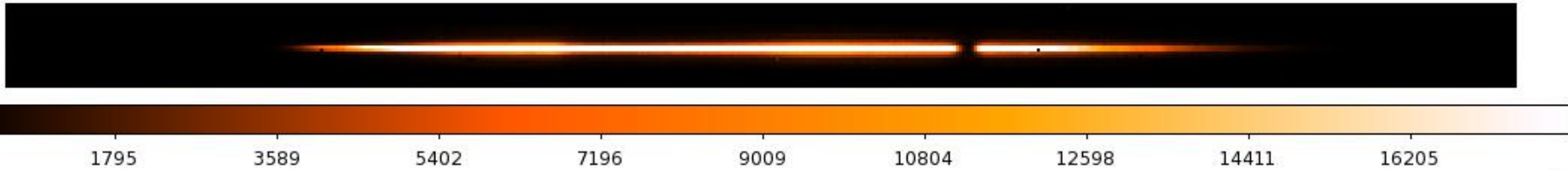


Mimicking the observation of an exoplanet transit

Analysis of a 3-hour exposure acquired at ISIM-CV3 and
assessment of systematic effects

G. Giardino, S. Birkmann, P. Ferruit and ESA SOT

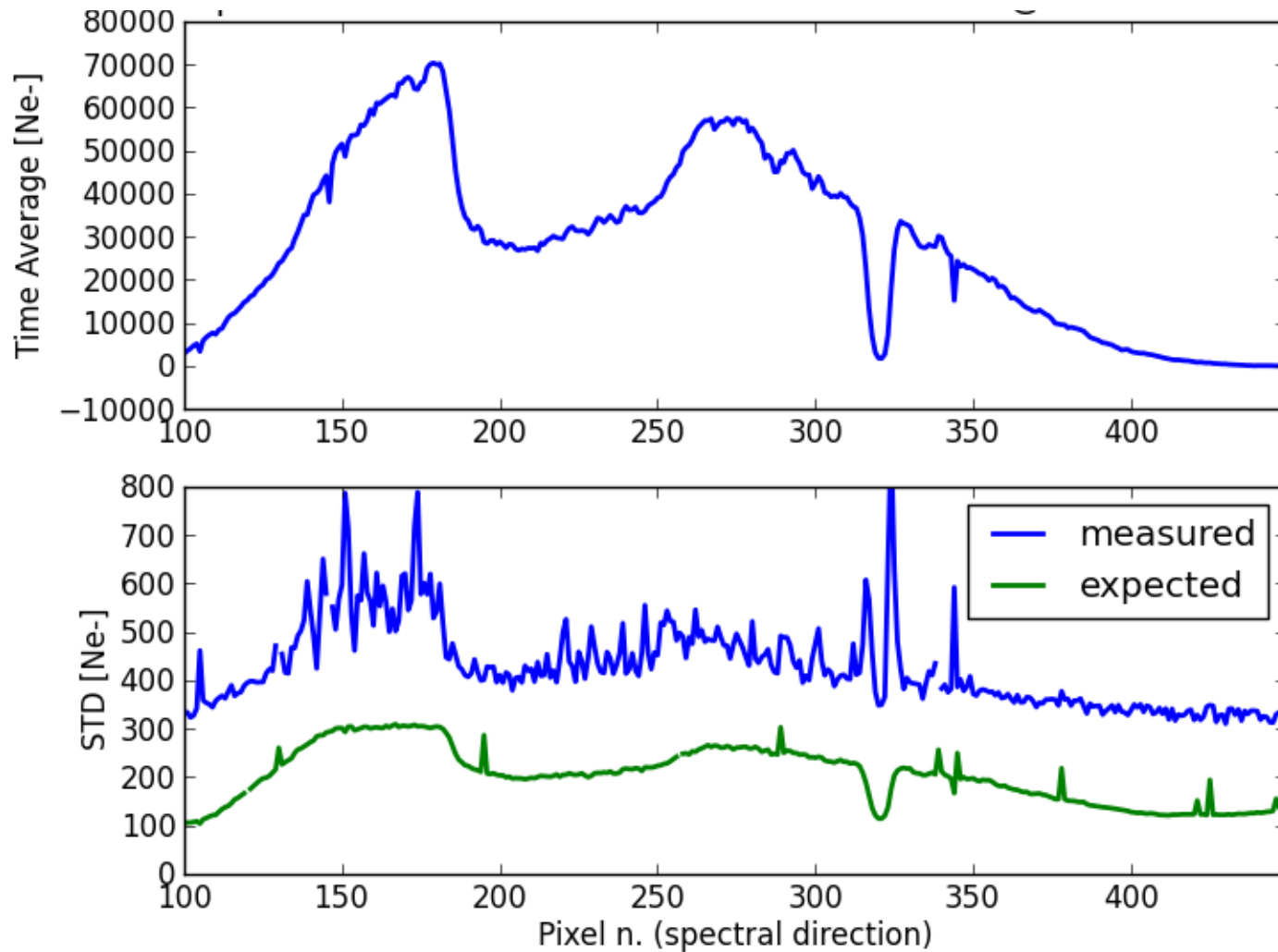
3-h exposure during ISIM-CV3



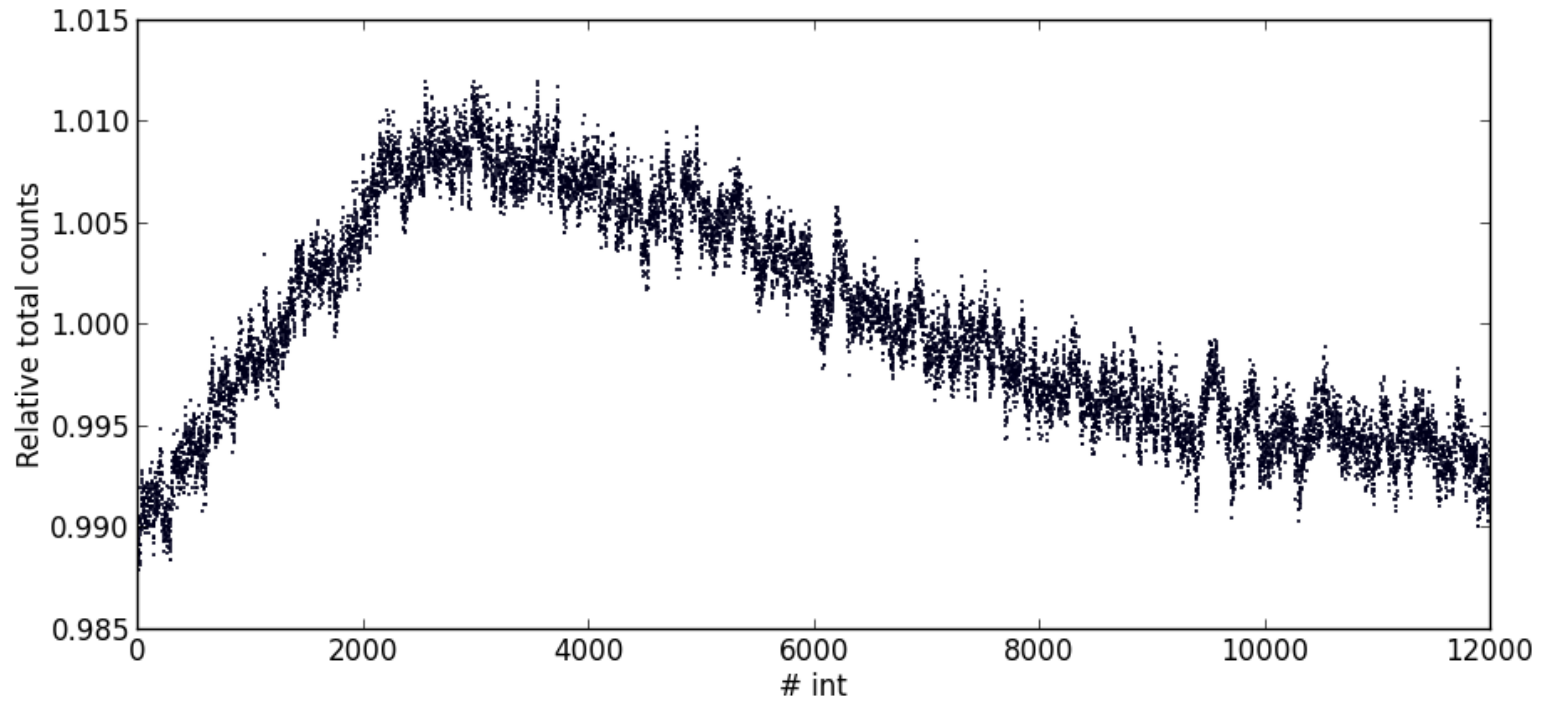
- PRISM
- 12,000 integrations
- WINDOW 512x32
- $t_g = 0.22$ s
- $n_g = 3$
- $t_{\text{int}} = (n_g - 1)t_g = 0.45$ s
- Source with JWST-like PSF
- Drift and jitter
- No requirements on the source in terms of flux stability

➔ Count-rate image produced by our standard ramp-to-slope pipeline for window mode

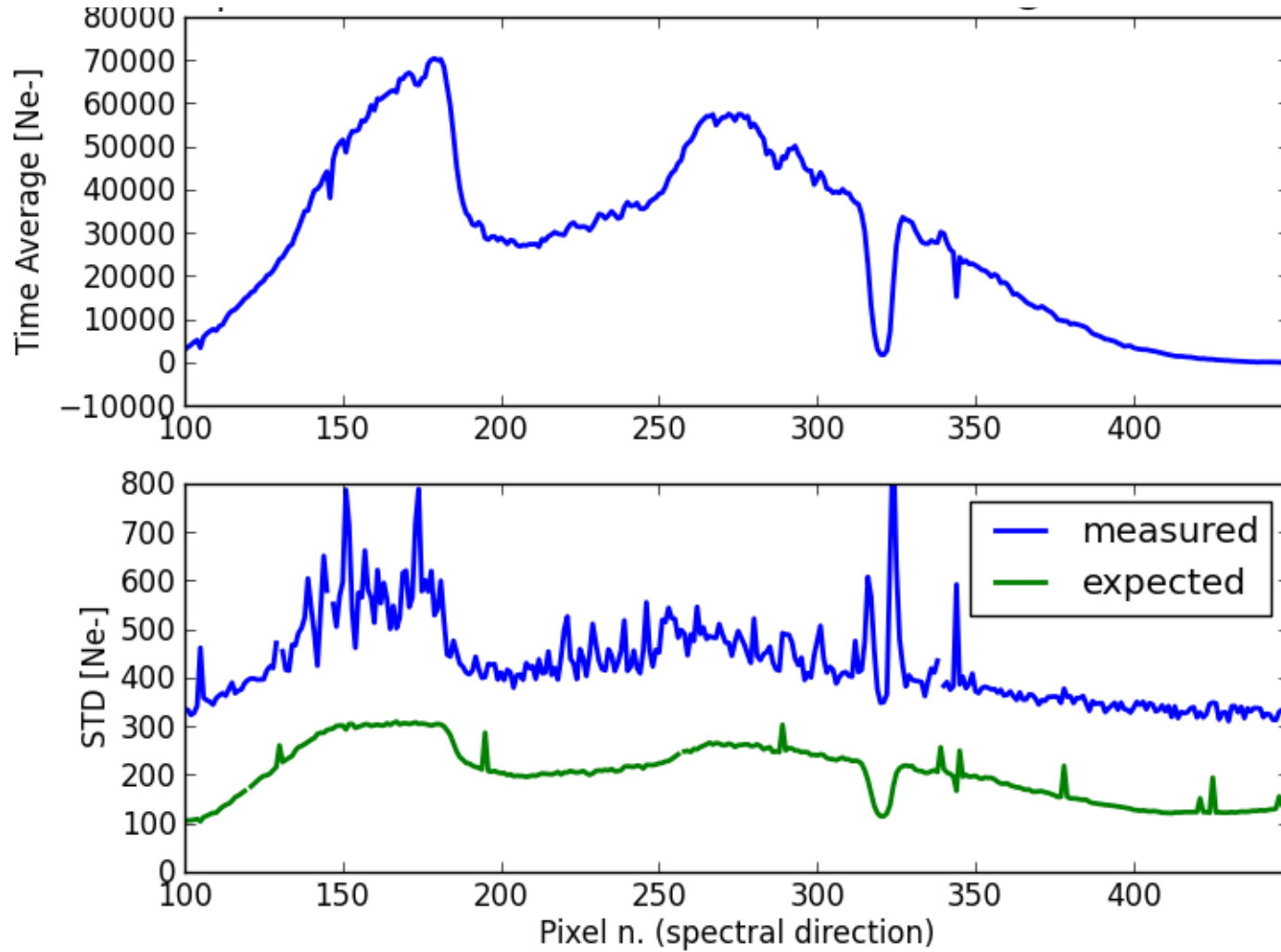
“raw” count-rate - collapsed trace



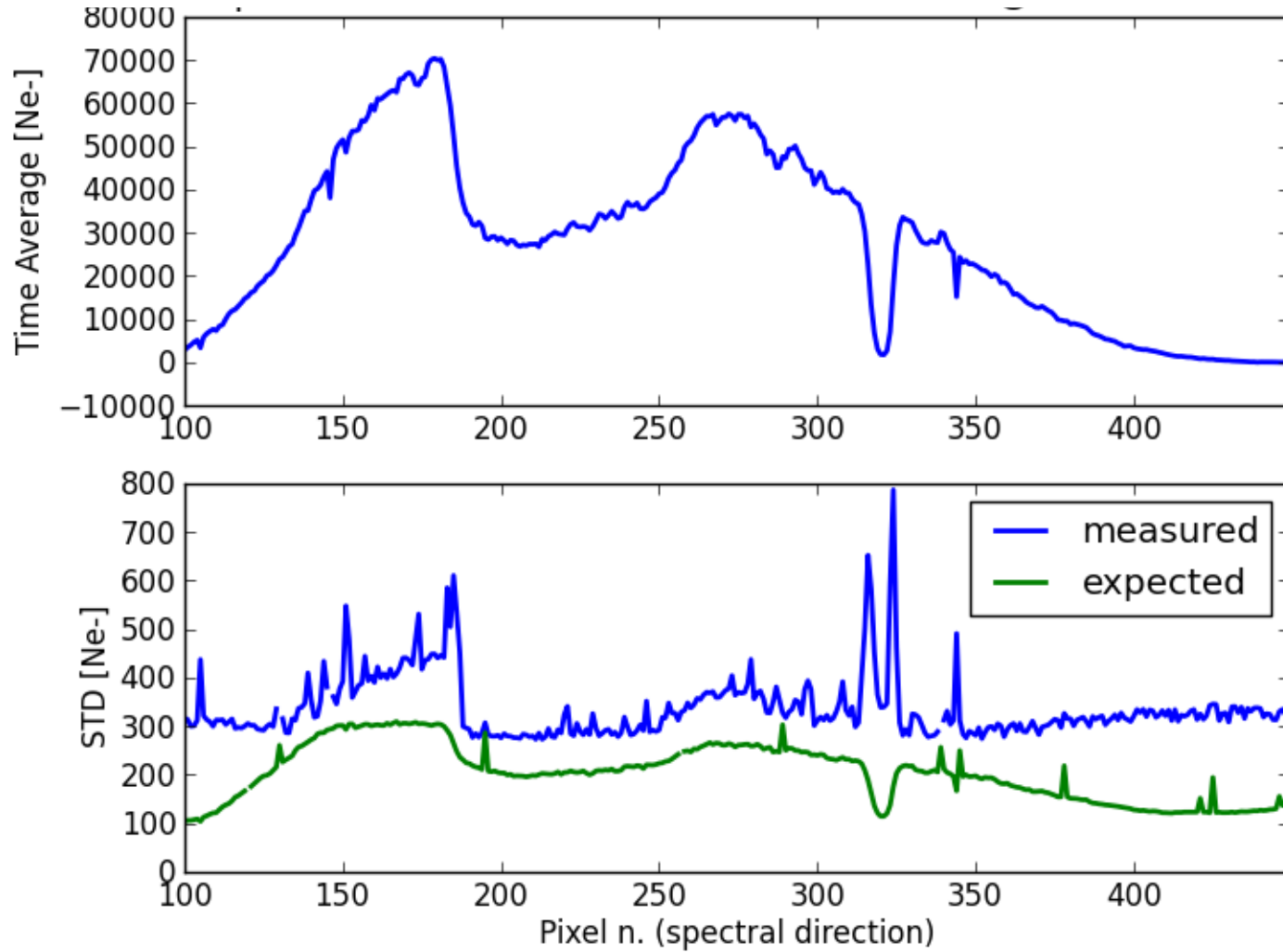
White light curve



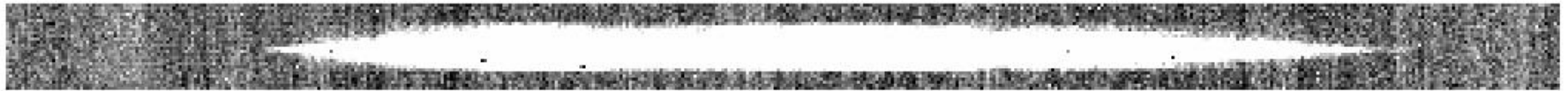
“raw” data (collapsed trace)



Normalize by white-light curve



1/f noise removal or 'destriping'



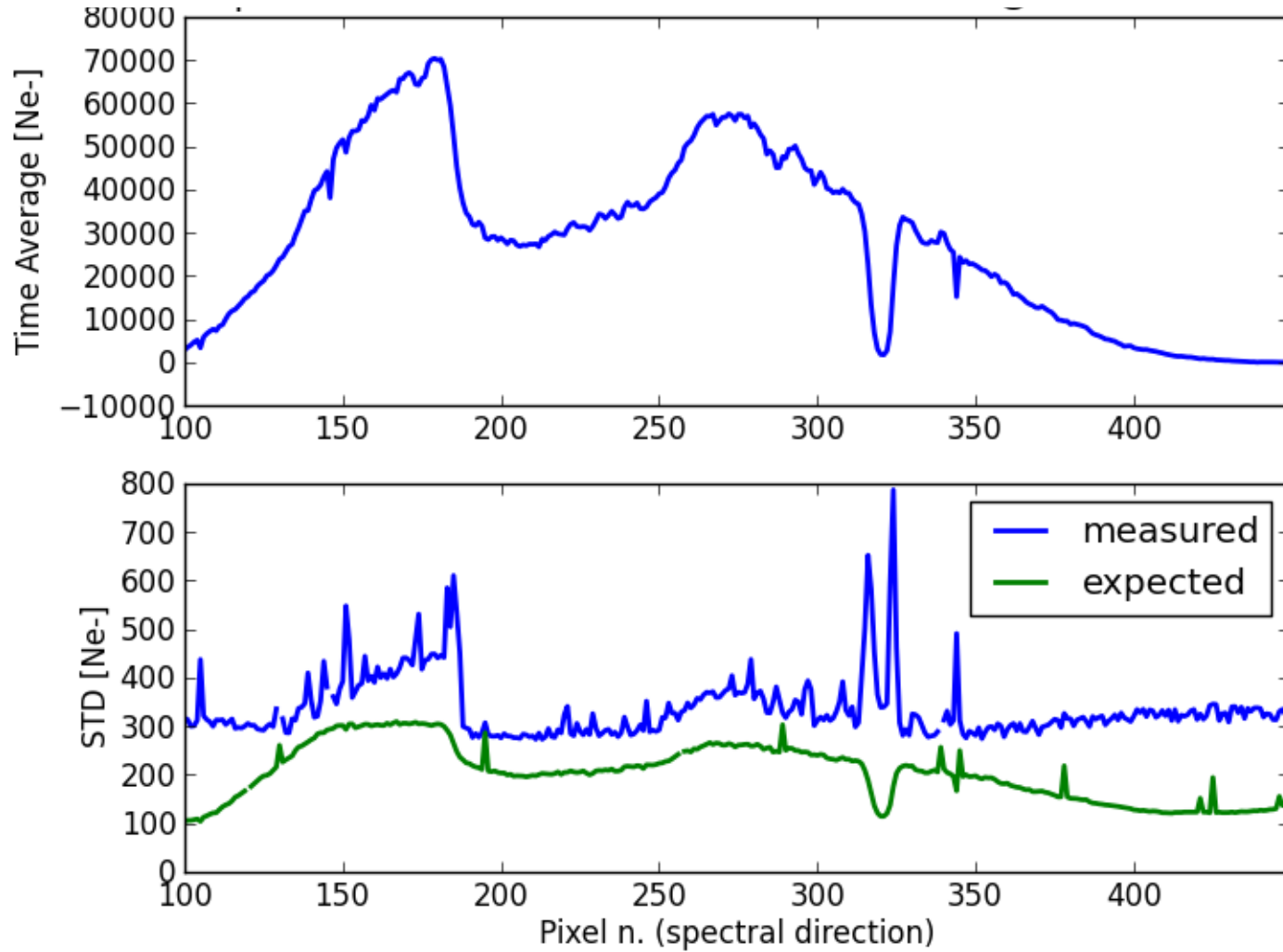
-80 -60 -40 -20 0.098 20 40 60 80

Basic algorithm to remove 1/f noise

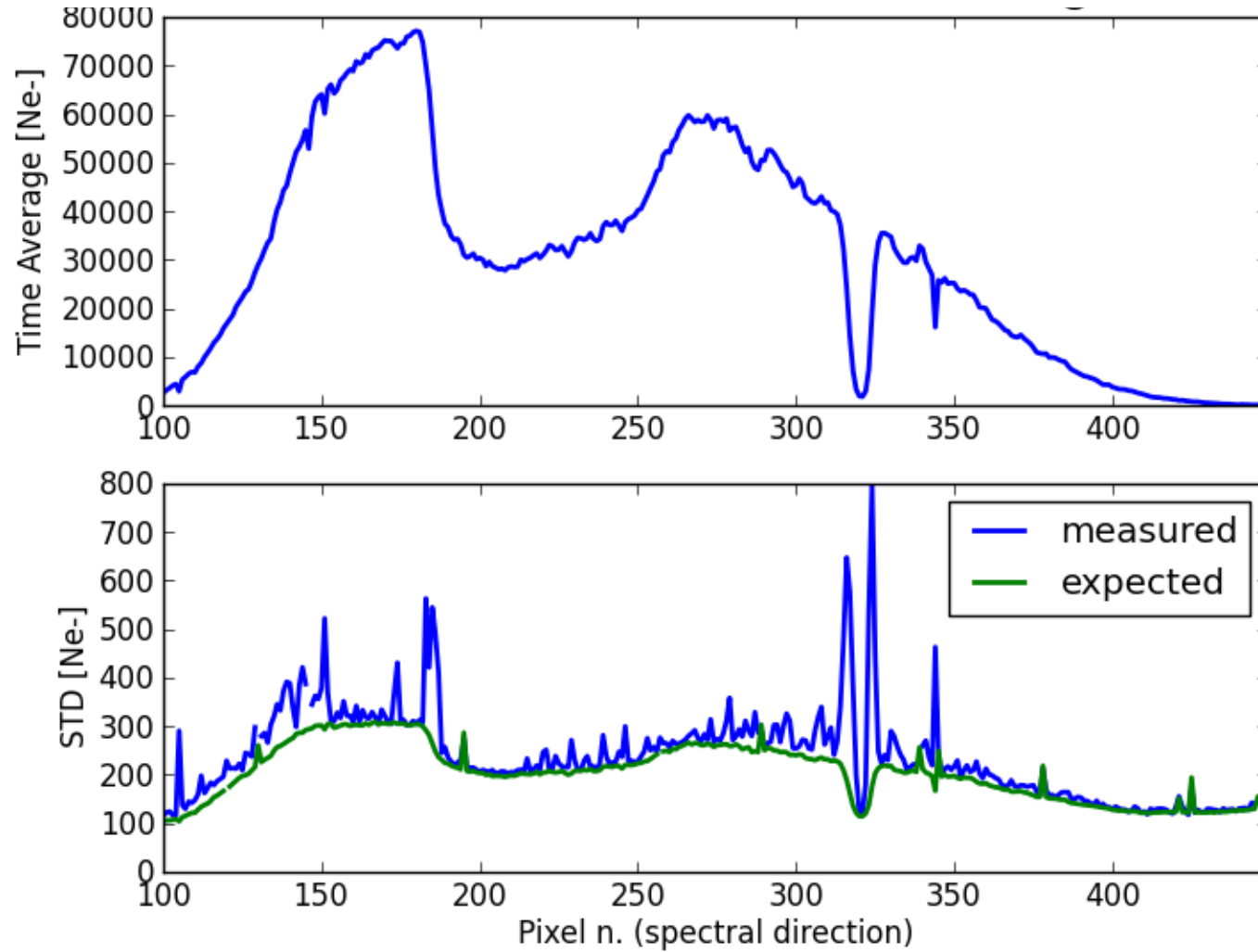
For each column:

- compute median value, v_{dark} of dark pixels (i.e. $Y_p > |0.5 S_y|$ - approx. 10 pixels)
- subtract v_{dark} from count-rate of all pixels in that column

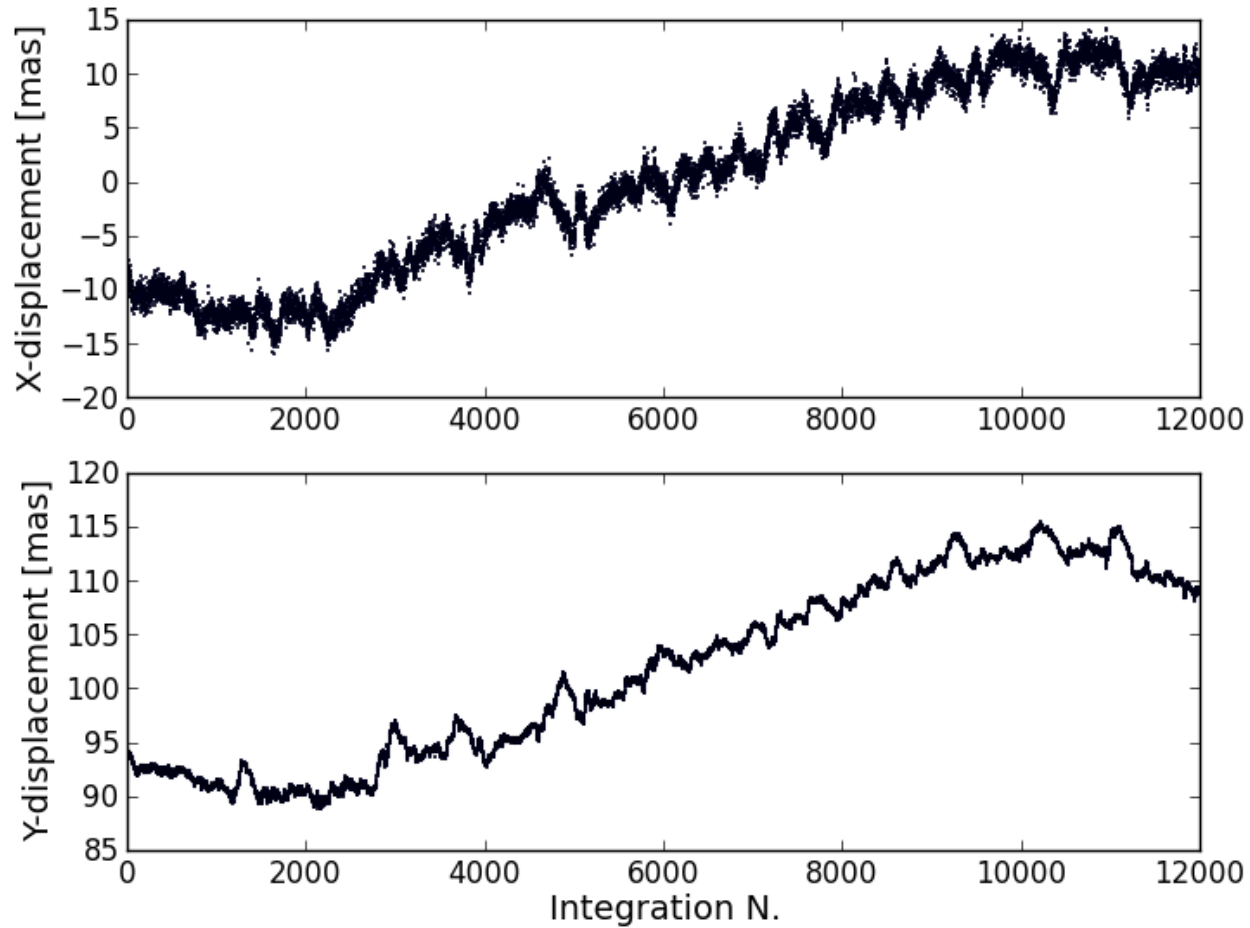
Normalize by white-light curve



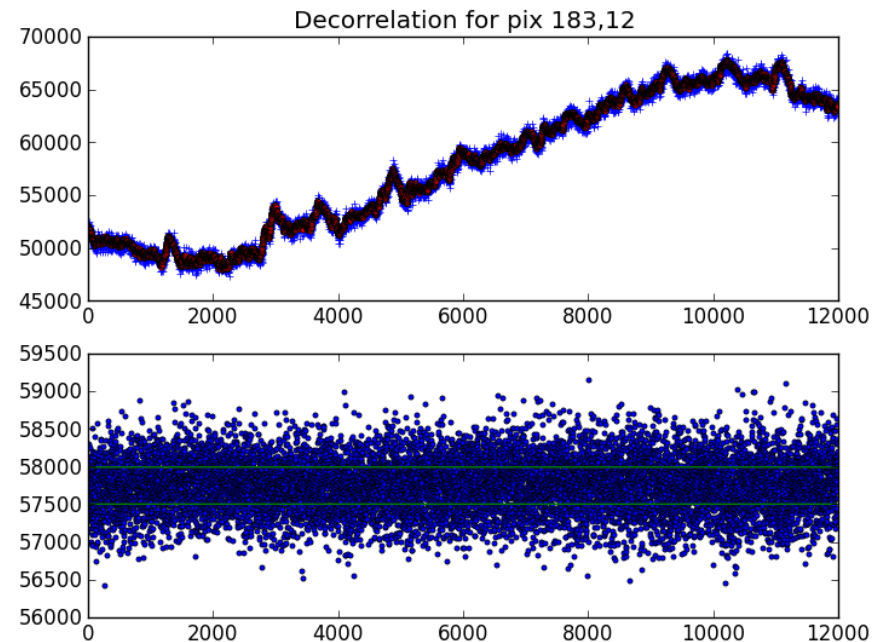
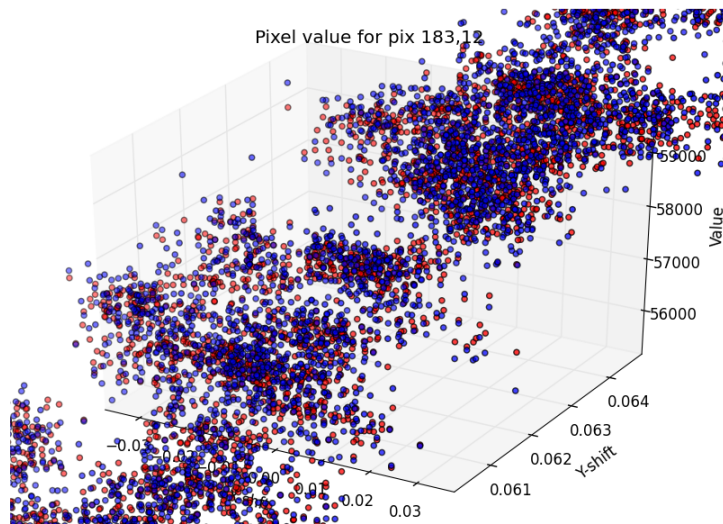
1/f-noise - removed



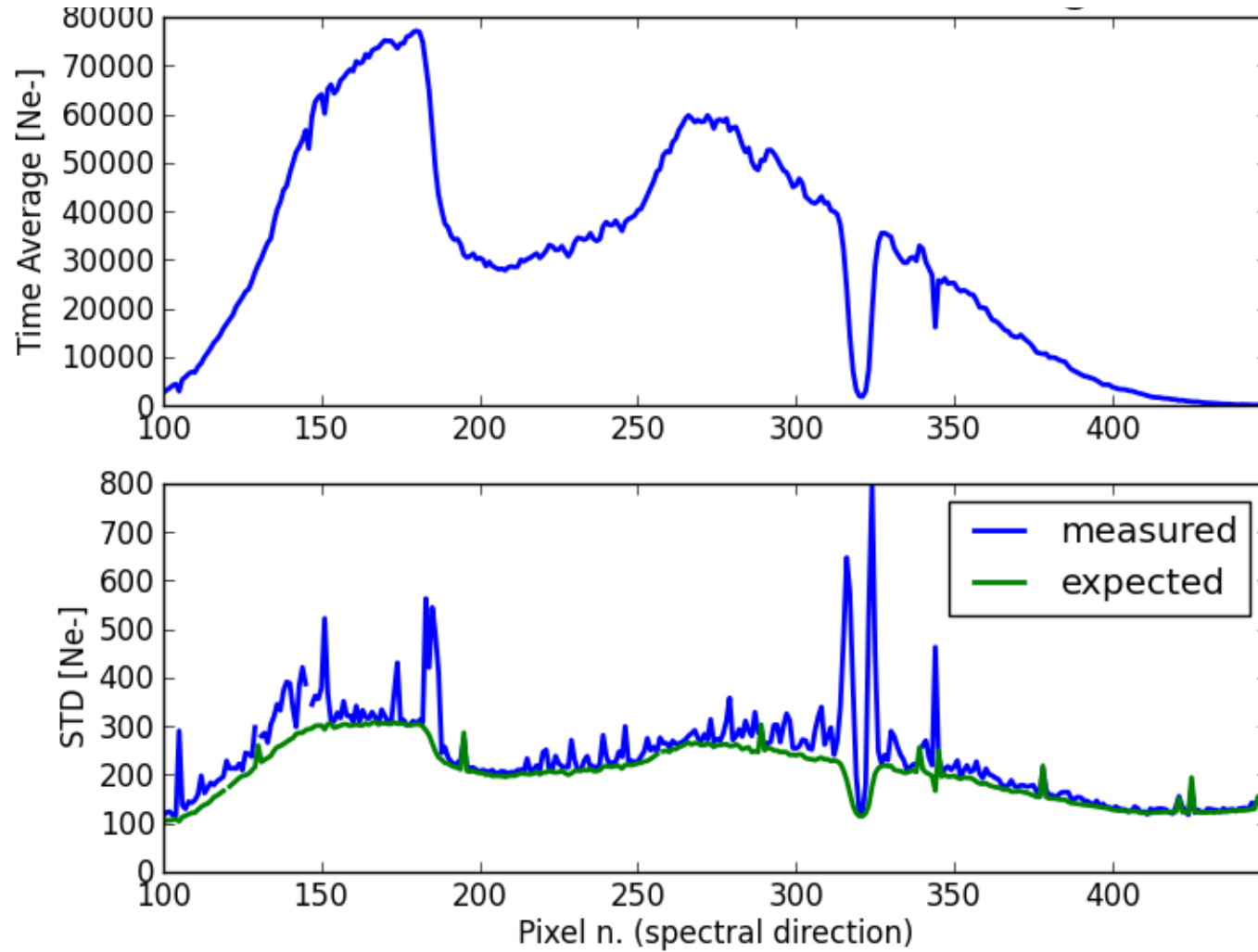
Source jitter & drift



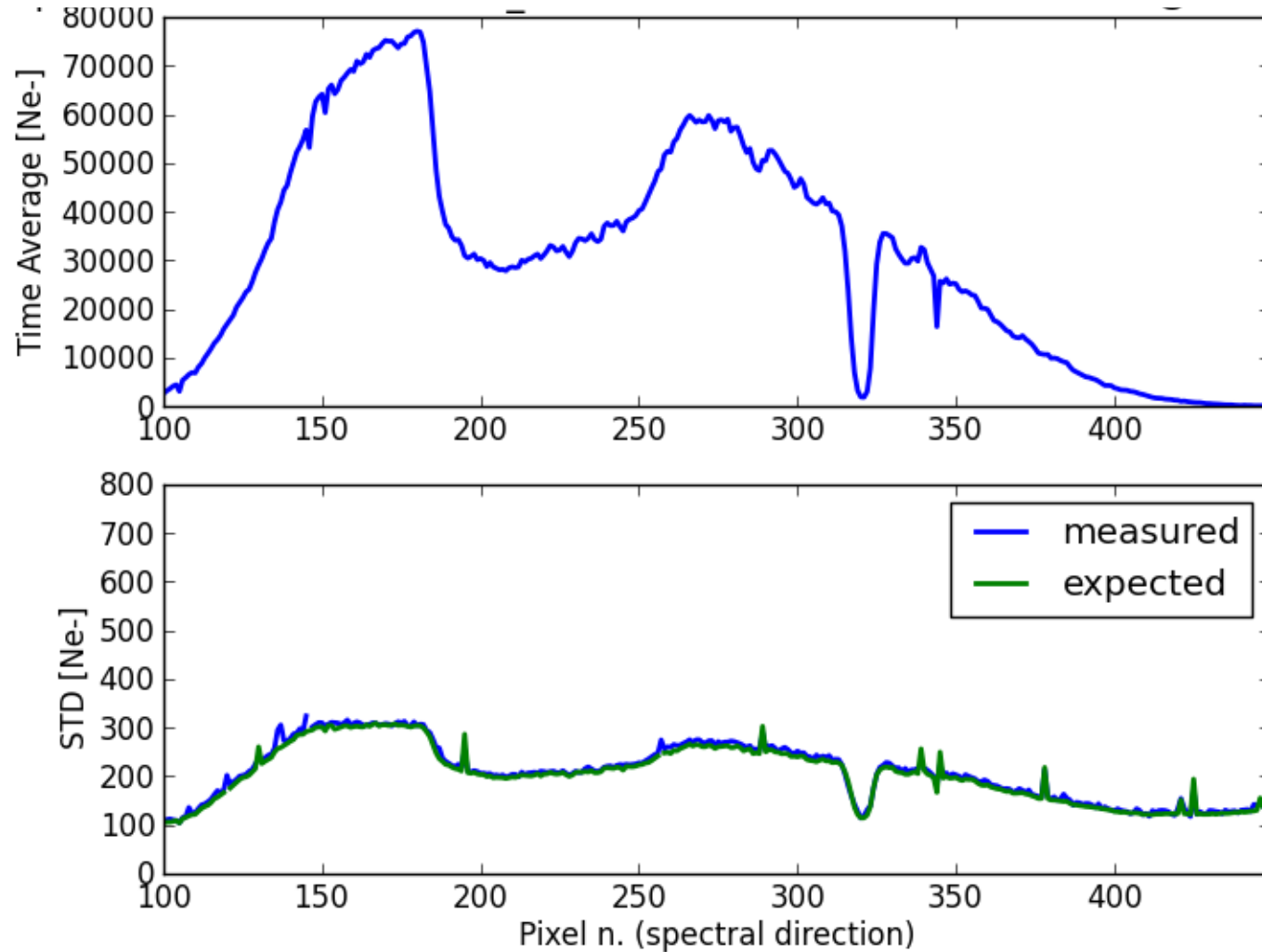
De-correlating signal from source movements: bilinear fit in X and Y shift



1/f-noise - removed

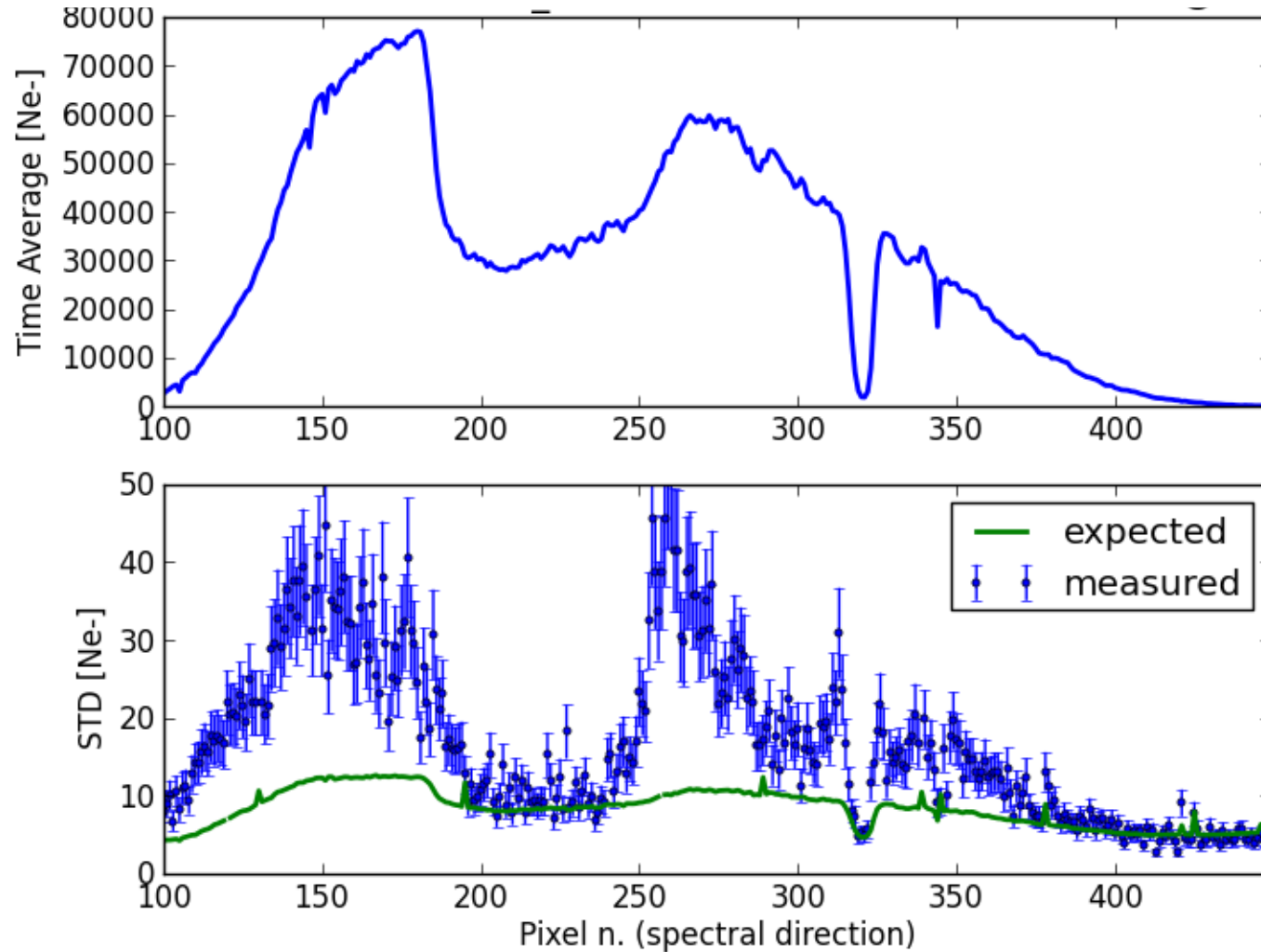


Decorrelation of source movement

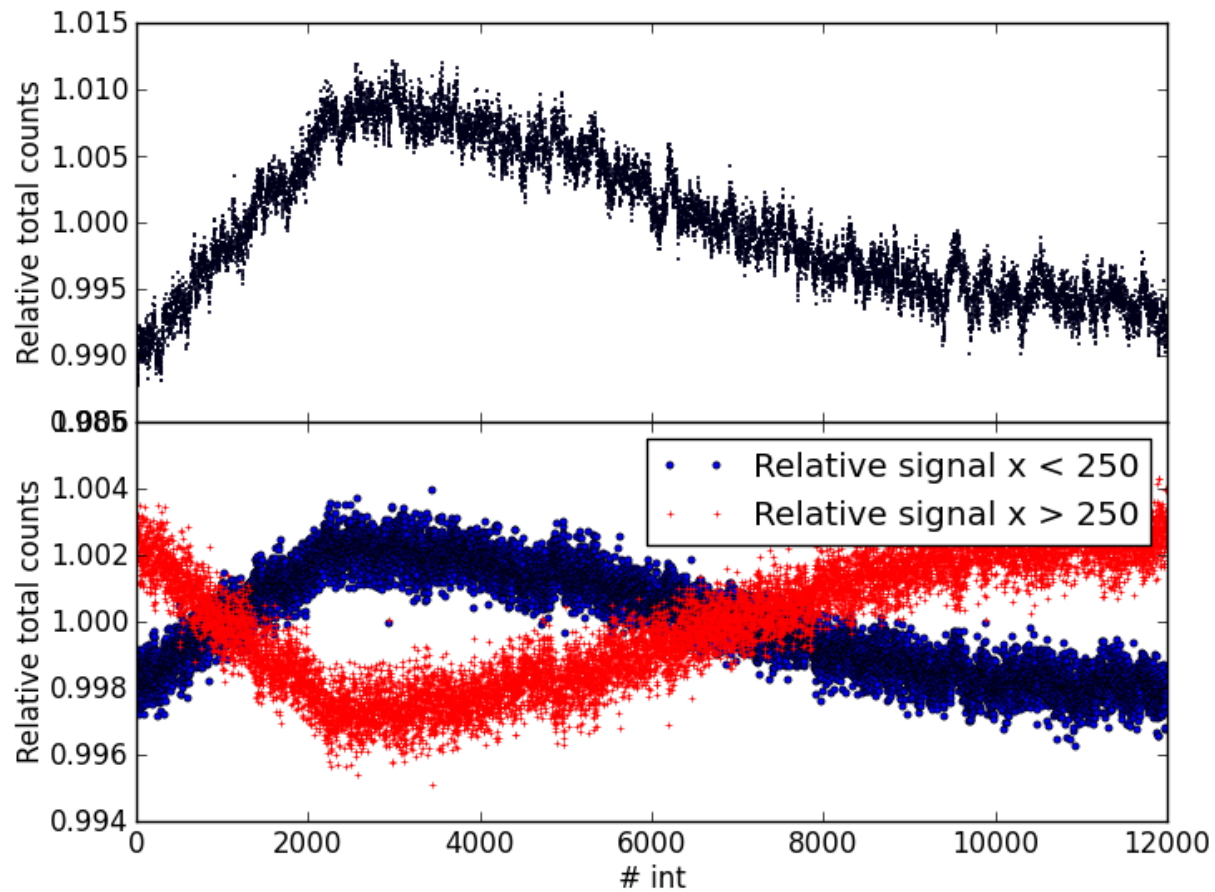


Temporal binning

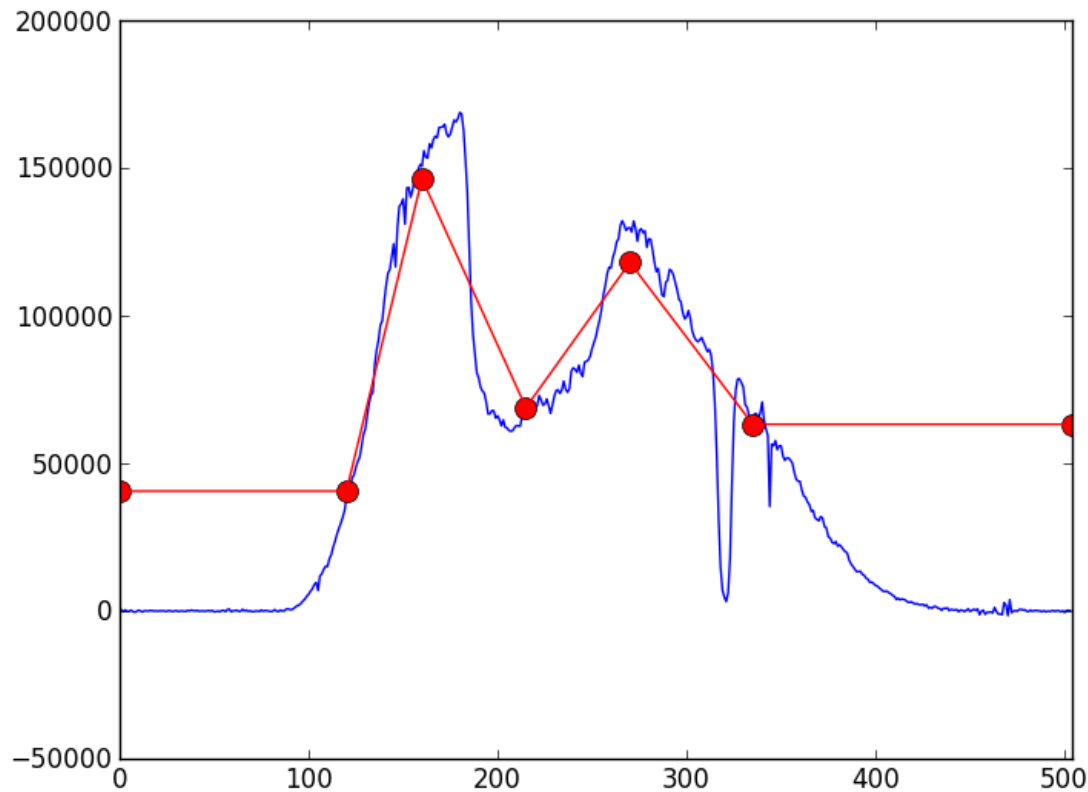
600 integrations per bins (approx 4.5 mins) – 15 bins



Wavelength-dependent flux-variations of the lamp

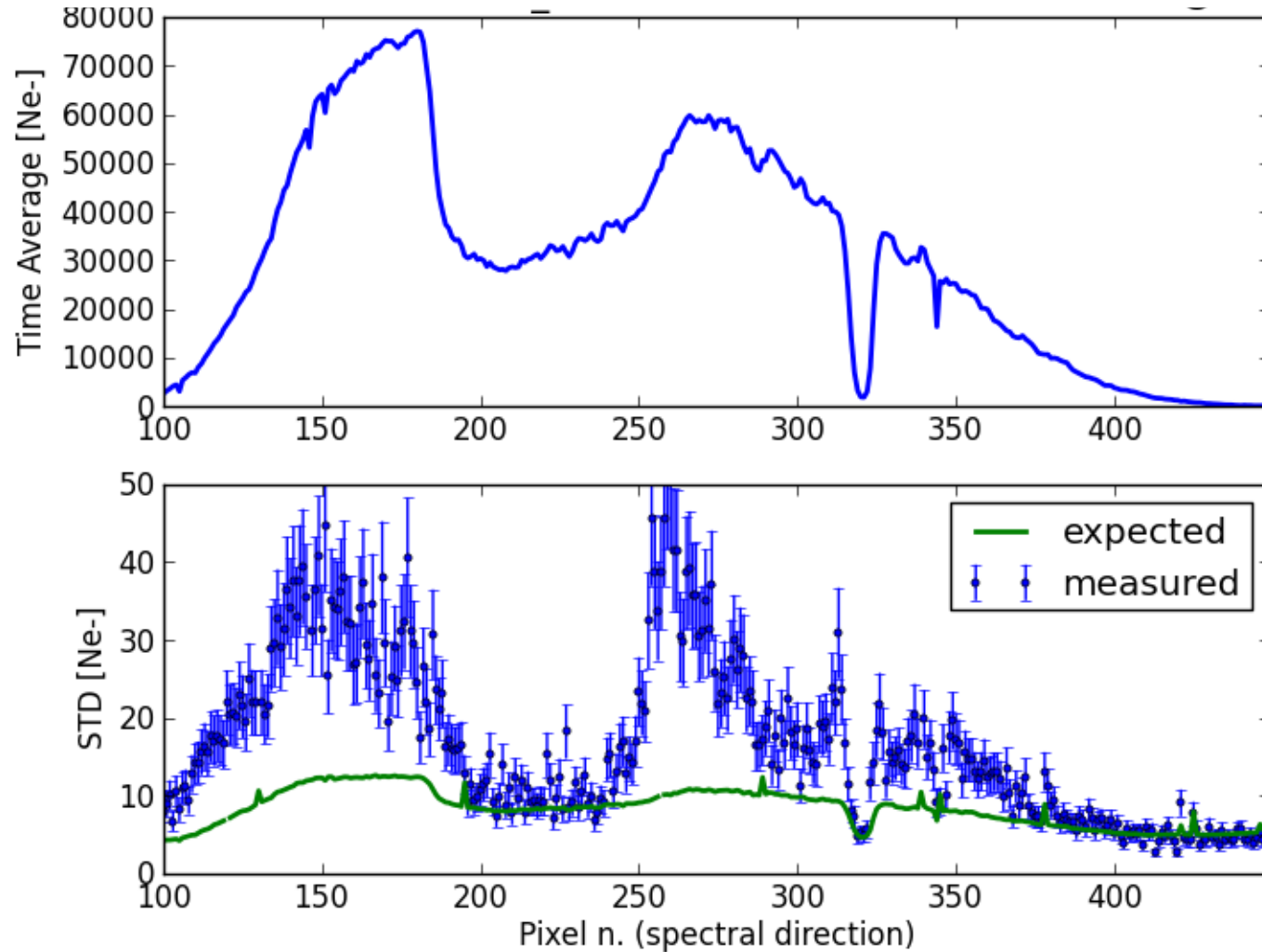


Light curve normalization by a '5-color' light curve



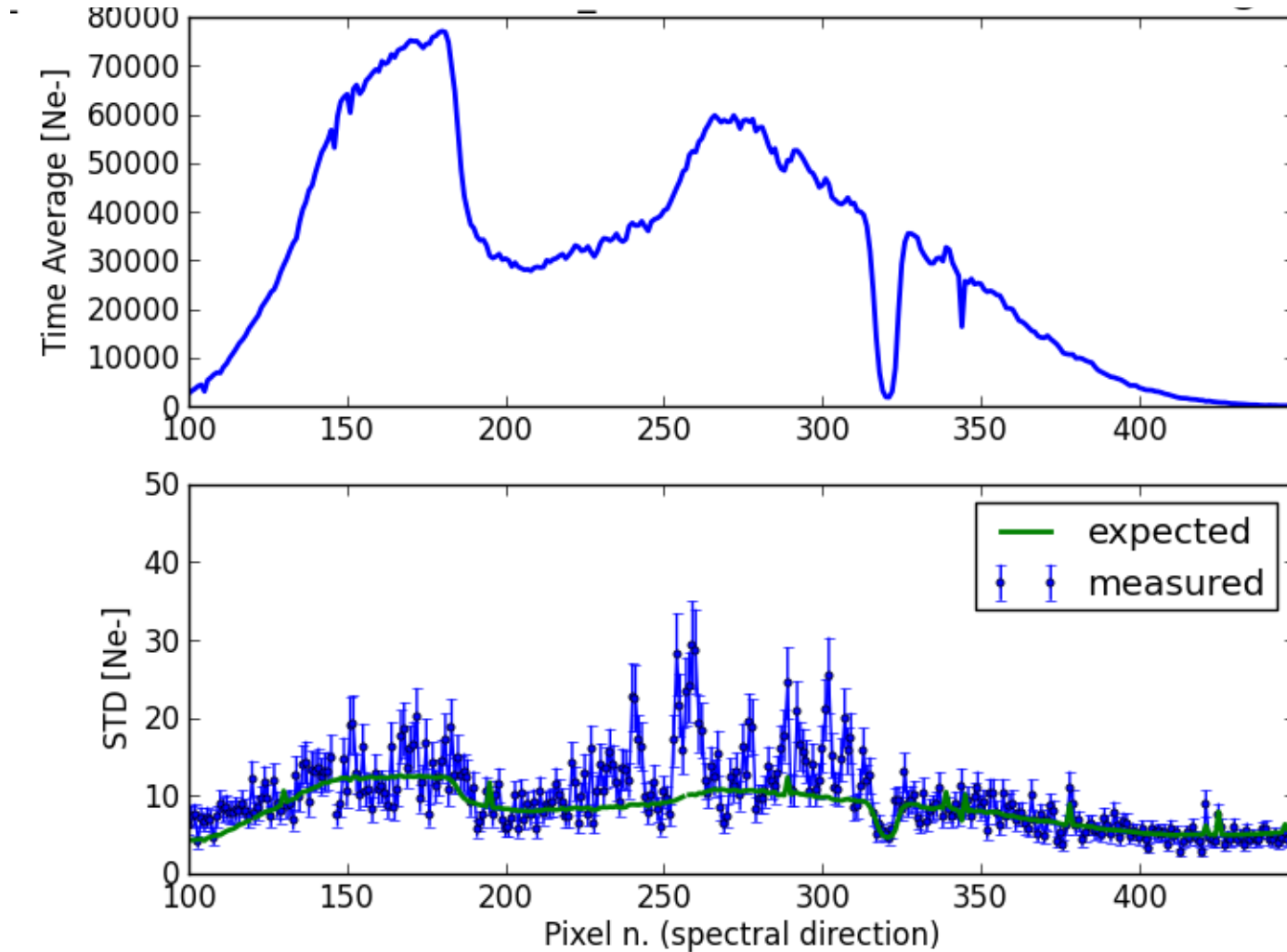
Temporal binning

600 integrations per bins (approx 4.5 mins) – 15 bins

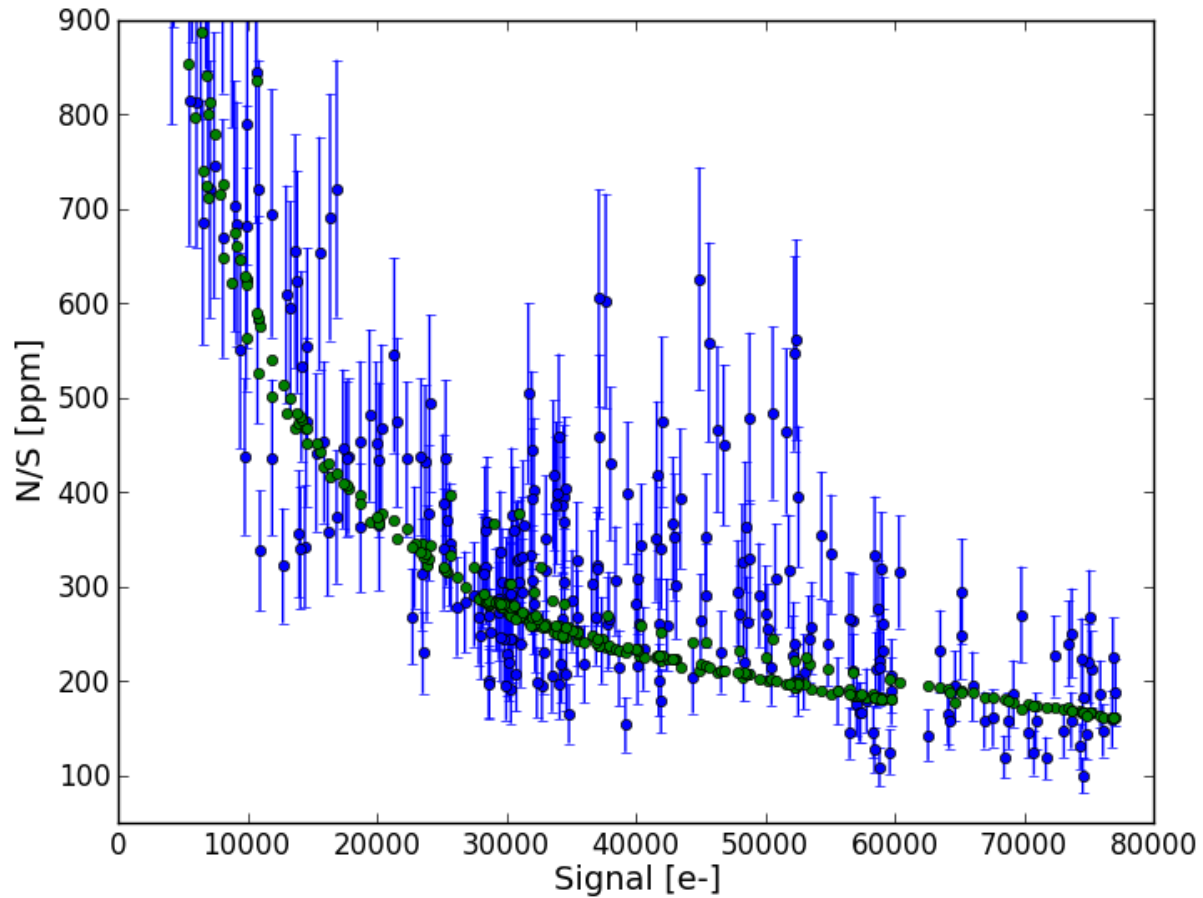


Temporal binning – Color normalization

600 integrations per bins (approx 4.5 mins) – 15 bins



Noise level vs Flux



Summary & Conclusion

- **Identified the two main source of systematic noise in NIRSpec data (BOTS mode):**
 - 1/f noise from detectors electronics
 - Flux-variations due to interplay between undersampled PSF and source movement
- **Identified (basic) methods to correct for these effects**
- **We have probed the data to a sensitivity below 200 ppm**
- **There is no evidence that NIRSpec cannot its reach noise-floor level of 200 ppm in less than 5 min of integration**

BOTS mode data and Simulations

- **IPS simulations of BOTS can be carried out**
- **What type of simulation depends on what is their purpose/
how they will be used**
- **Timeline need to be agreed in advance**
- **ISIM-CV3 data presented here also provide a good start to get familiar with data format and features**
- **We can provide help to access and process these data sets**