Measuring the Delayed Crosstalk

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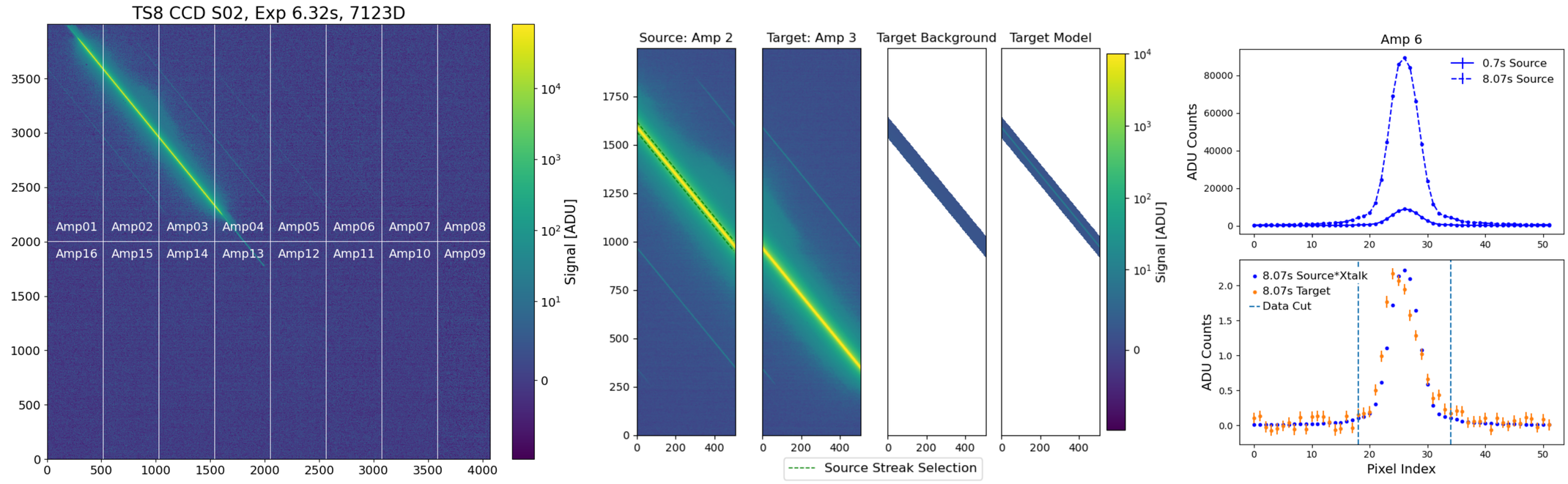
Data Configuration

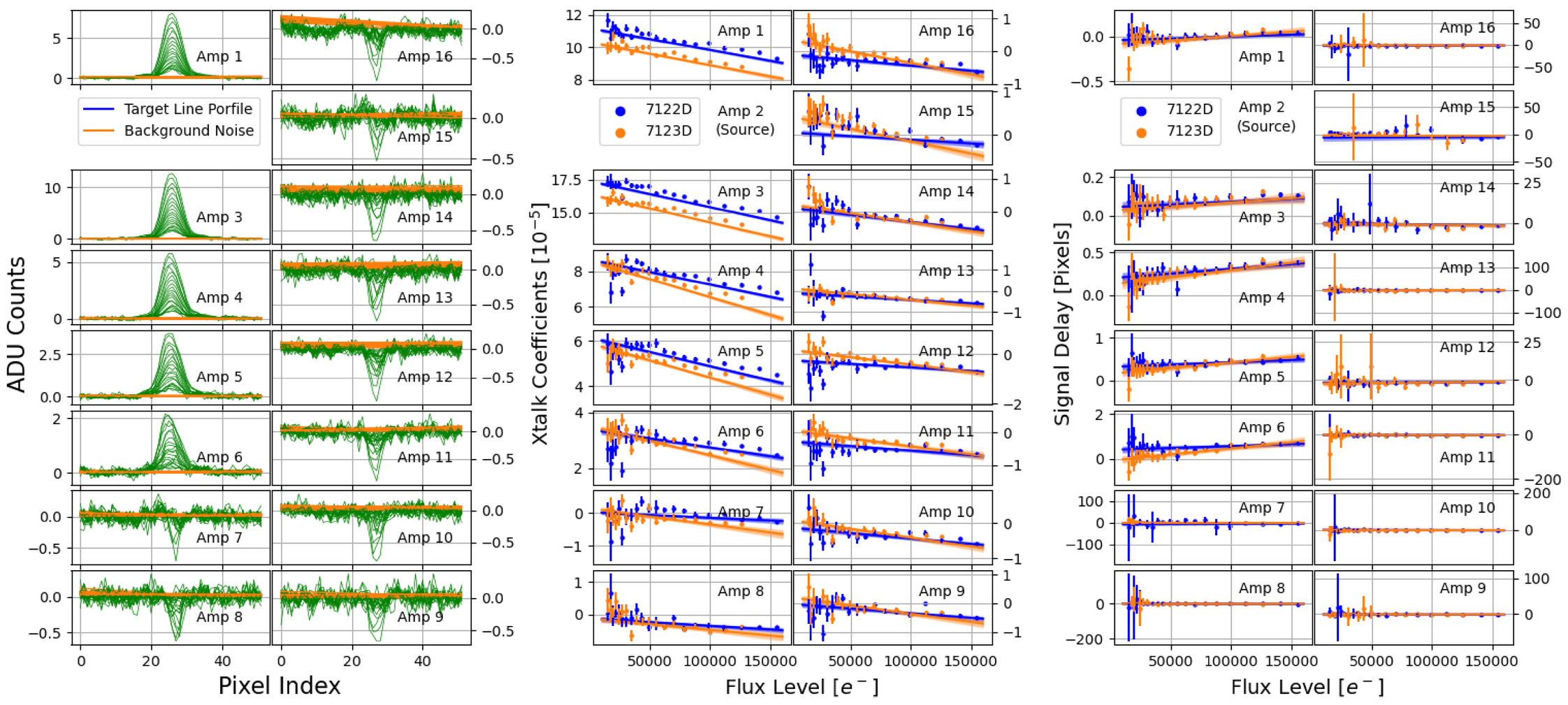
Figure 1: Left: Projected streak mimicking a satellite track. Middle: Source and target (echoes) selection and background modeling. Right: Averaged line profiles.



We measure the signal delay of CCD crosstalk using a test stand in preparation for the LSST Camera. We use a collimated beam projector to cast a narrow streak onto the CCD, mimicking a bright satellite track. The same streak selection mask is applied to the source streak from amp 2 and target streaks from other amps. Selected regions are averaged along the streak direction for a line profile. **We observe off-peak target profiles**, indicating a delayed crosstalk signal. We measure the crosstalk signal x and the signal delay d (in pixel units) simultaneously by comparing the source and target profiles. The target profiles are modeled with $\bar{t}_i = x\,[s_i(1-d) + s_{i+1}d]$, where s_i is the source profile and i denotes pixel indices. Note that the channel read-out is from right to left, so that $d = 0$ means no delay and $d = 1$ means a delay of 1 pixel.

Results

Figure 2: Left: Target profiles at different source flux level. Middle: Measured crosstalk as a function of flux level. Right: Measured signal delay as a function of flux level.



We first measure the crosstalk signal x and the signal delay d on individual exposures. We observe a strong flux dependency from both parameters, as shown by the data points in the middle and right panels. We then adopt a hierarchical model for both x and d, modeling them to be linearly dependent on the flux level, and fitting for all images simultaneously. The results are shown in shaded lines in the middle and right panels. Note that the lines are not fitted to the data points directly, but fitted to line profiles at all flux levels.

We compare two sets of data: run 7122D with the fiducial gain settings, and 7123D with a higher ASPIC gain. We find stronger crosstalk signals in channels closer to the source streak, and weaker signals in more distant channels. The differences between two runs share the same trend: larger differences in closer channels and indistinguishable in far-away channels. This indicates that the crosstalk signal might have multiple origins. As for the signal delay, we observe a reversed trend: larger delays in more distant channels. We can only measure a meaningful delay signal up to 4 Amps away, and the gain dependence is not conclusive yet.

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