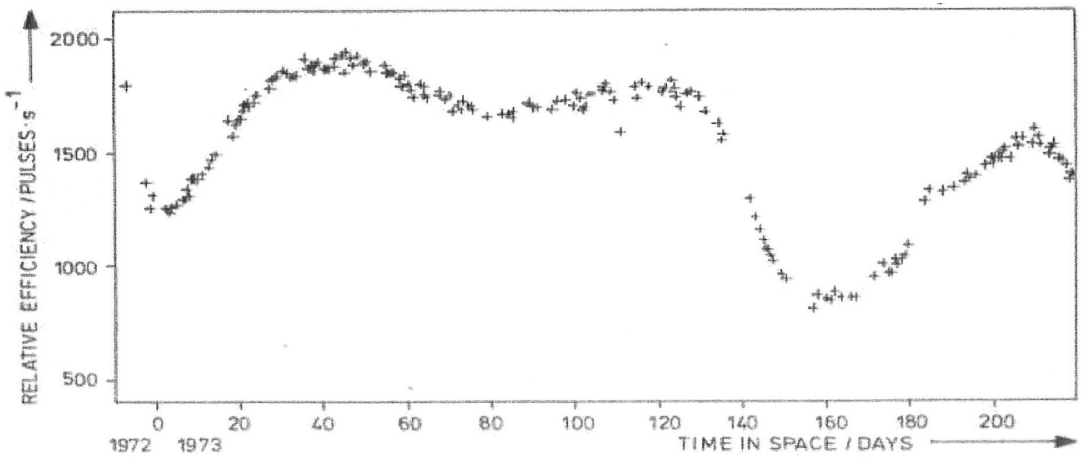


Figure 13a: Count rate changes of a Bendix MEM 306 multiplier using a nickel 63 radioactive beta source (Schmidtke et al., 1975).

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SolACES – degradation sources

- in 1972 Dr. Gerhard Schmidtke used a Ni63 source to calibrate an EUV-detector
- in the figure the changes in the efficiency are shown.
- The changes in the efficiency correlate very well with temperature differences measured.

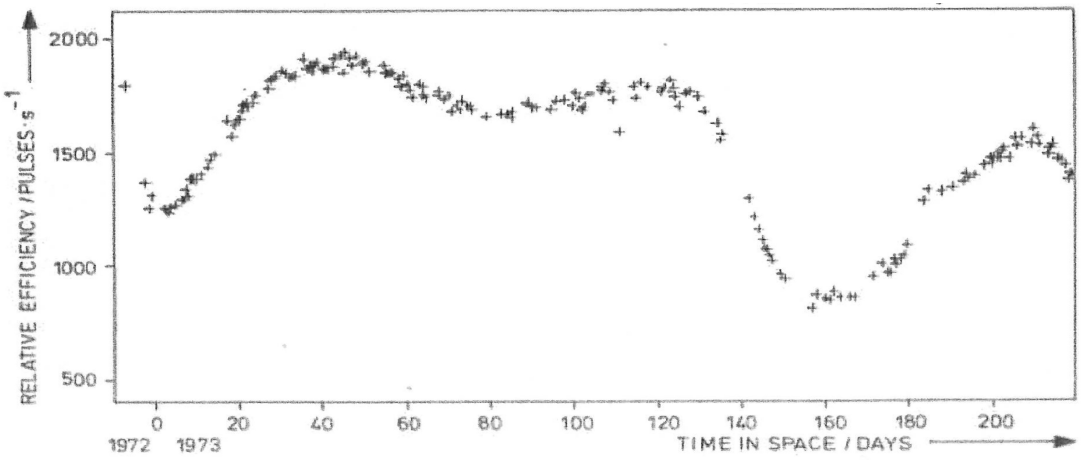

Figure 13a: Count rate changes of a Bendix MEM 306 multiplier using a nickel 63 radioactive beta source (Schmidtke et al., 1975).

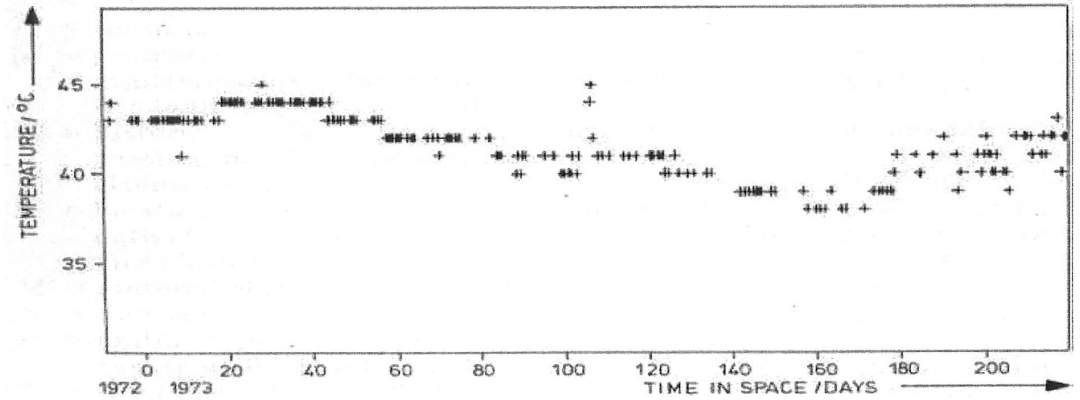

Figure 13b: Trace of the temperature changes during the mission of AEROS-A to be compared with the count rate changes during the same time (Figure 13a).

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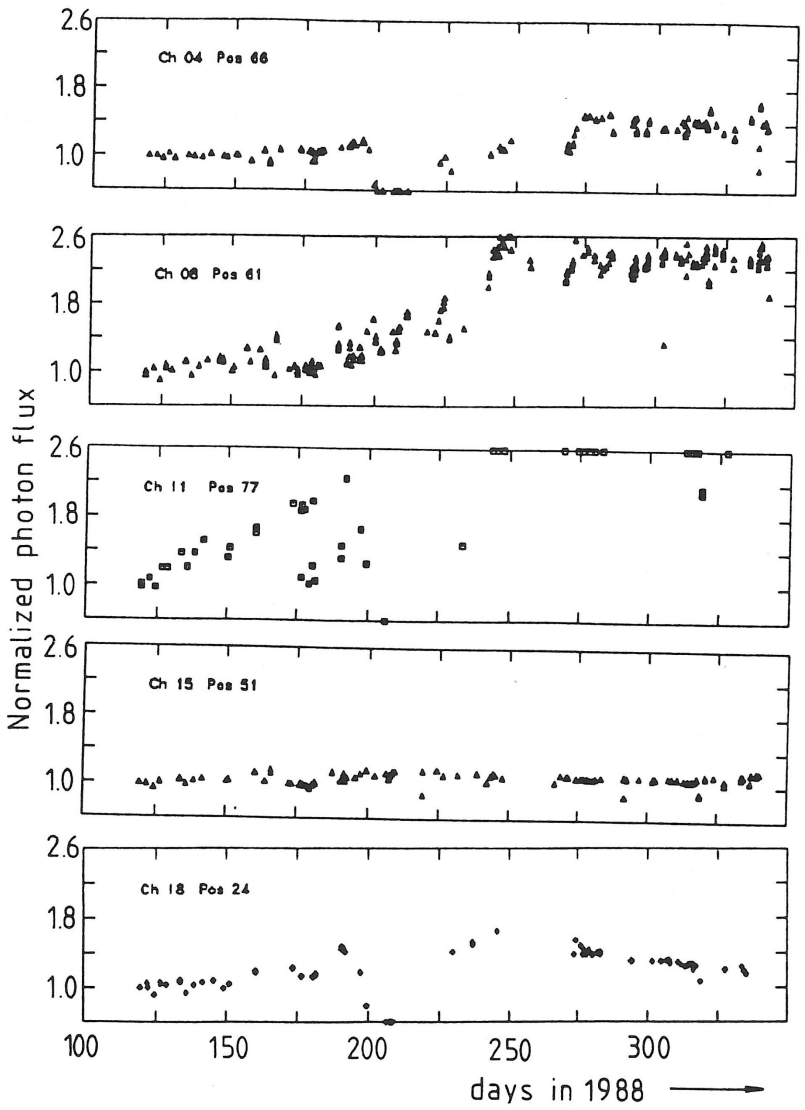
SolACES – degradation sources

- the figure on the right shows measurements of Ly-α
- 5 channels with 5 equal detectors, measuring at the same time and showing differences of a factor 2.6
- 5 different results →5 different efficiency curves.



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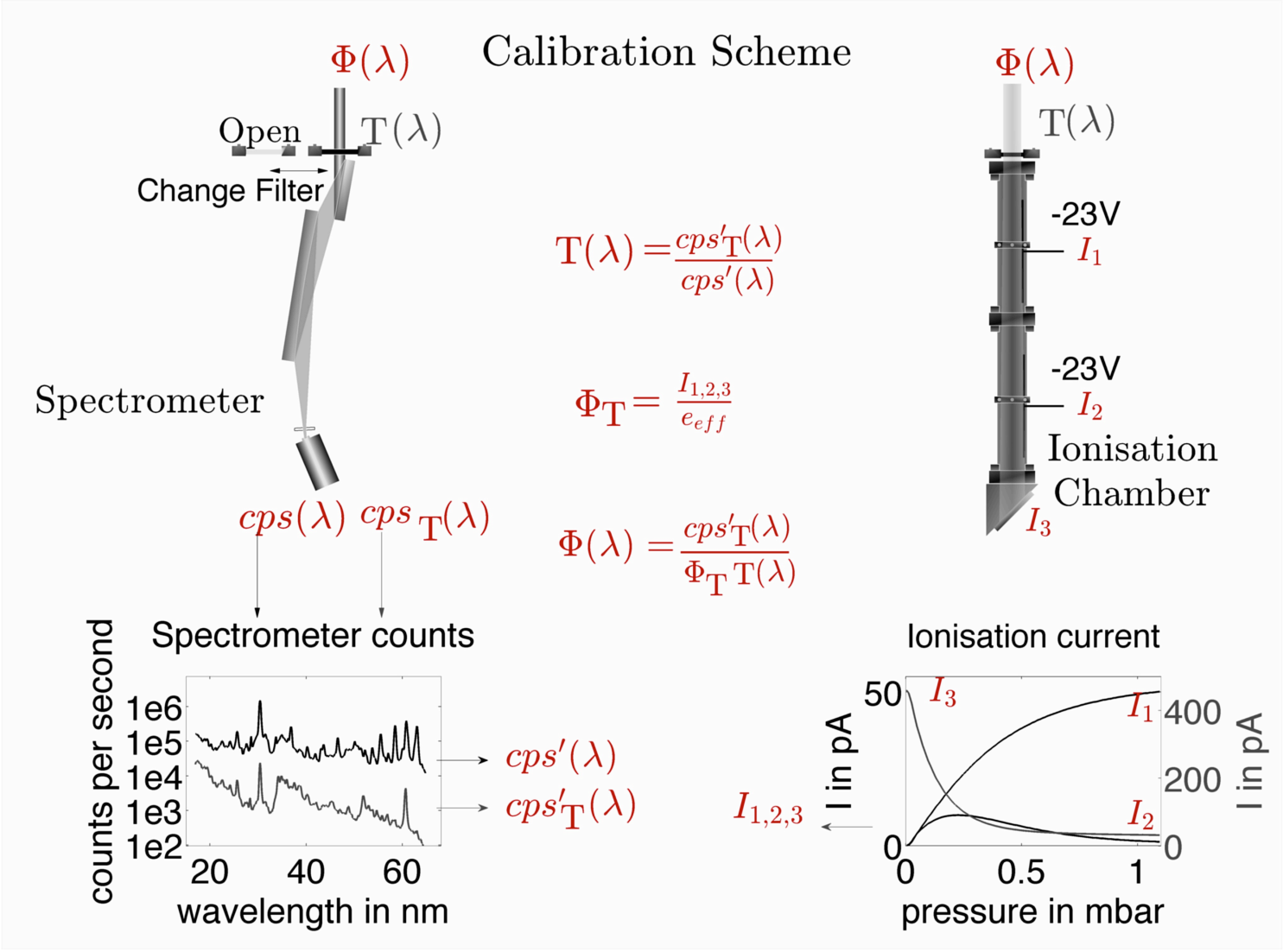
SolACES – measurement systems in SolACES



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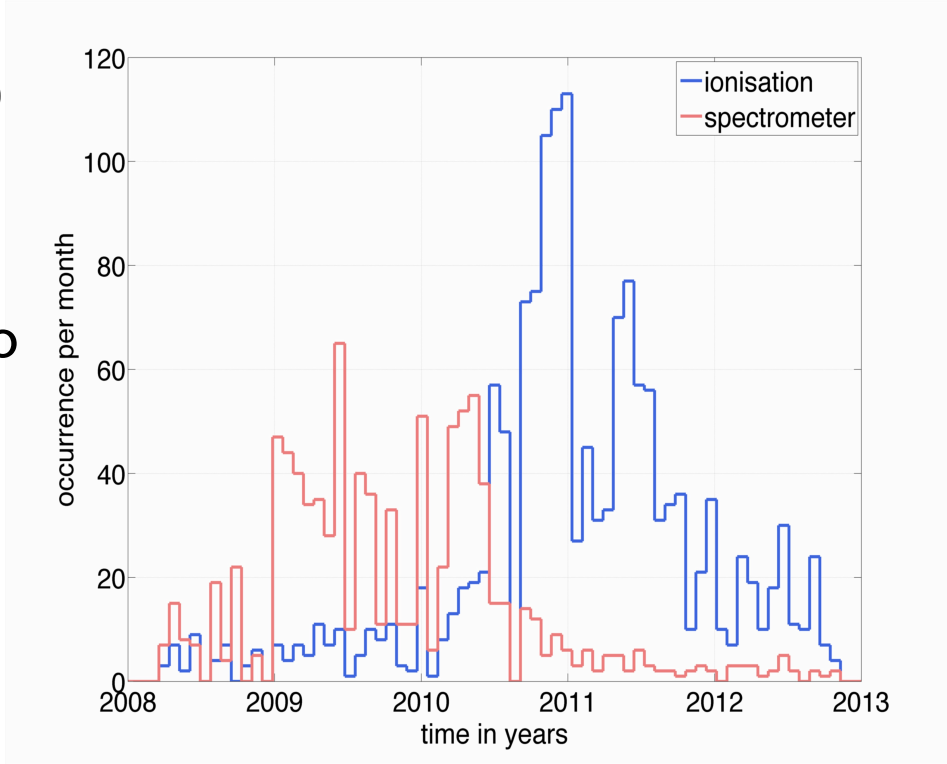
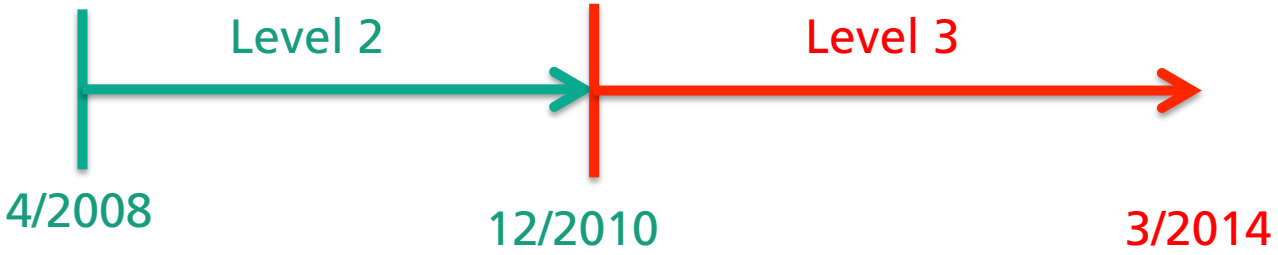
SolACES – Level 3 data product

- Level 2 contains of more than 500 spectra until the end of 2010
- Level 3 starts where Level 2 left off
  - differential degradation had to be corrected
  - → complete new set of parameters had to be developed after correction





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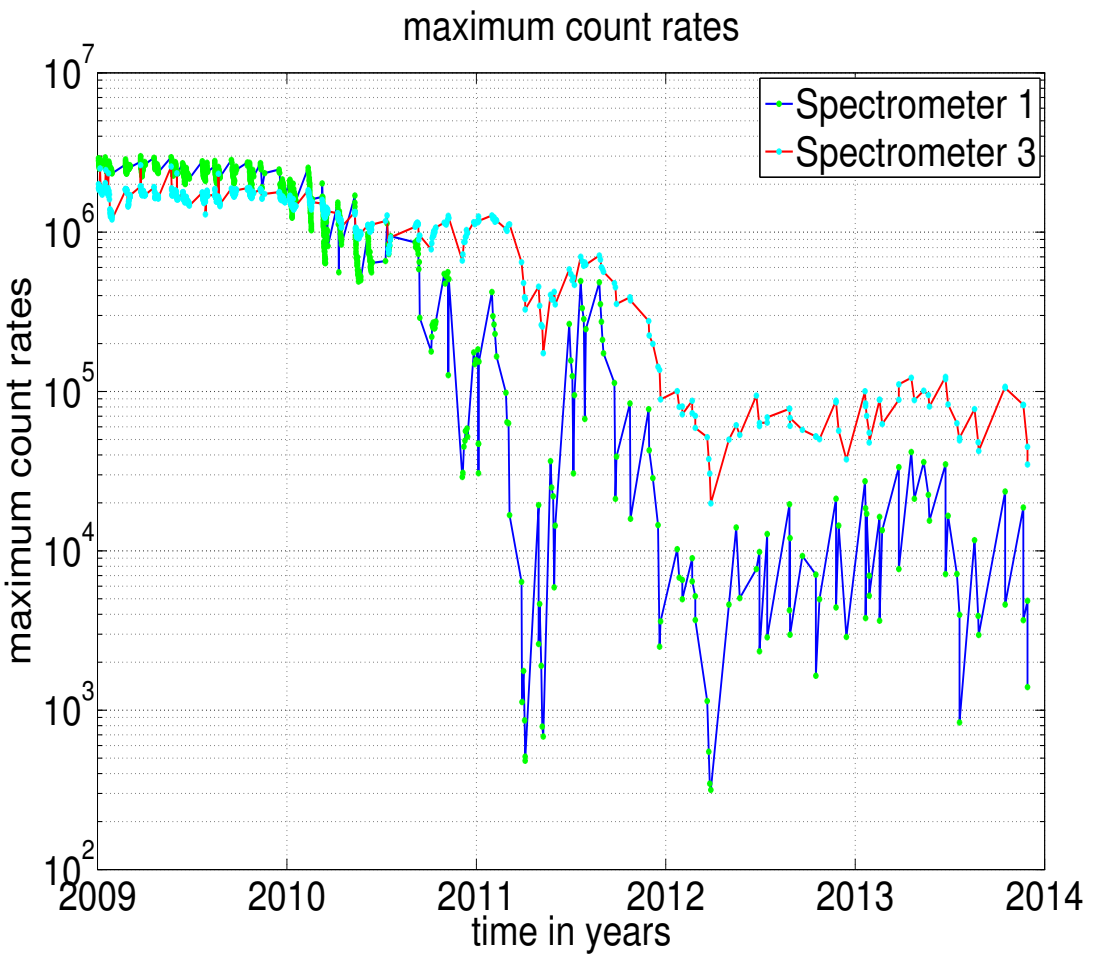
SolACES – Level 3 product

- max count rates drop since the middle of 2010 rapidly
- This leads to degradation during the acquisition of a spectrum
- drop of efficiency during one spectrometer measurement between a 5% and 60% →this is called

  differential degradation



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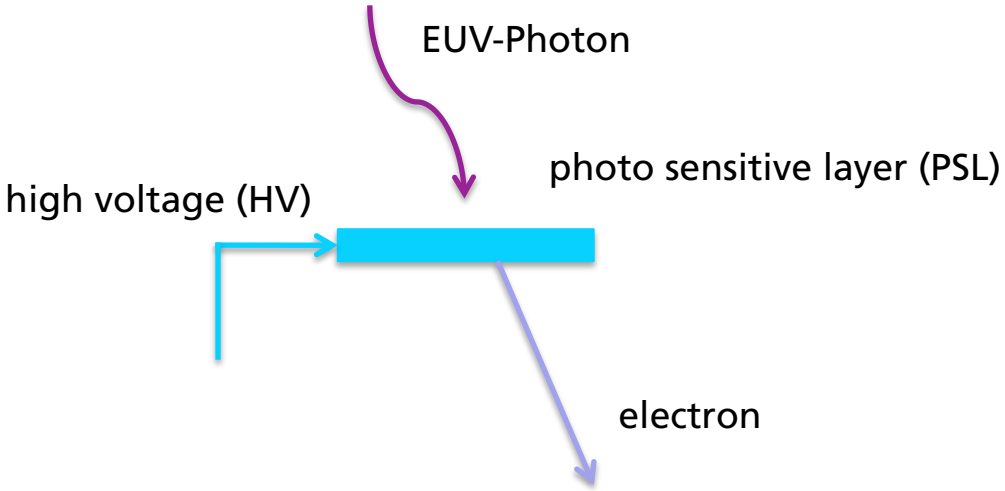
SolACES – differential degradation

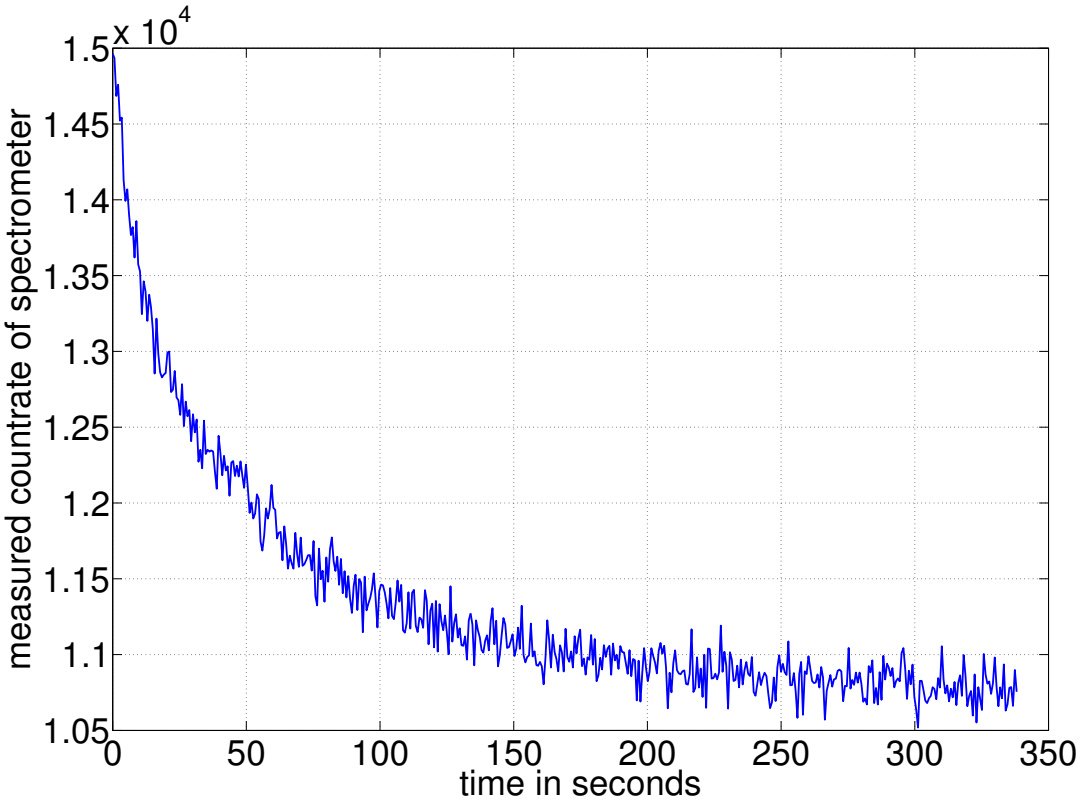
- HV supplies the PSL
- incoming photons ionize the material and detach electrons
- over time the internal resistance of the PSL rises
- → it takes longer to replenish the PSL with electrons
- less electrons are generated from the PSL due to incoming photons



- effect is dependent on previous measurements:
  - strong lines degrade the PSL more, higher drop in efficiency
  - smaller lines degrade the PSL less and even regenerate the efficiency

SolACES – differential degradation

- example of efficiency drop during a measurement at constant wavelength
- drop is dependent on incoming photons
- →on strong lines the spectrometer degrades more, on weak lines less or even recovers



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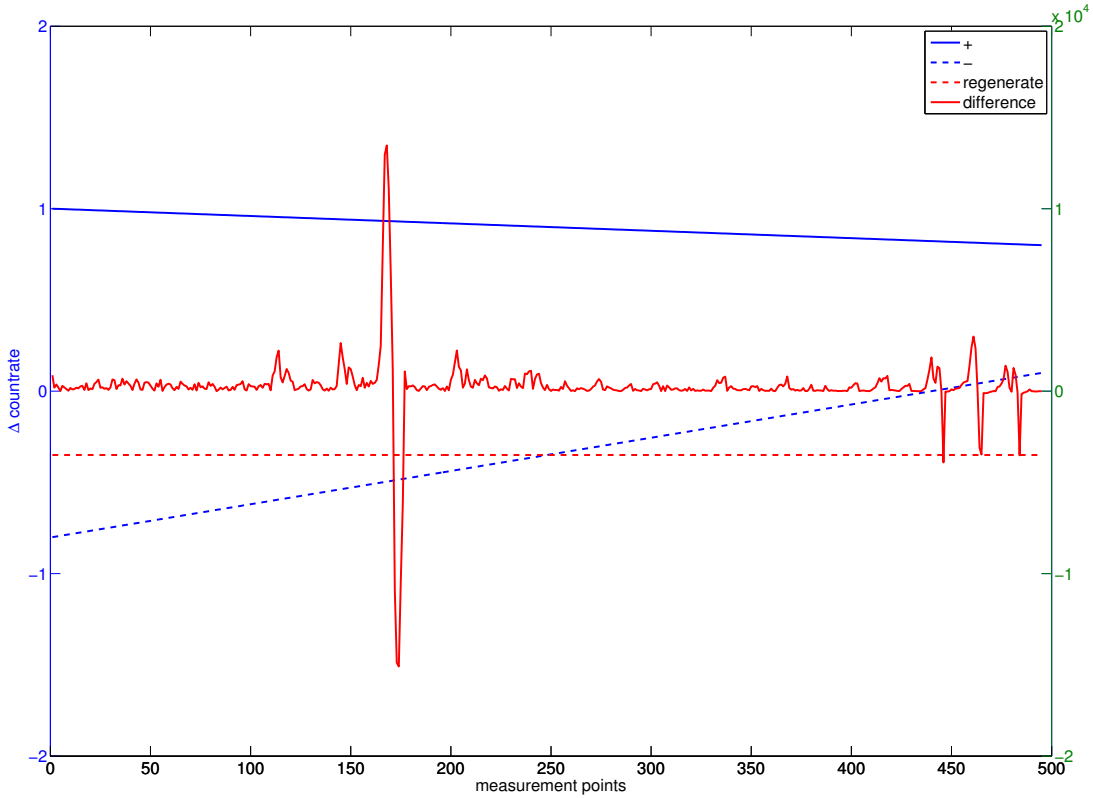
SolACES – differential degradation

- degradation is dependent on incoming photon flux→
- we use the differences in the countrate from point to point to estimate the degradation



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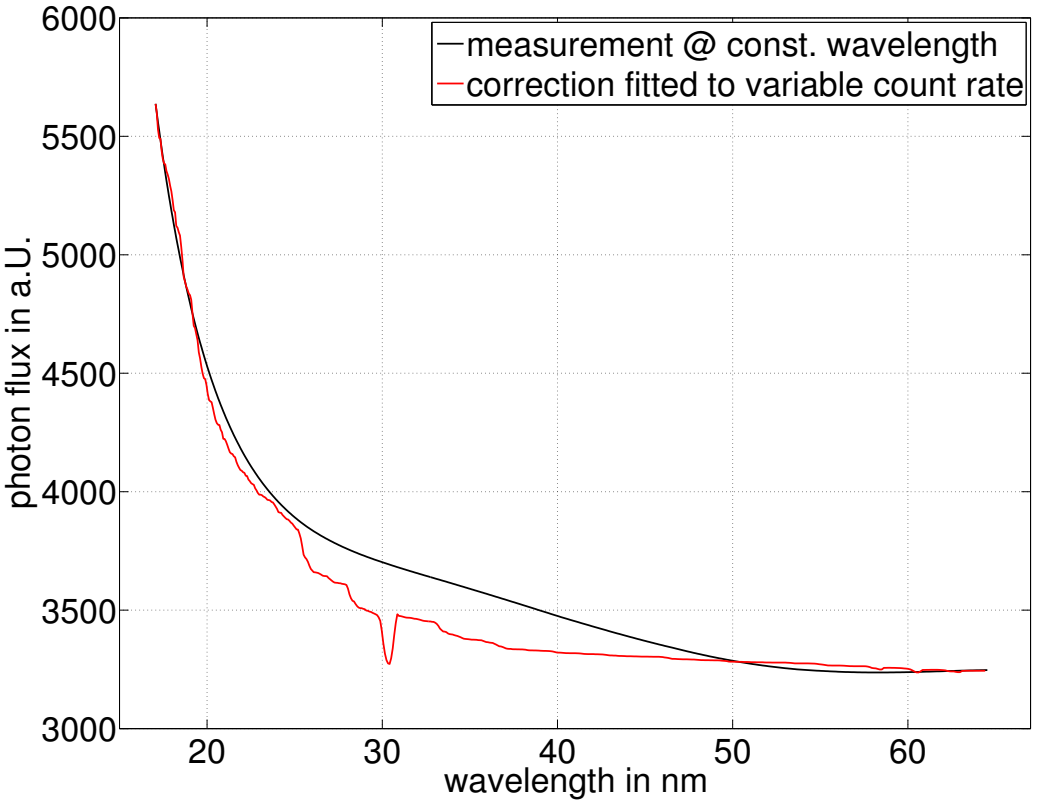
SolACES – differential degradation

- The reciprocal of the cummulative sum is being fitted to the relative known degradation for the actual countrate



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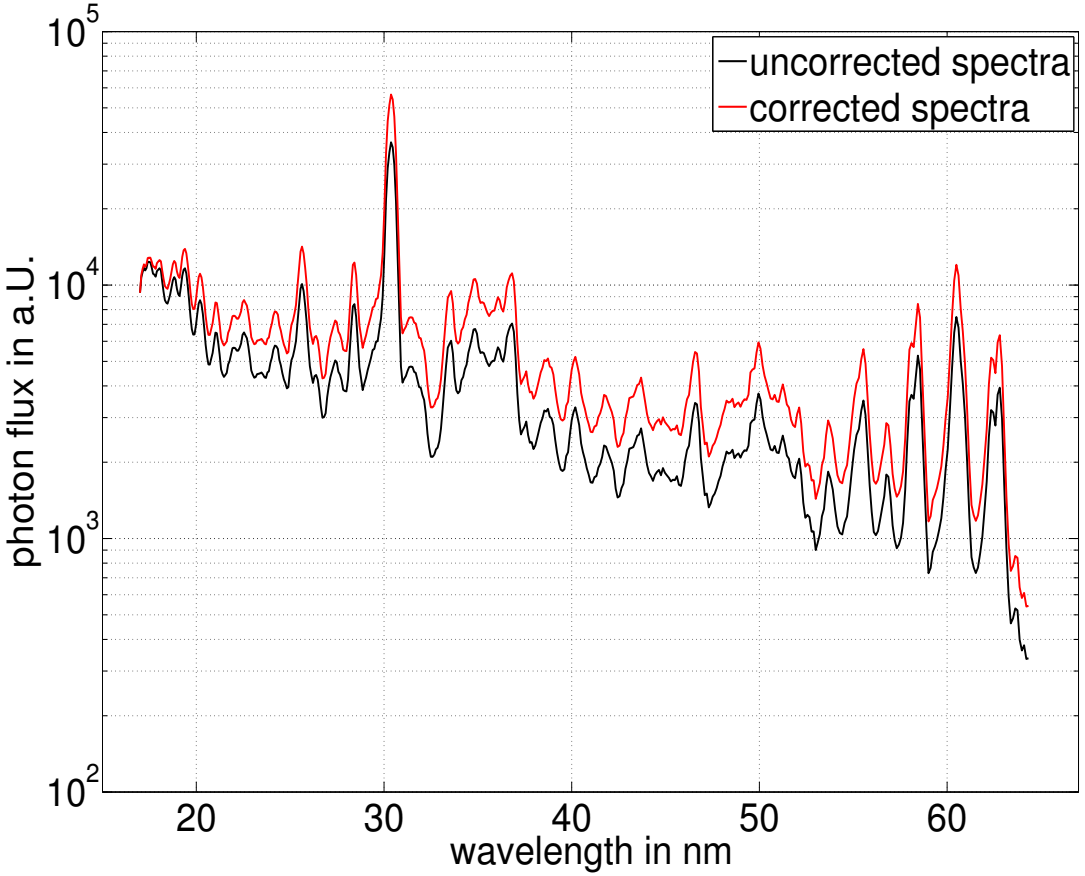
SolACES – differential degradation

- correcting the spectra with the estimated degradation
- the correction leads to a different qualitative spectra
- all other corrections have to be applied to the new spectra



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SolACES – changes in the overall evaluation

- dead time correction over the FWHM of the HeII line
- varying the dead time to fit the spectrometer resolution

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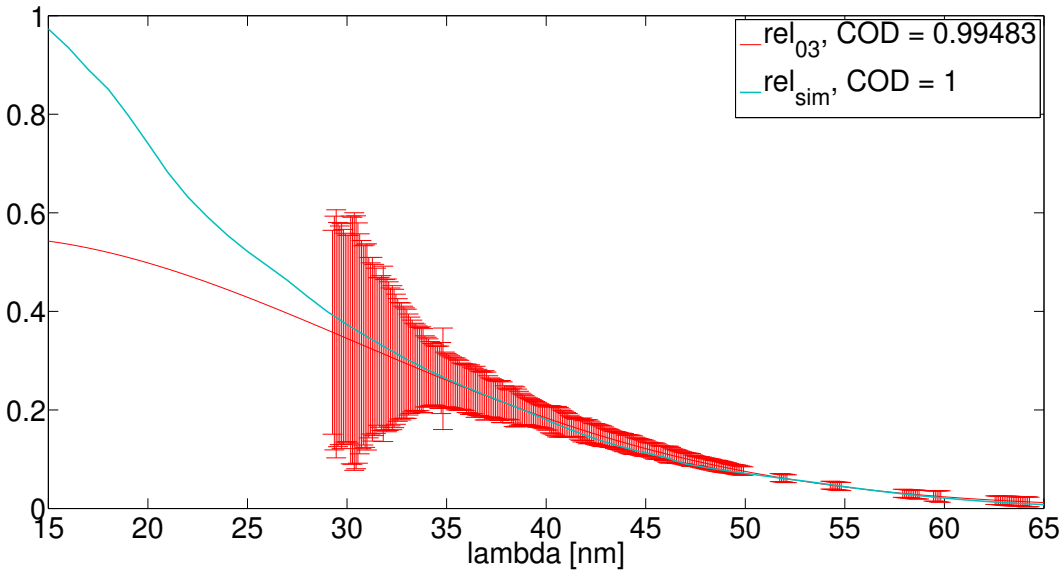
SolACES – changes in the overall evaluation

- recalculating the relation from first optical order to second optical order
- comparison with theoretical simulation second optical order relation
- simulation and calculation have a Correlation of 99.483% for the wavelength region above 34nm.
- relation is difficult to calculate below 34nm



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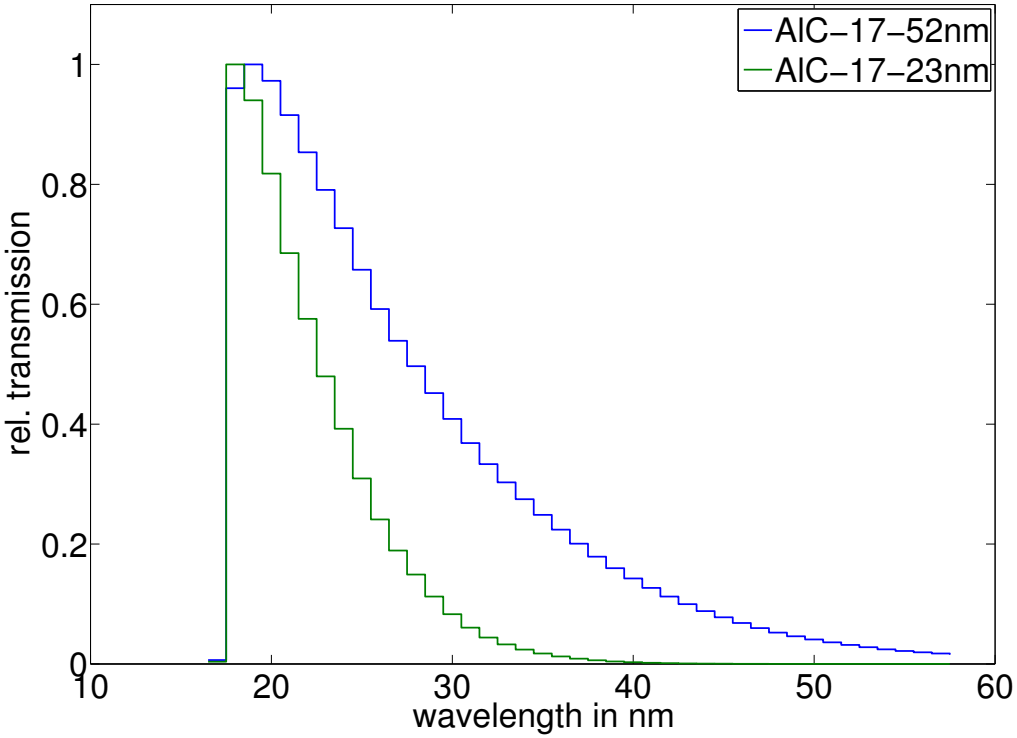
SolACES – double calibration method and results

- The calibration is based on a simulation of the ionization currents inside the chamber
- the current is dependent on the incoming photon flux
- We choose a double calibration in order to simulate specific wavelength regions seperatly in this case with to AlC-filters



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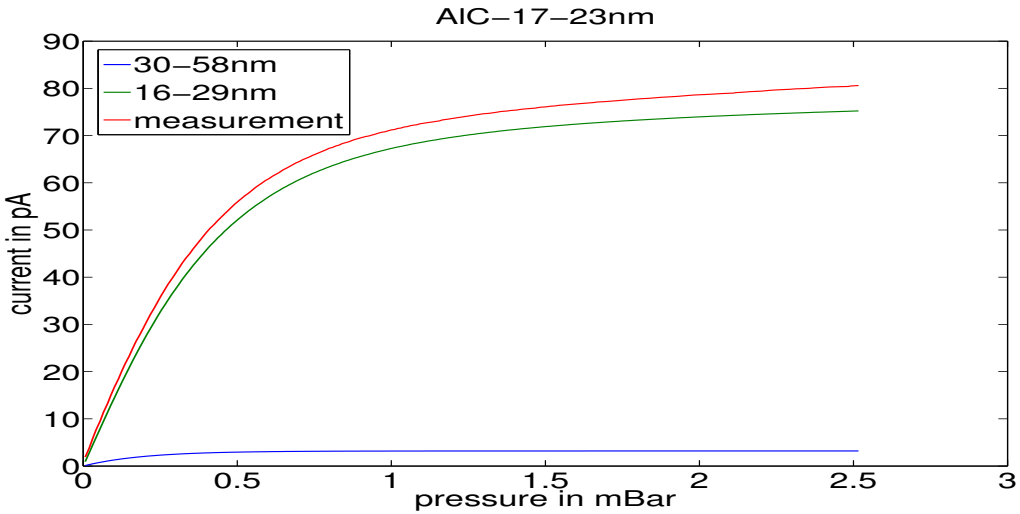
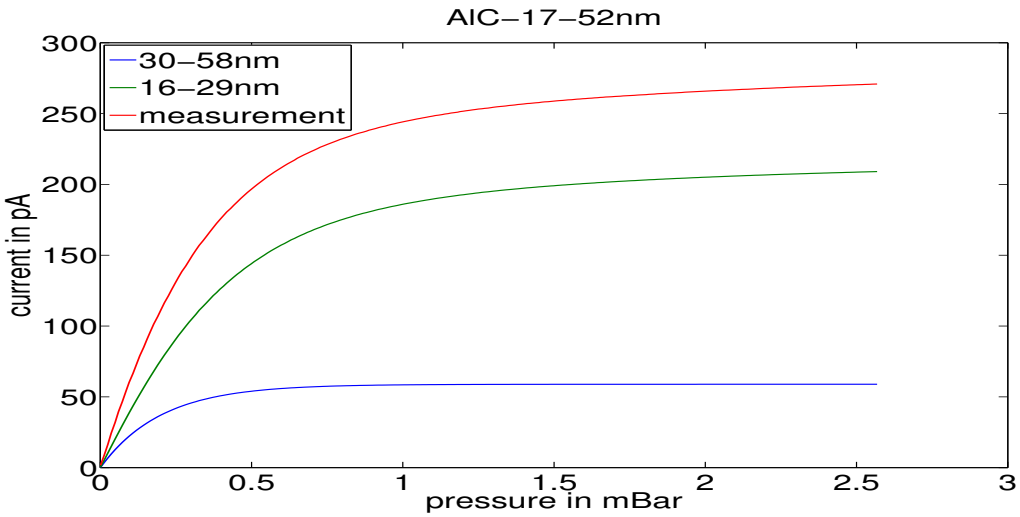
SolACES – double calibration method and results

- The calibration with AlC-17-23nm estimates the photon flux in the region from 16-29nm very exactly-> the current is dominated by this region



- The calibration with AlC-17-52nm gives detail to the region above 29nm. Especially to the HeII line



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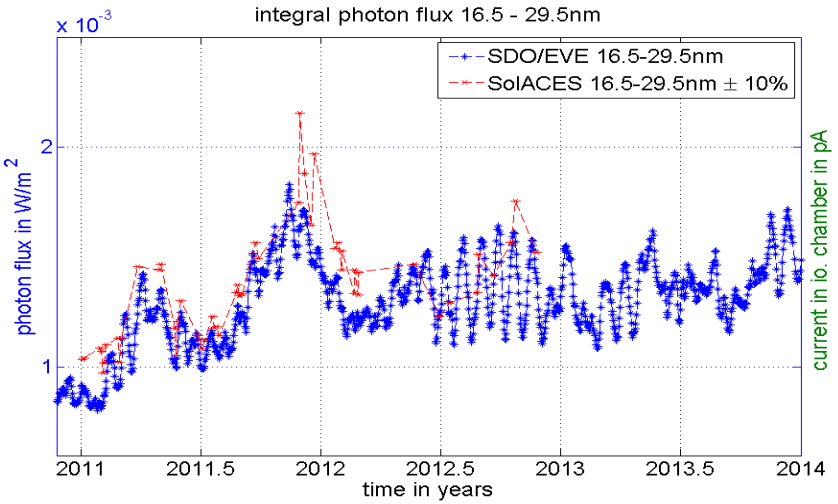
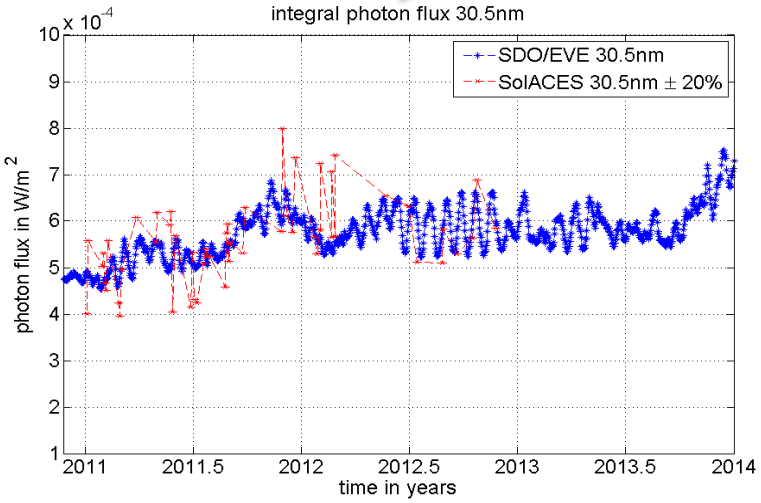
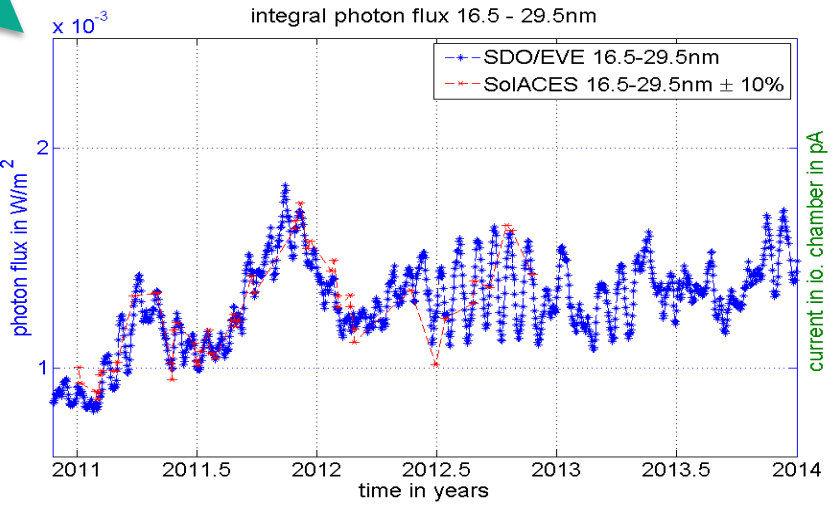
SolACES – double calibration method and results

- The precalibration focuses on the region from 16-29nm.
- The final calibration sets the details for the region from 16-29nm and also fine tunes the other regions







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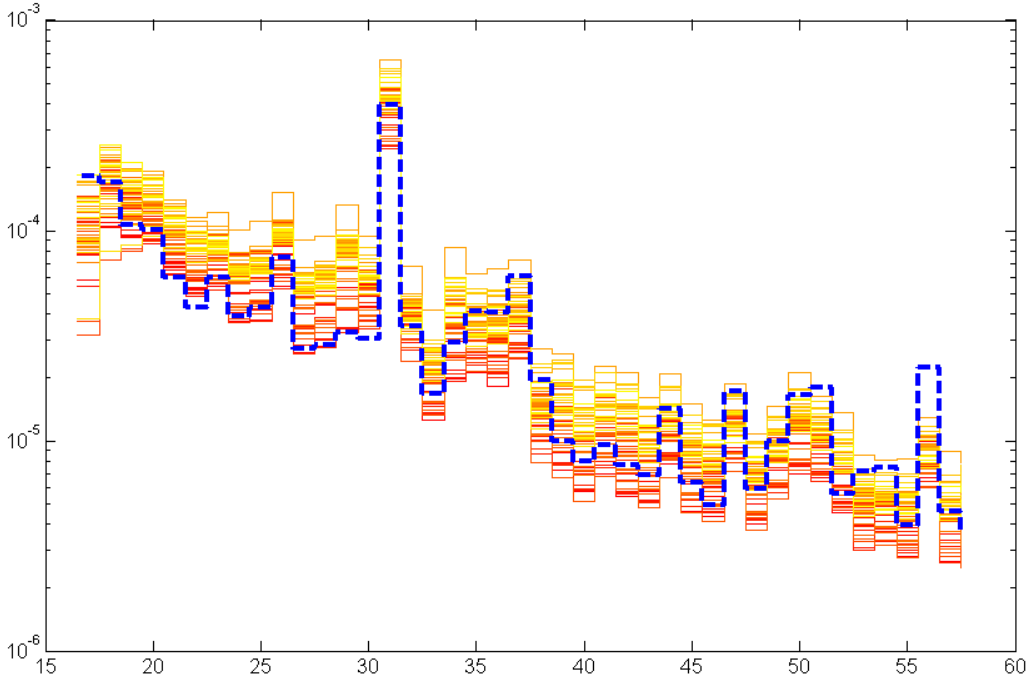
SolACES – double calibration method and results

- The results after double calibration show very good correlation with an example spectra from SDO/EVE L3V4



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SolACES – conclusion

- degradation is still a big challenge in the EUV-region
- we can estimate the differential degradation at fast changing countrates
- the methods will be applied in the Level 3 dataset that is soon be available
- we get promissing results with the double calibration method.