

Non-linear study of the cross-talk effect through a profile examination

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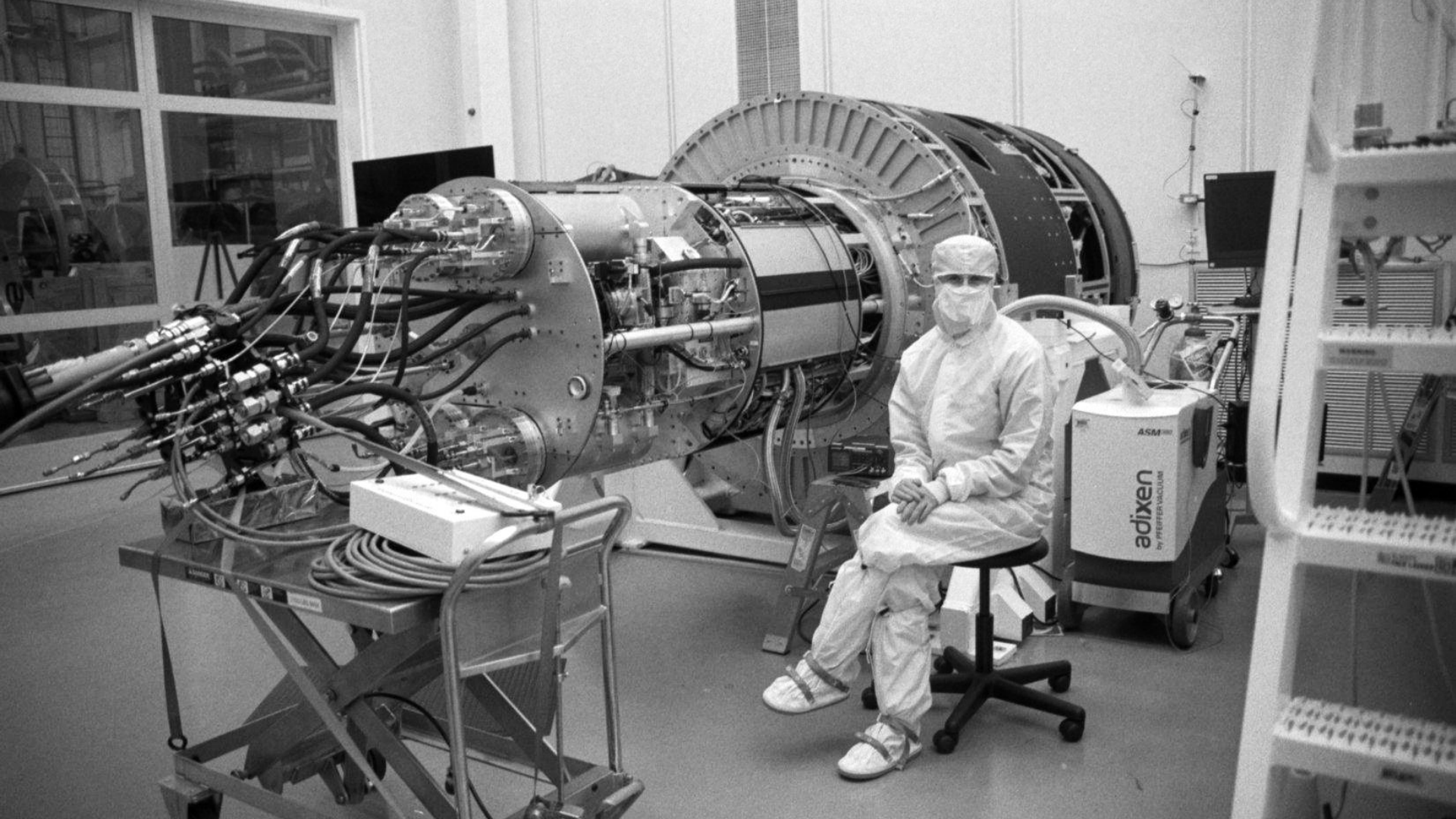


LSST Camera

The Rubin's camera has **3.2 gigapixels**. (+250 iPhone 13!)

The LSST science experiment will generate a color movie of the Southern sky to a depth of 27th magnitude. It is estimated to detect **20 billions of galaxies and stars**.

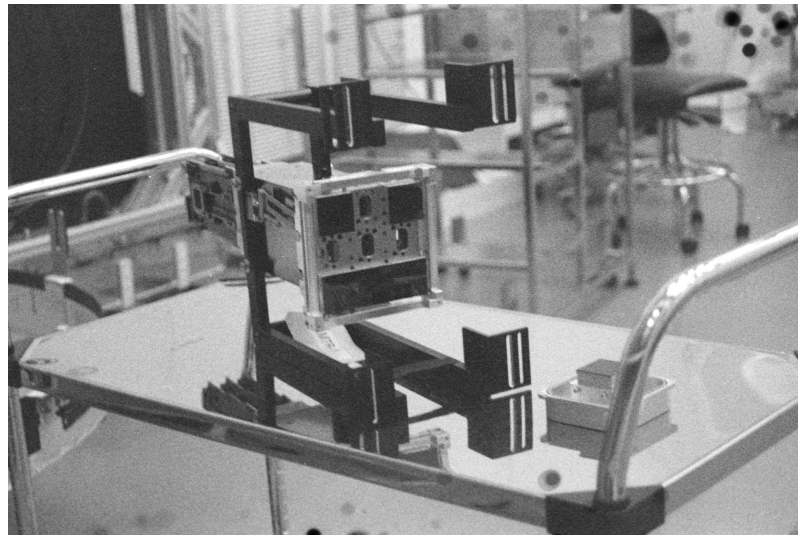
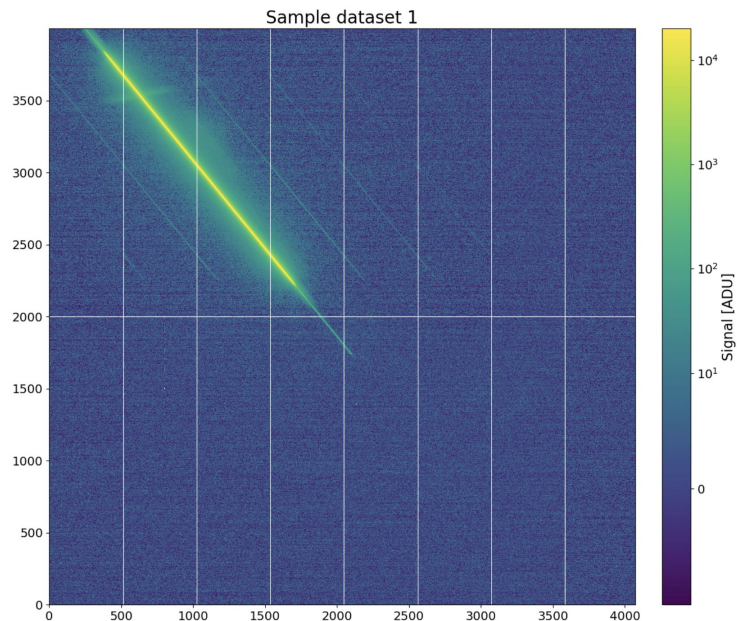
Each CCD has a total of 16 amplifiers, and there are a total of **189 CCDs**.



The (short) project:

What are CCDs?

CCDs (Charged-Coupled Devices) are circuits containing an array of **capacitors** called pixels that can transfer electric charge.

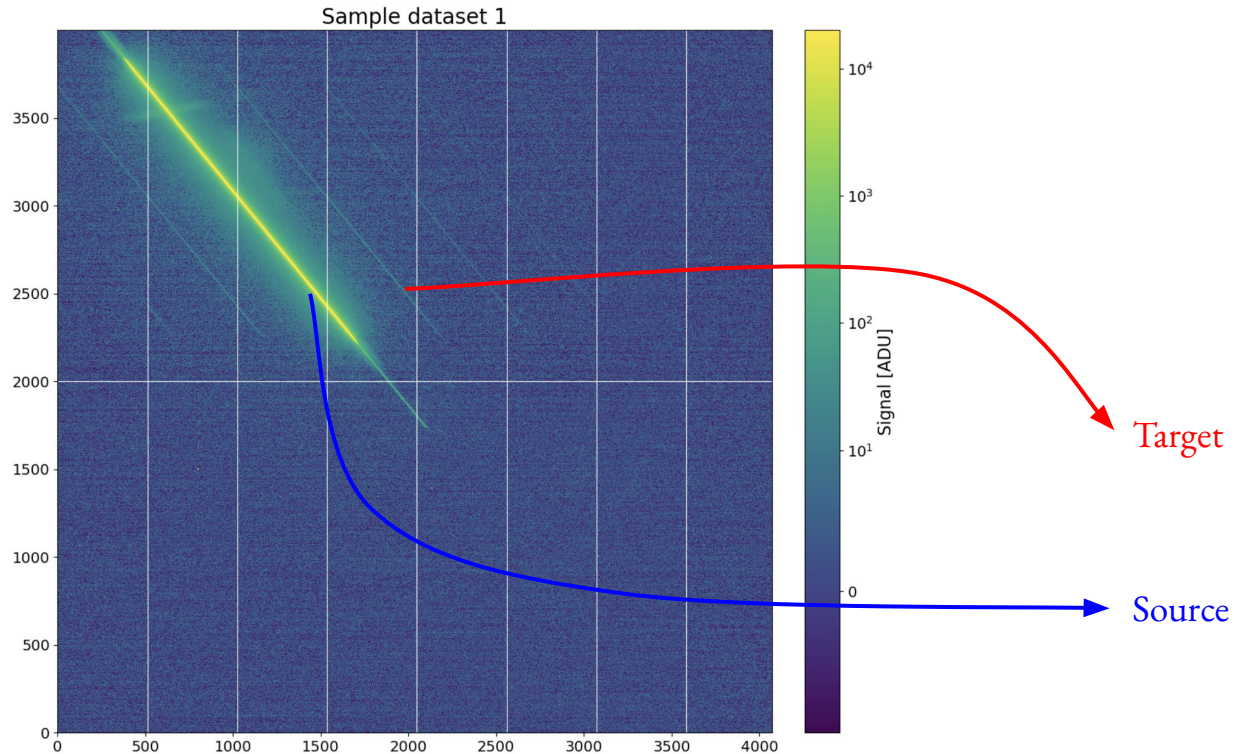


Goal of the project

Characterize the intra-CCD crosstalk by co-adding samples of streak images with different exposures and positions in a CCD.

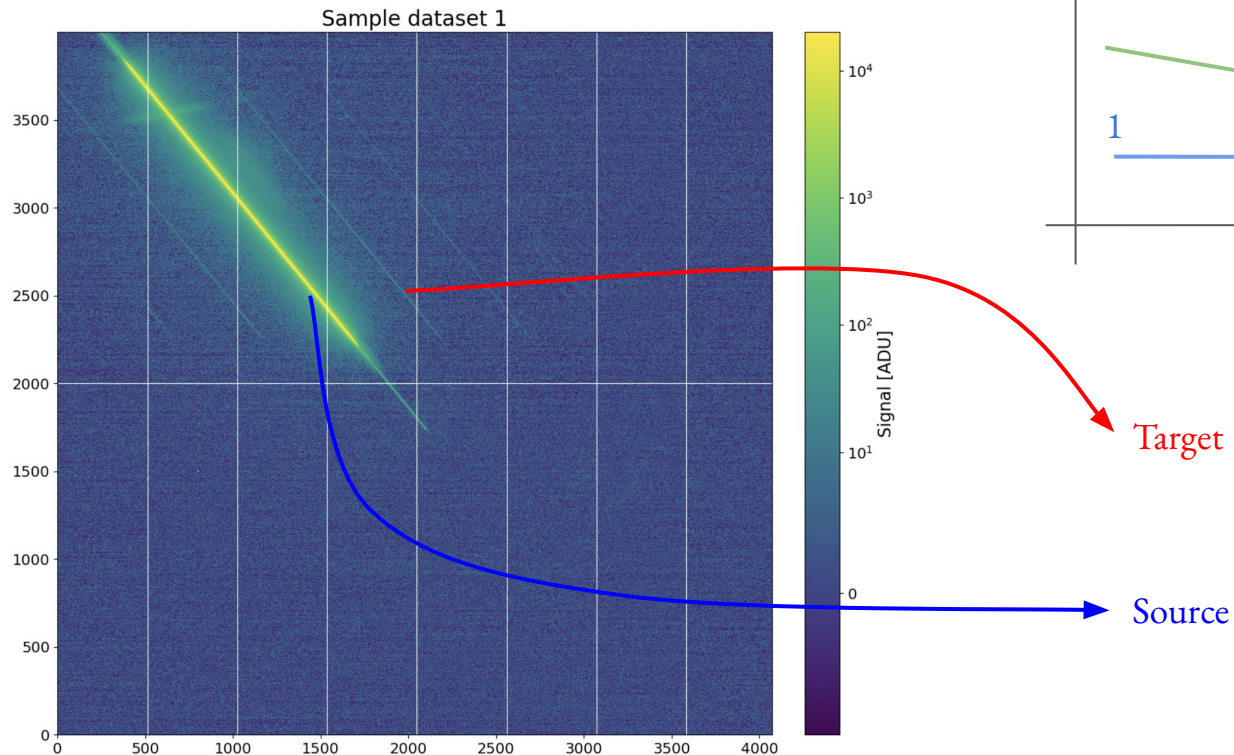
Scientific question

- Is there a non-linearity in the cross-talk?

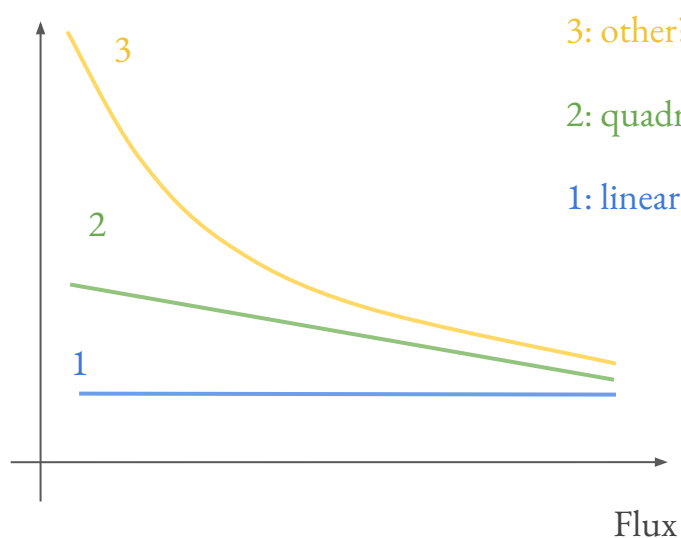


Scientific question

- Is there a non-linearity in the cross-talk?



Cross-talk coefficient

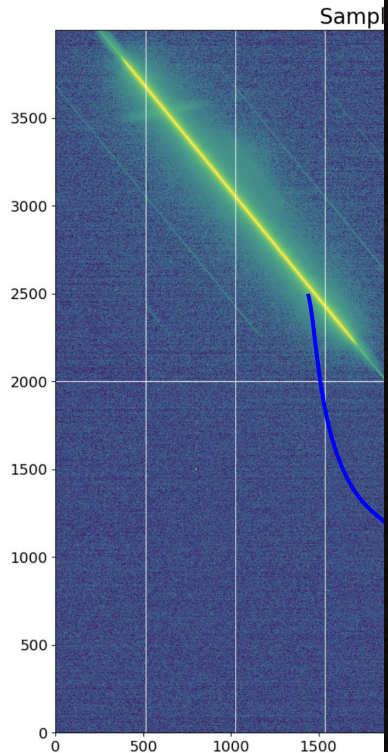


Cross-talk coefficient:
Ratio between the source
and the target

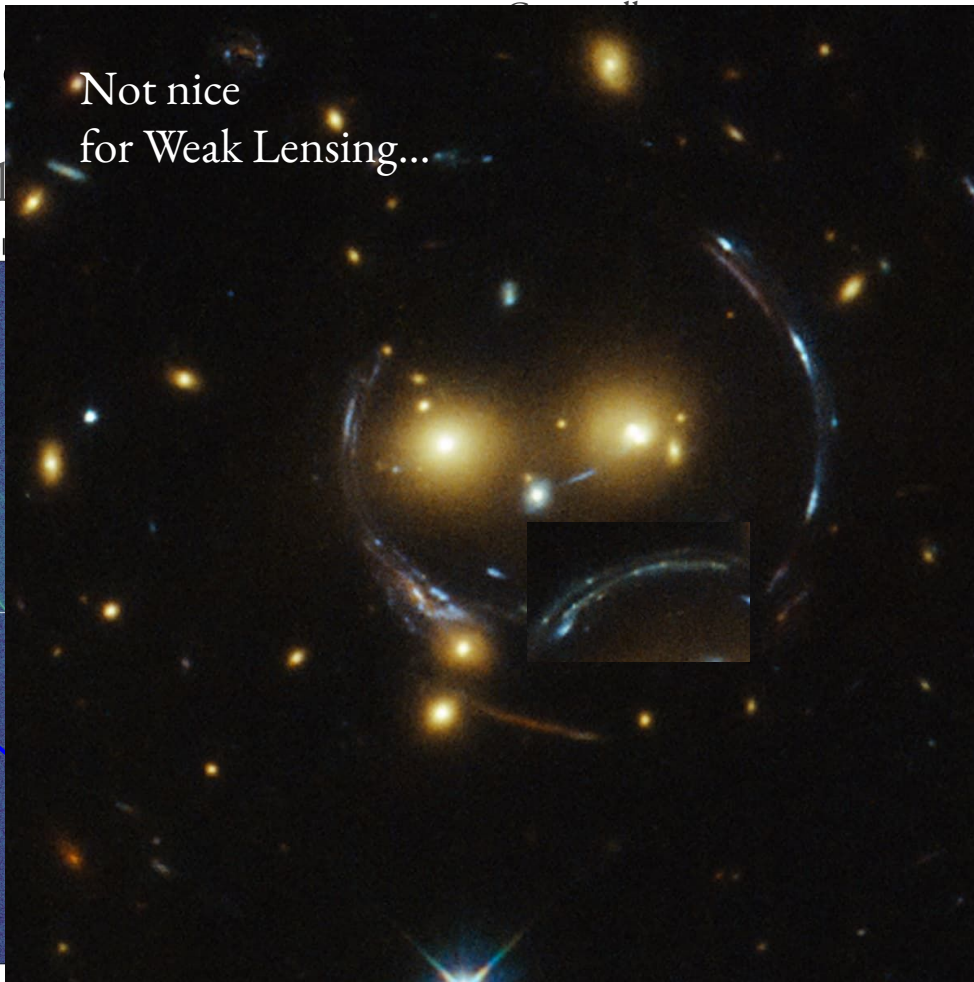
ADU: Analog Digital Unit

Scientific question

- Is there a non-linear relationship between



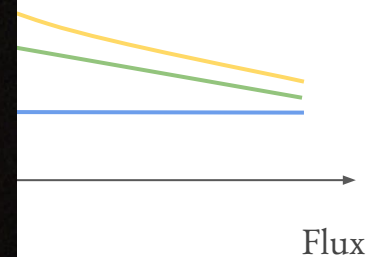
Not nice
for Weak Lensing...



3: other?

2: quadratic

1: linear



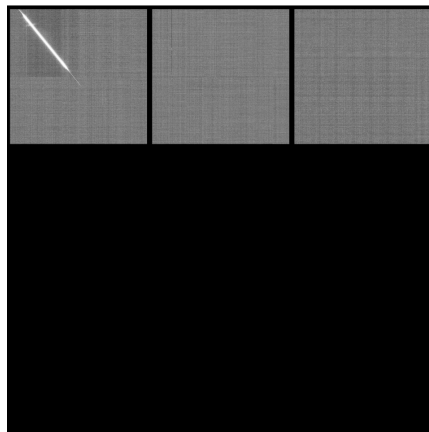
Cross-talk coefficient:
ratio between the source
and the target

ADU: Analog Digital Unit

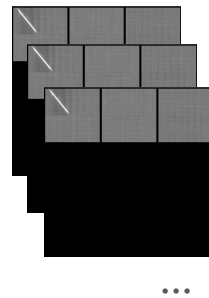
Data collection:

Each dataset consisted in a total of 18,900 images.

SPOT:

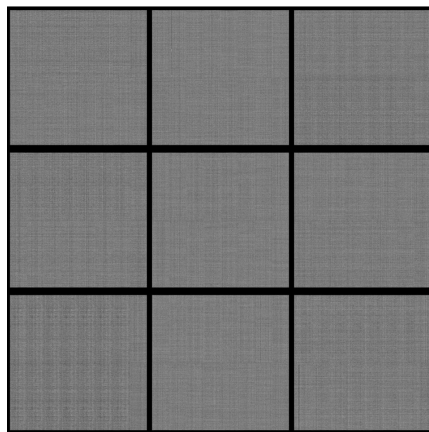


+

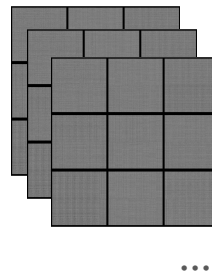


18,720
images

BIAS:



+

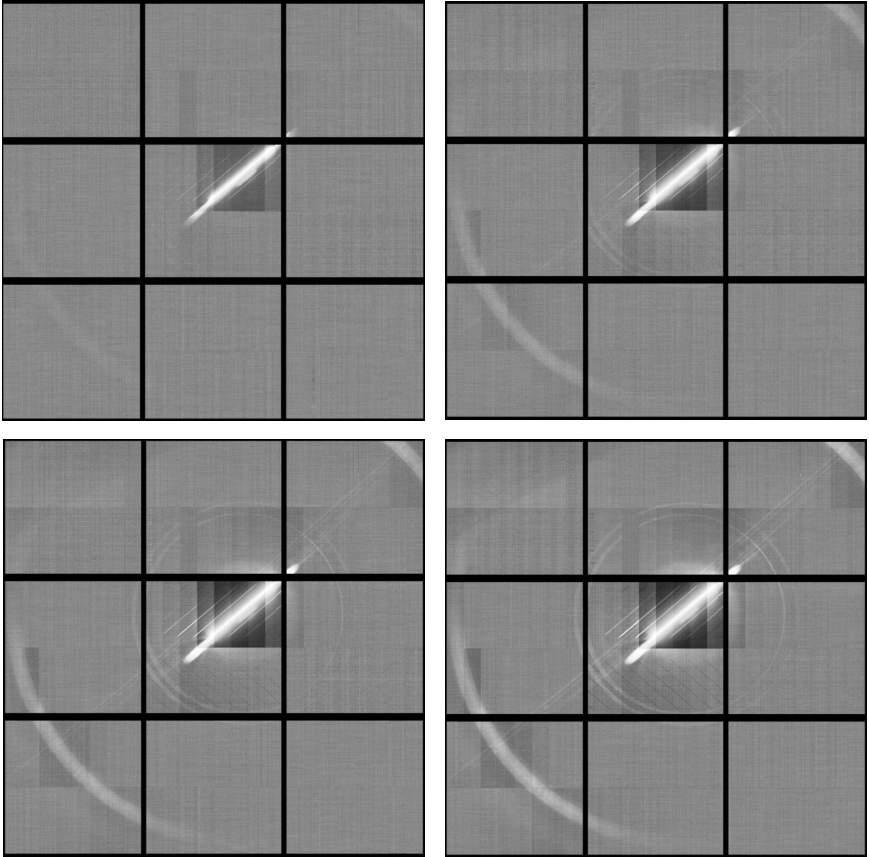


180
images

26 exposures

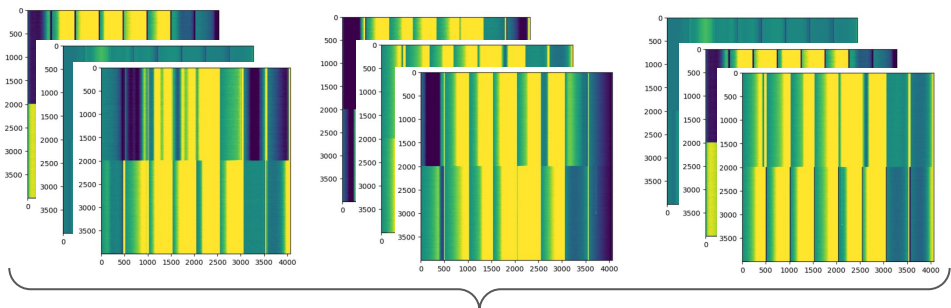
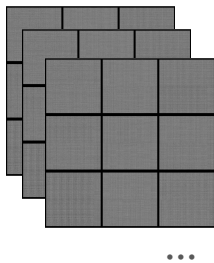
Time exposures:

0.7 , 0.79, 0.89, 1.01, 1.14, 1.29, 1.46, 1.65, 1.86, 2.1 ,
2.38, 2.69, 3.03, 3.43, 3.87, 4.38, 4.95, 5.59, 6.32,
7.14, 8.07, 9.11, 10.3 , 11.64, 13.15 and 14.86 seconds.



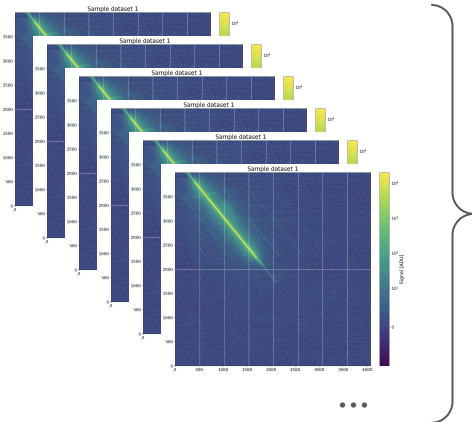
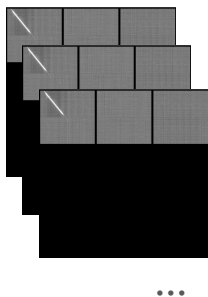
Data calibration:

Bias images:



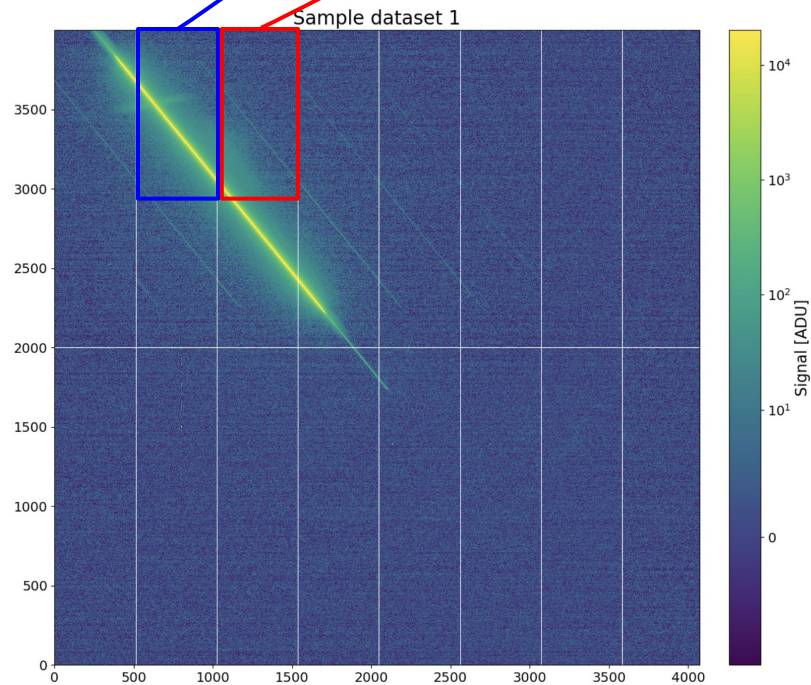
9 mean stacked ISRed (Instrument Signature Removed) images

Spot images:

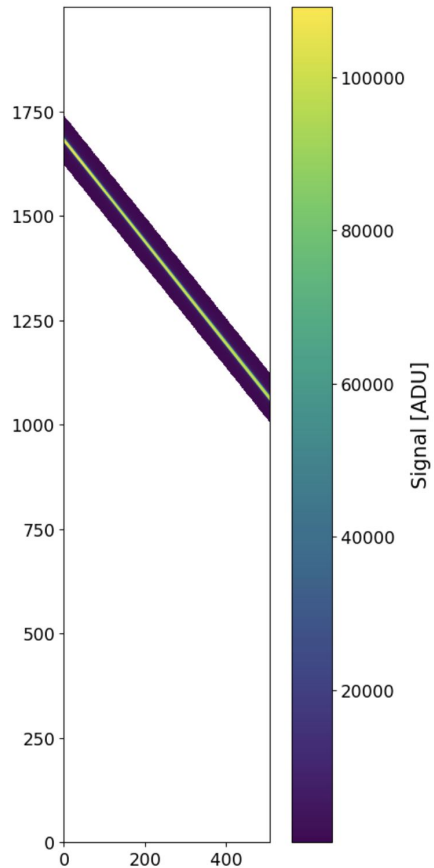


936 mean of ISRed images at each flux

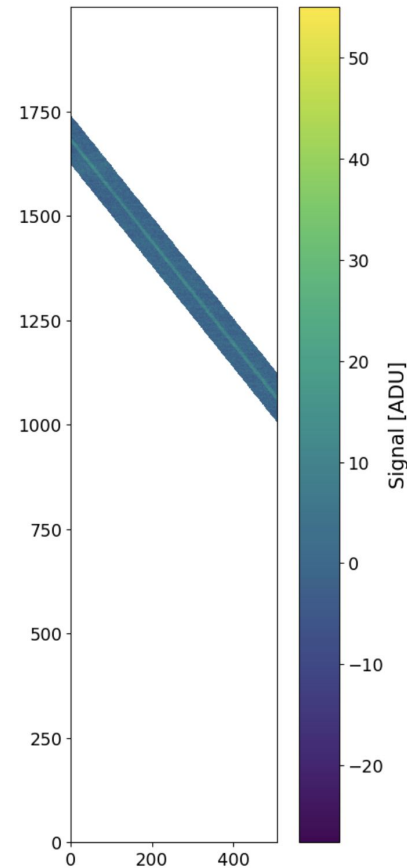
1. Fit of the streak



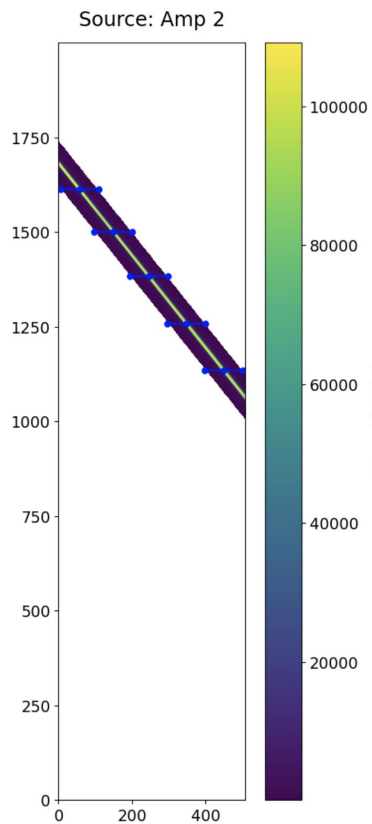
Source: Amp 2



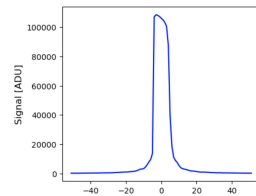
Target: Amp 3



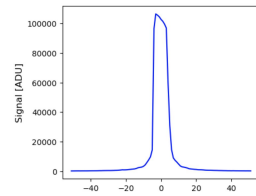
2. Make the 2D segment flux a 1D problem



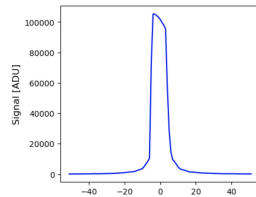
Source cut at column 57



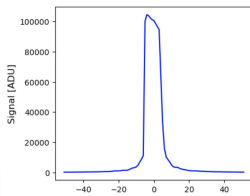
Source cut at column 149



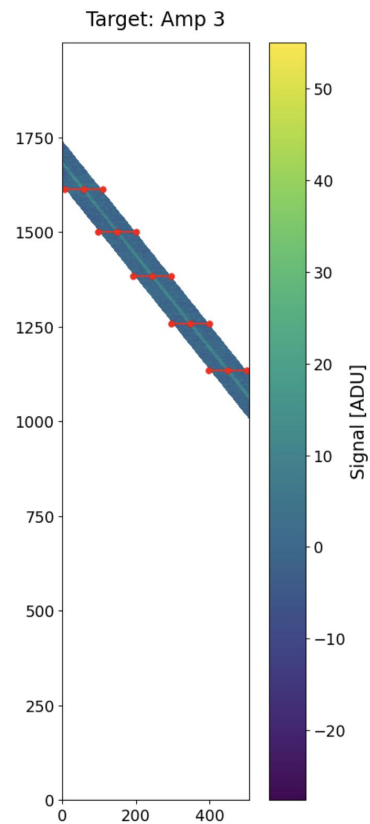
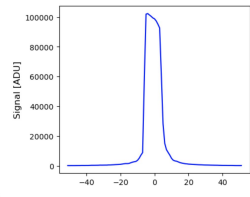
Source cut at column 245



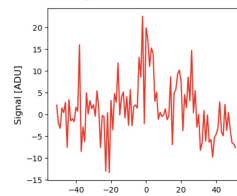
Source cut at column 348



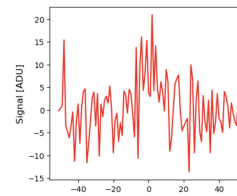
Source cut at column 449



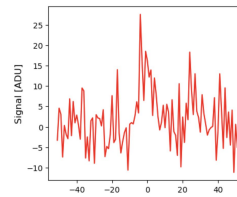
Target cut at column 57



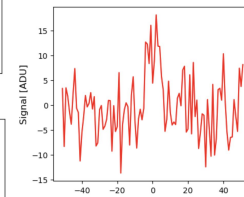
Target cut at column 149



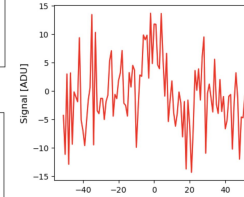
Target cut at column 245



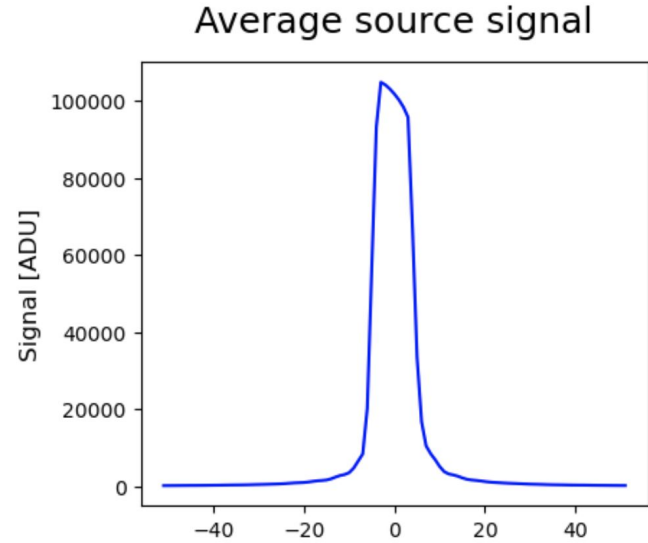
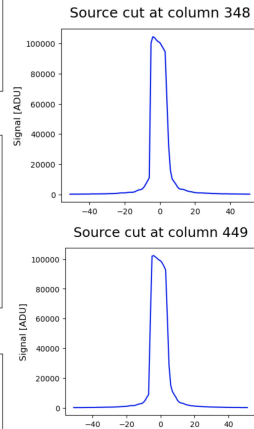
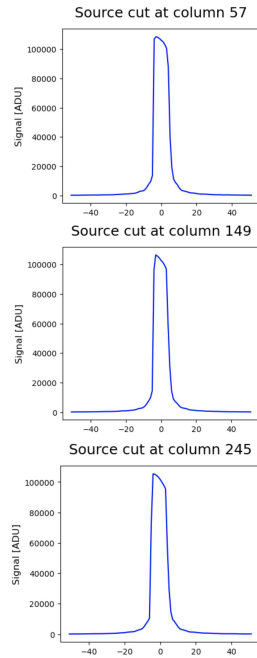
Target cut at column 348



Target cut at column 449

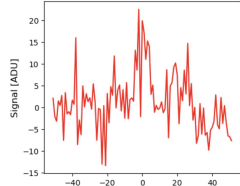


2. Make the 2D segment flux a 1D problem

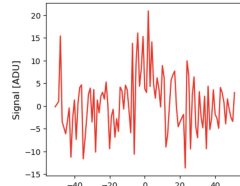


2. Make the 2D segment flux a 1D problem

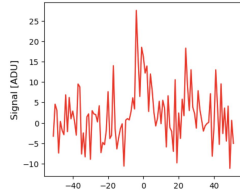
Target cut at column 57



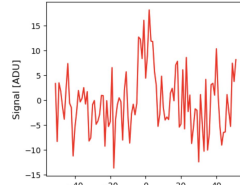
Target cut at column 149



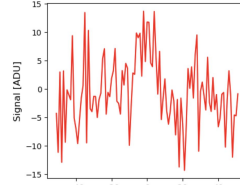
Target cut at column 245



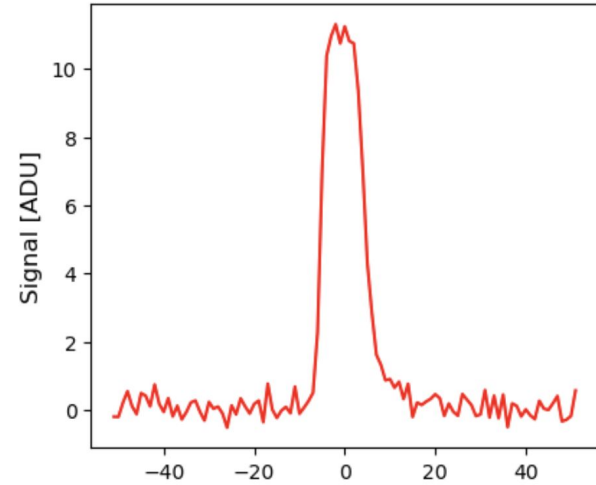
Target cut at column 348



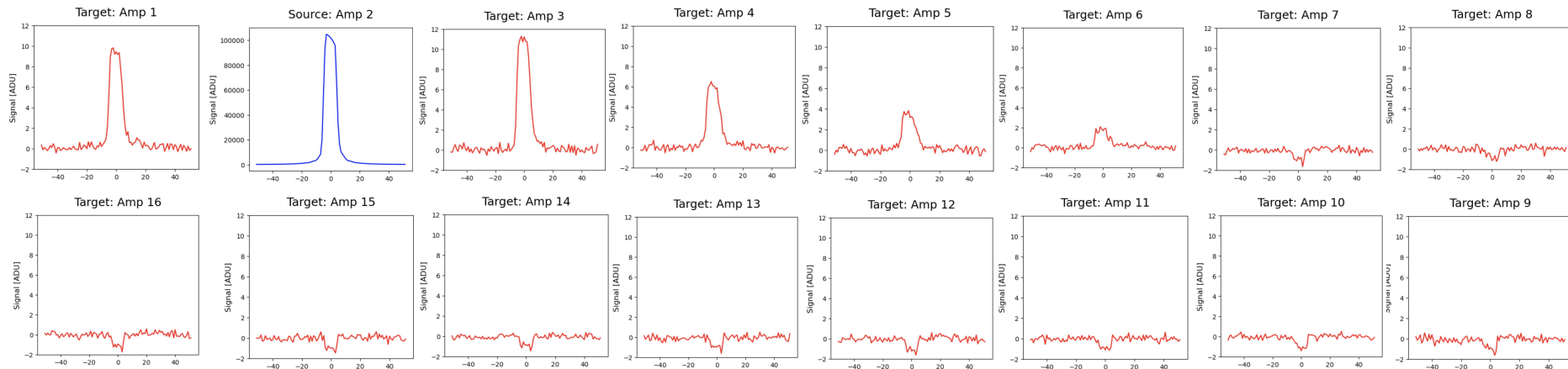
Target cut at column 449



Average target signal

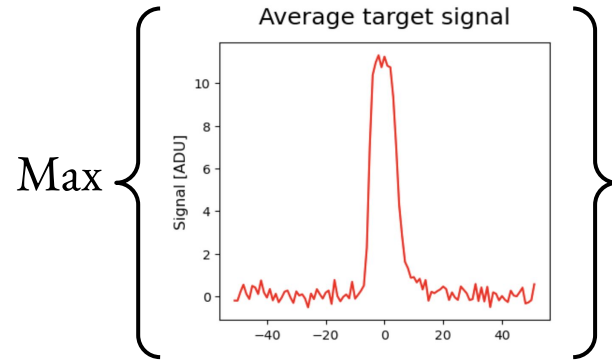


Visualization of the other averaged amplifiers

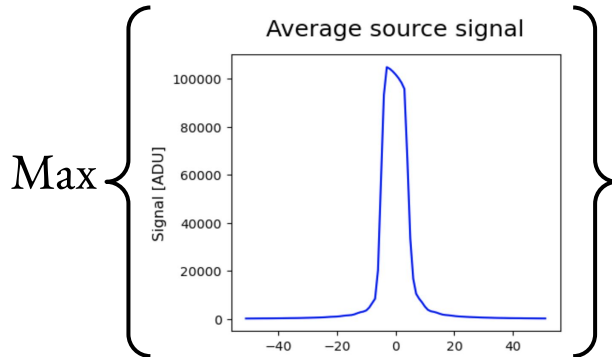


3. Calculate cross-talk: Optimization of all pixel distances + errors

We used the maximum flux on the source signal per exposure time.



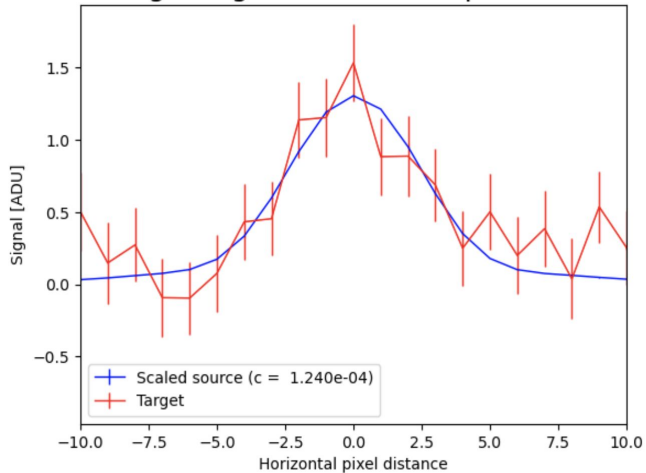
= Cross-talk coefficient



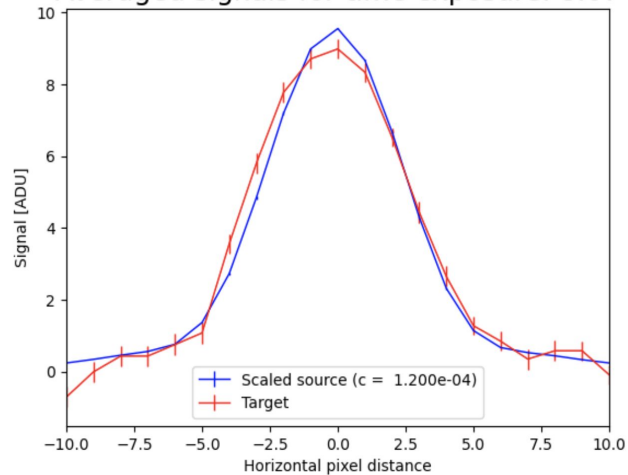
Source: Amp 2

Target: Amp 3

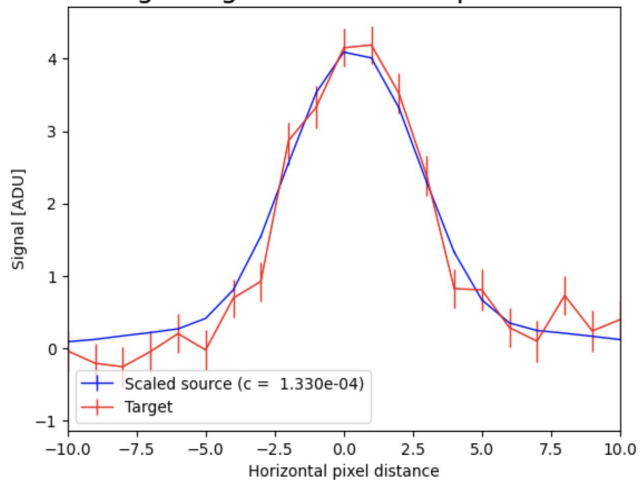
Averaged signals for time exposure: 1.01



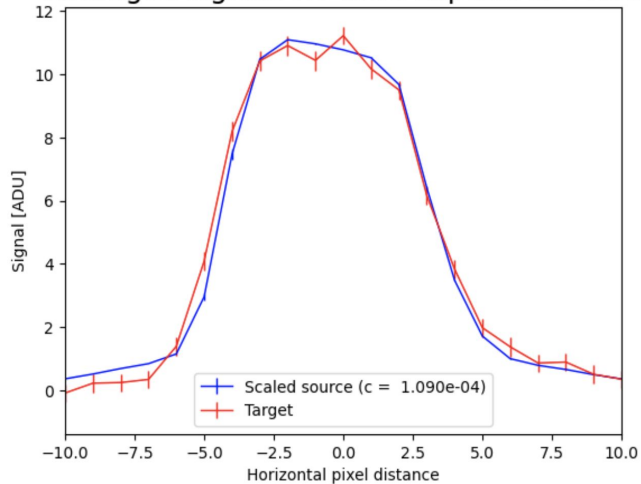
Averaged signals for time exposure: 8.07



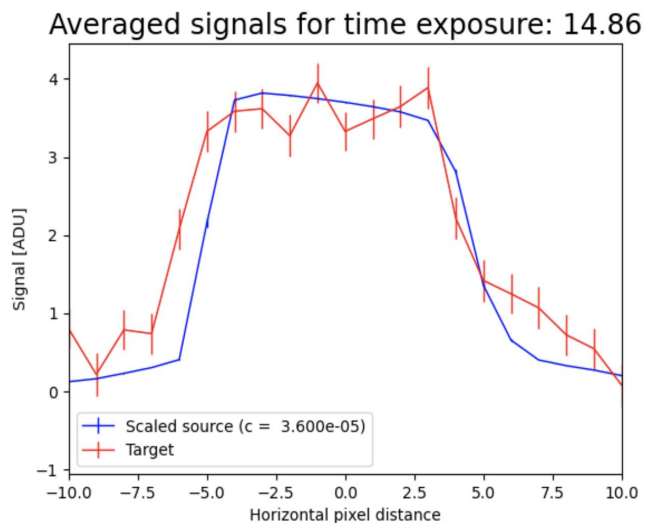
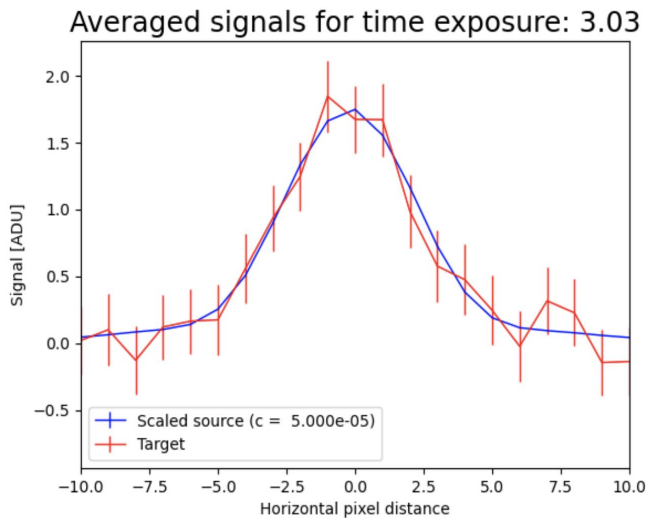
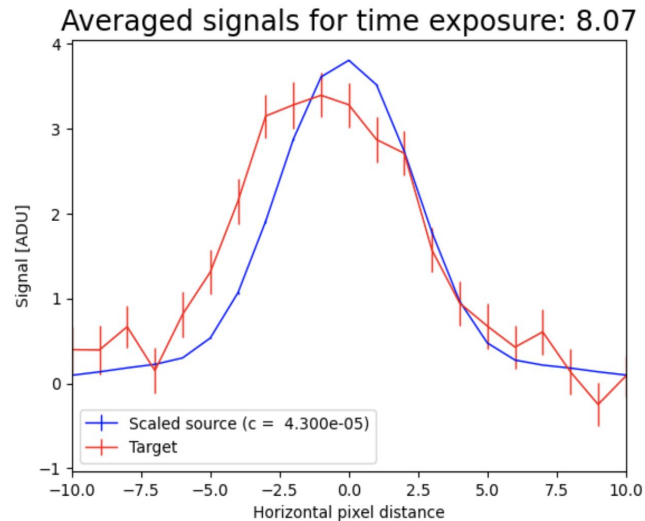
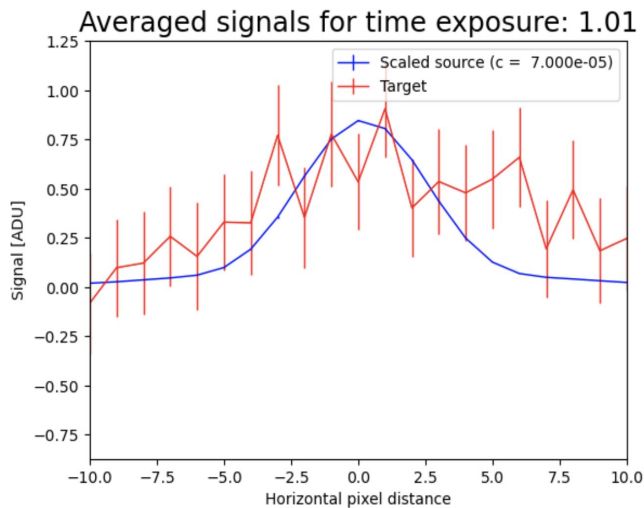
Averaged signals for time exposure: 3.03



Averaged signals for time exposure: 14.86

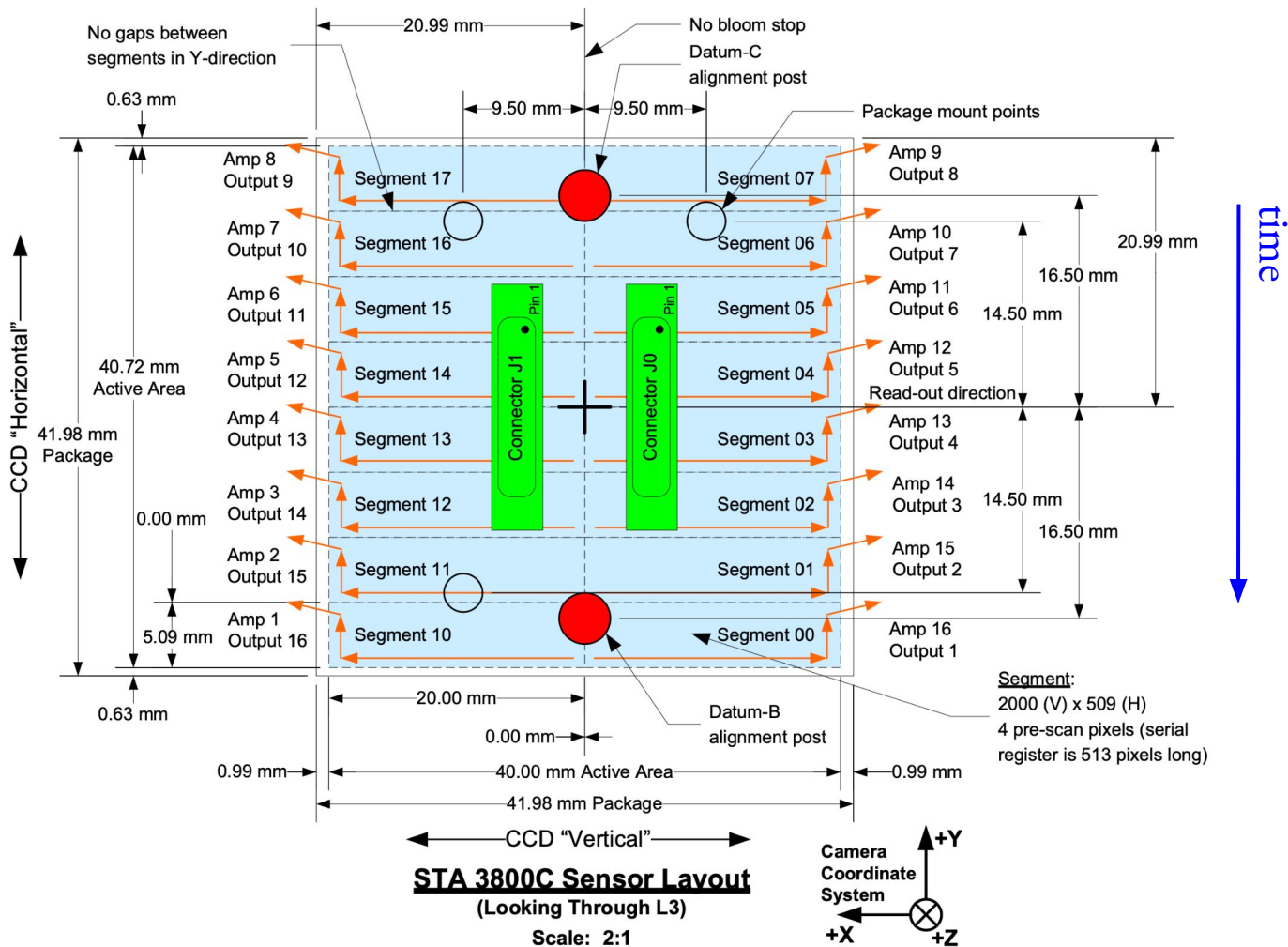


Source: Amp 2
Target: Amp 5



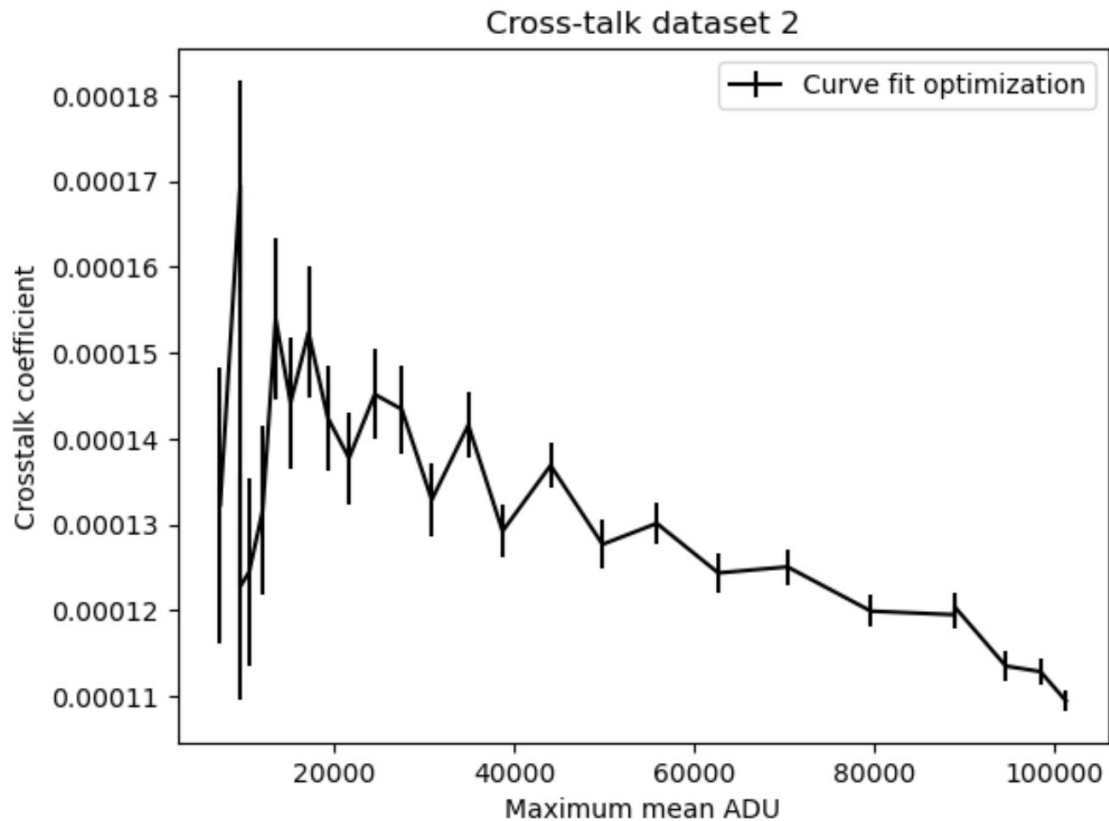
* For the third nearest neighbors

ITL CCD layout



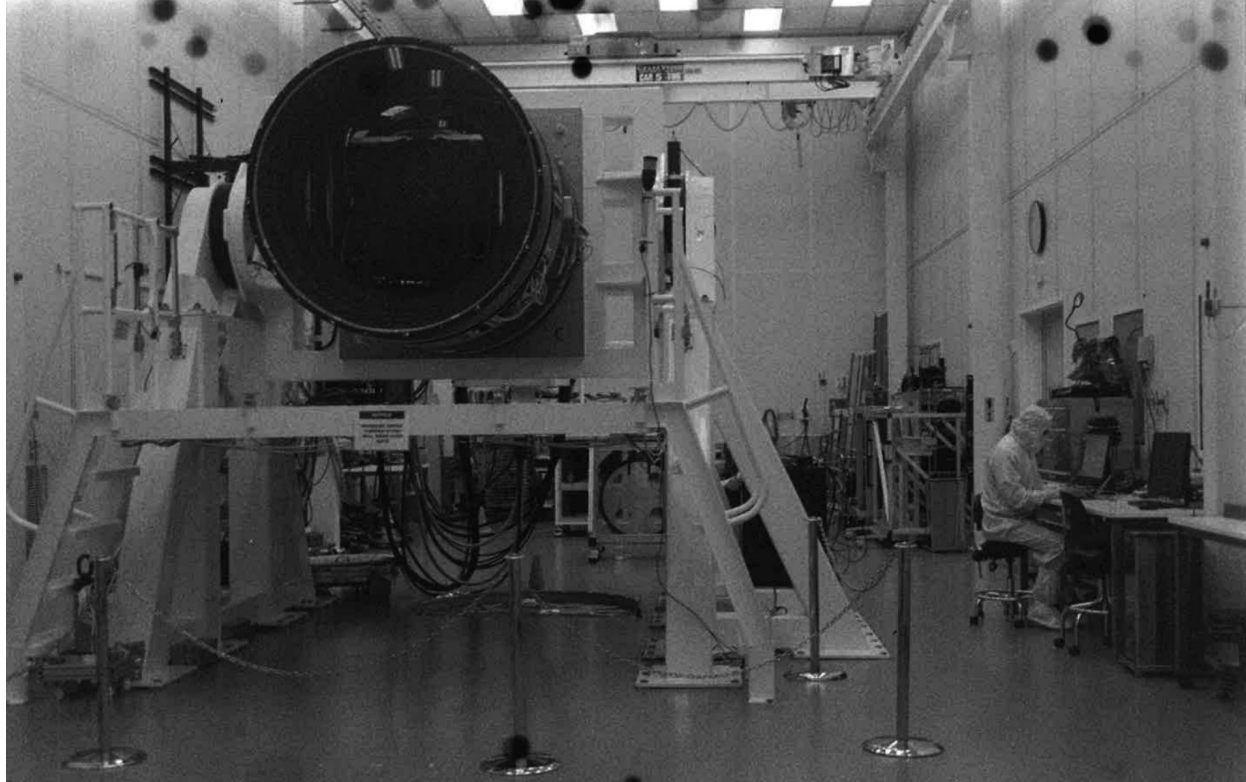
Results:

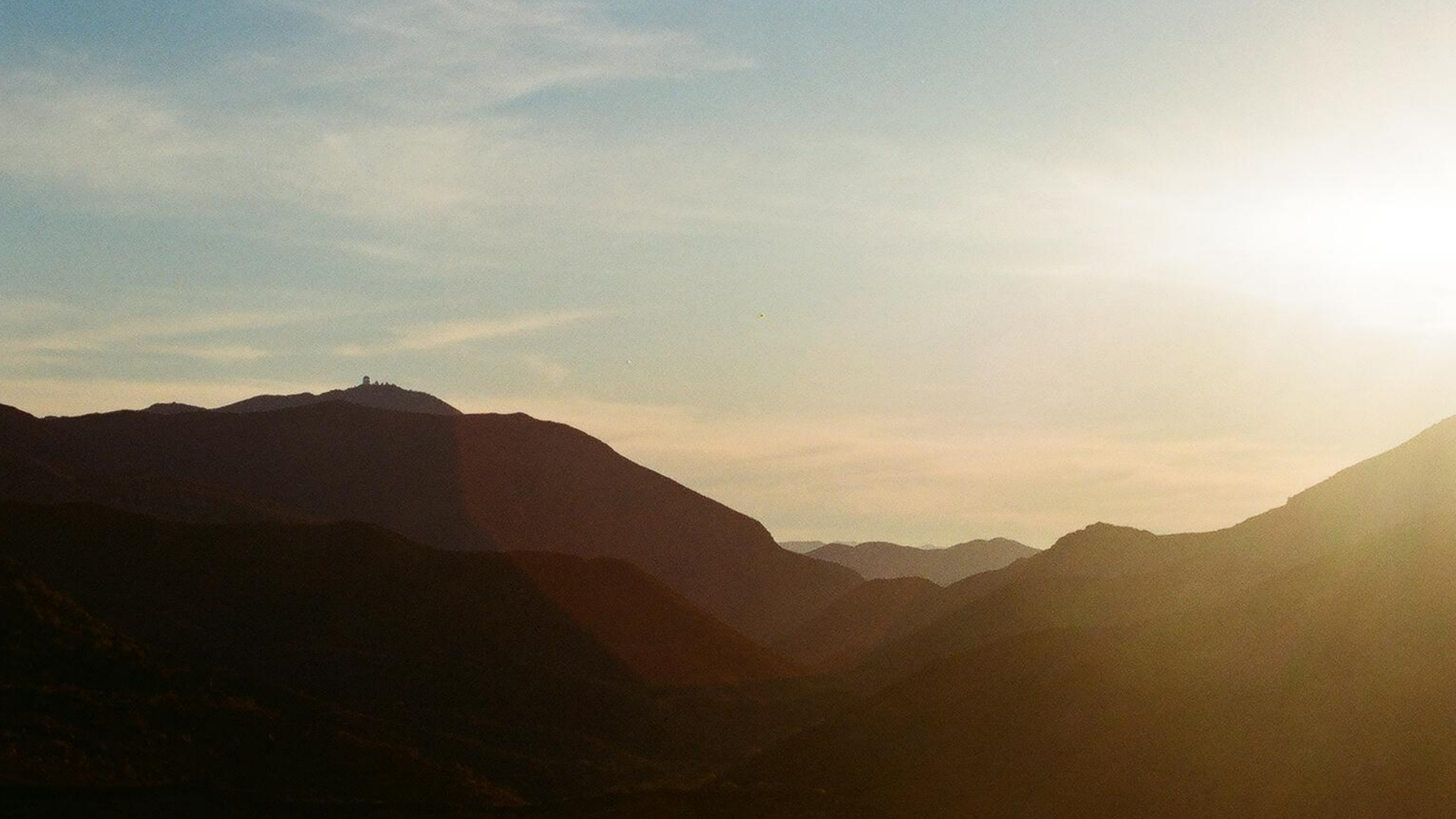
There are larger errors in the low flux detections, but there is a **clear non-linear behaviour**.



If there is time and you want...

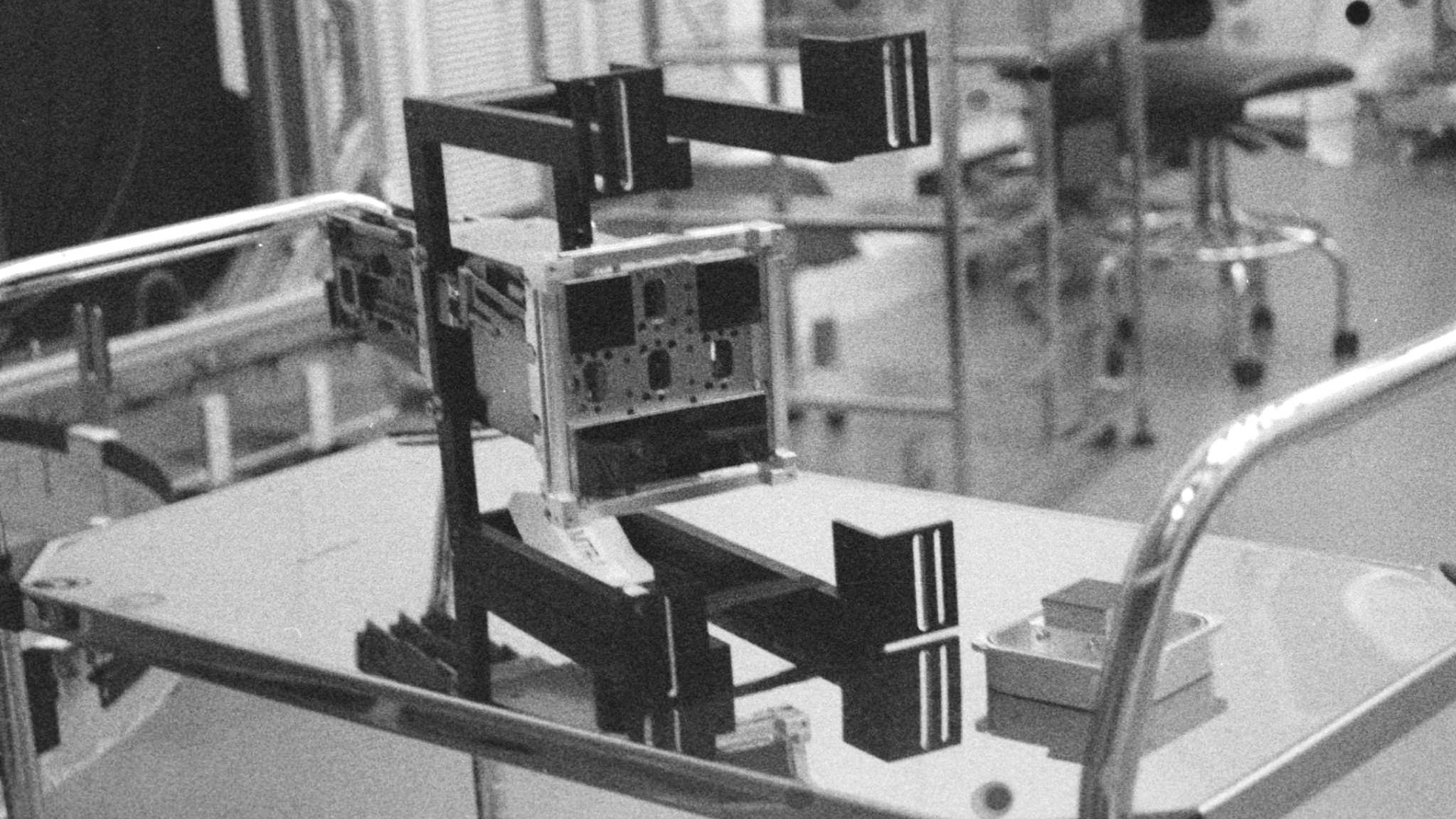
More pictures!

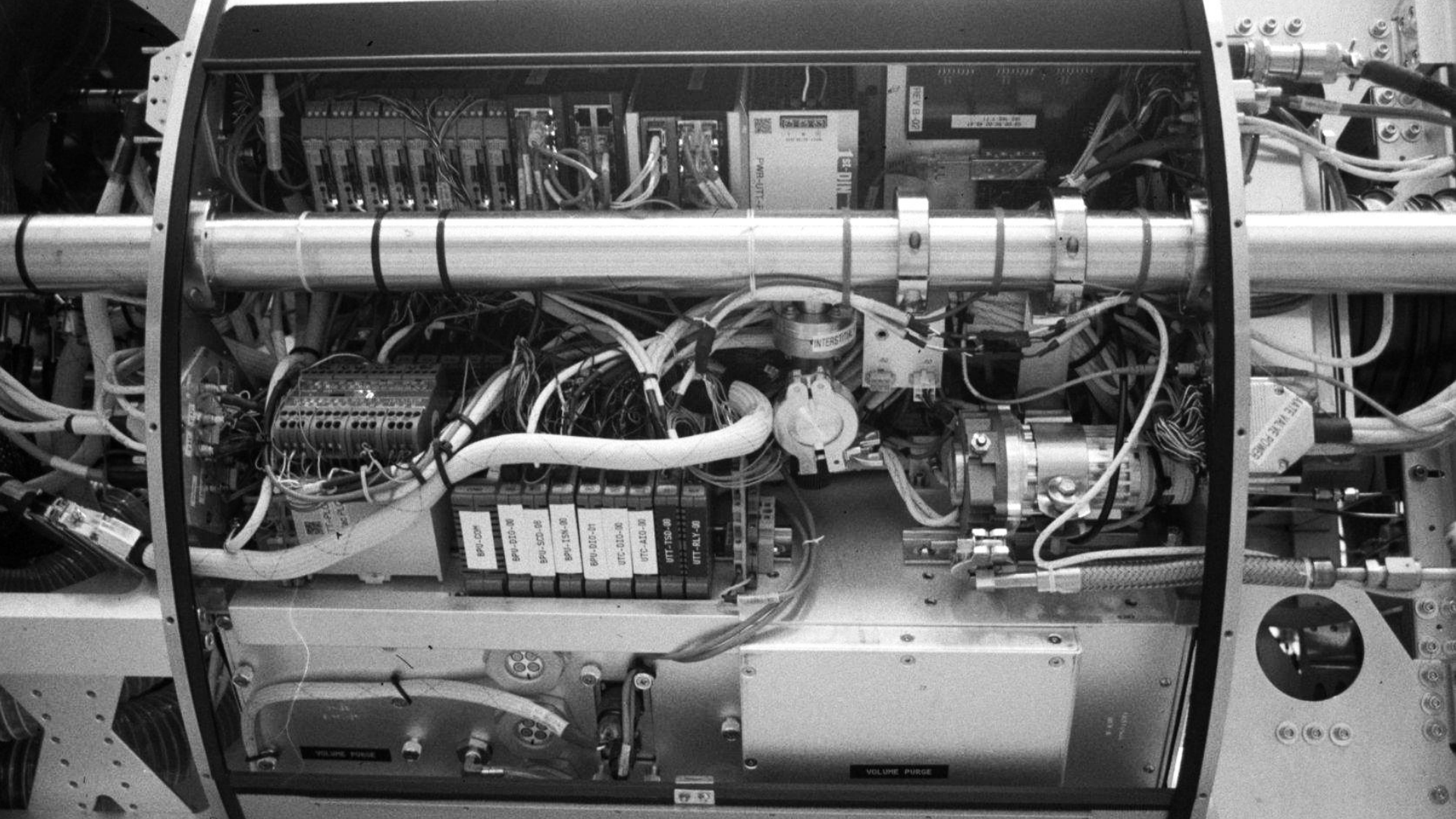


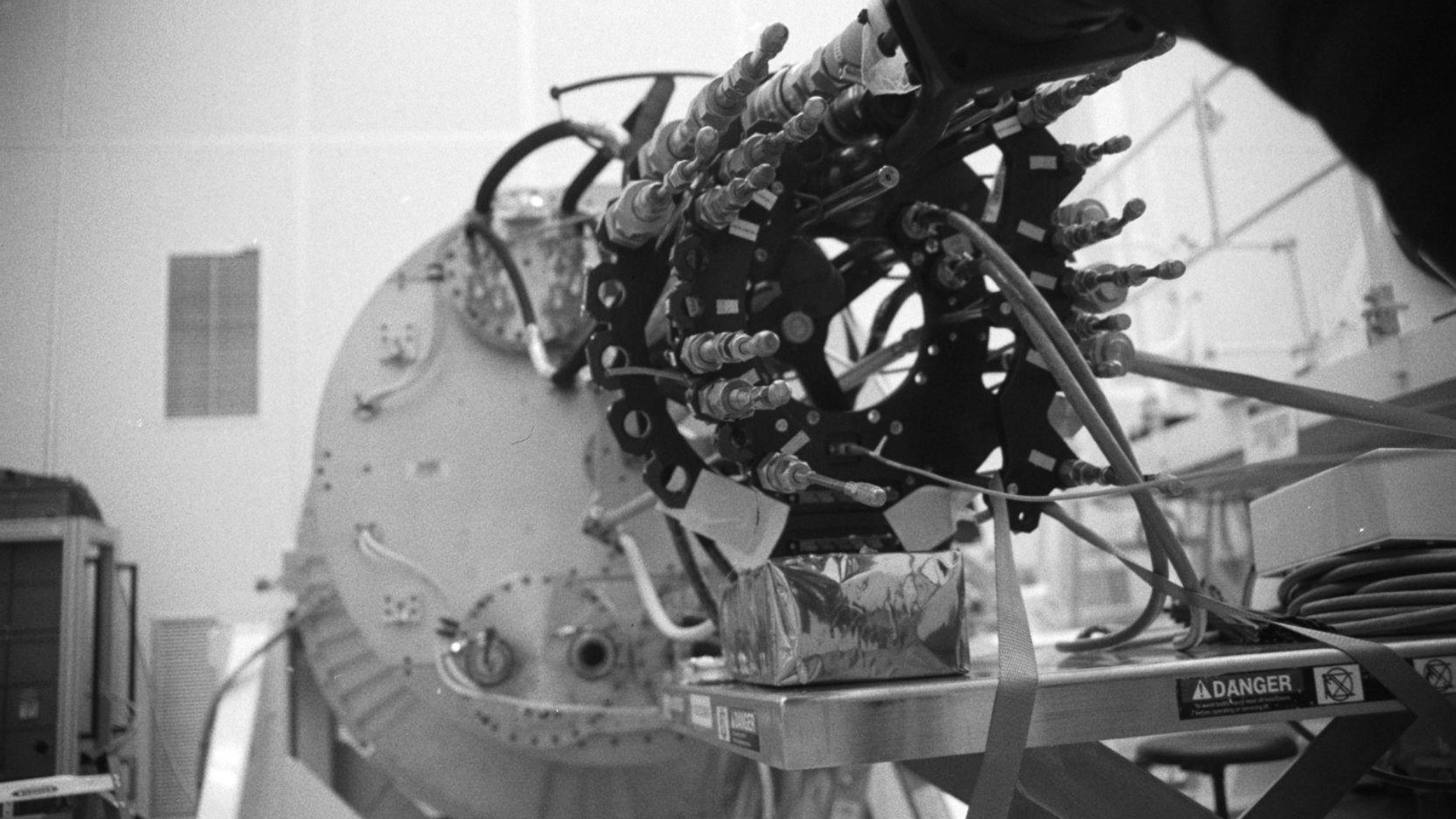


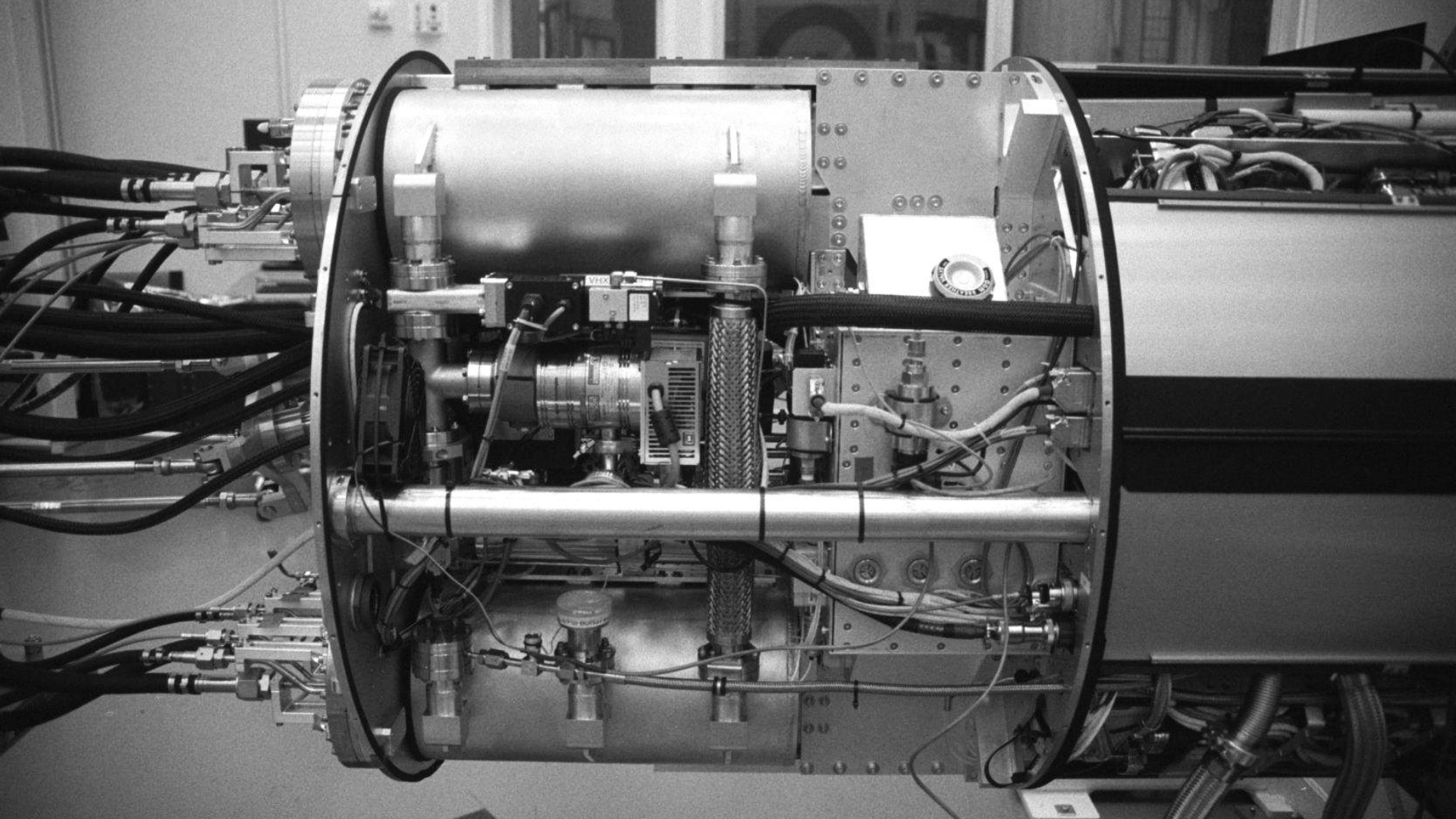




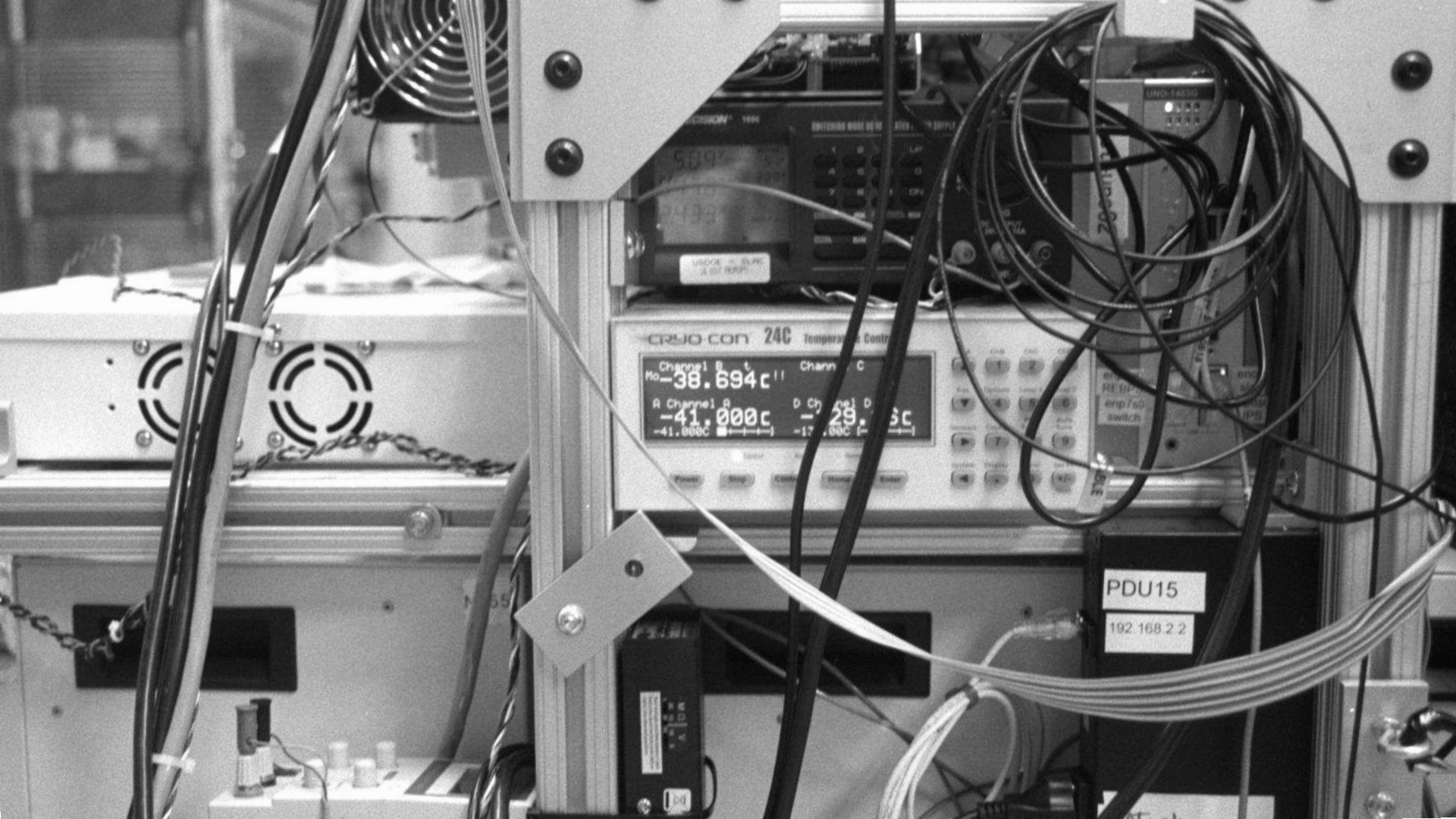










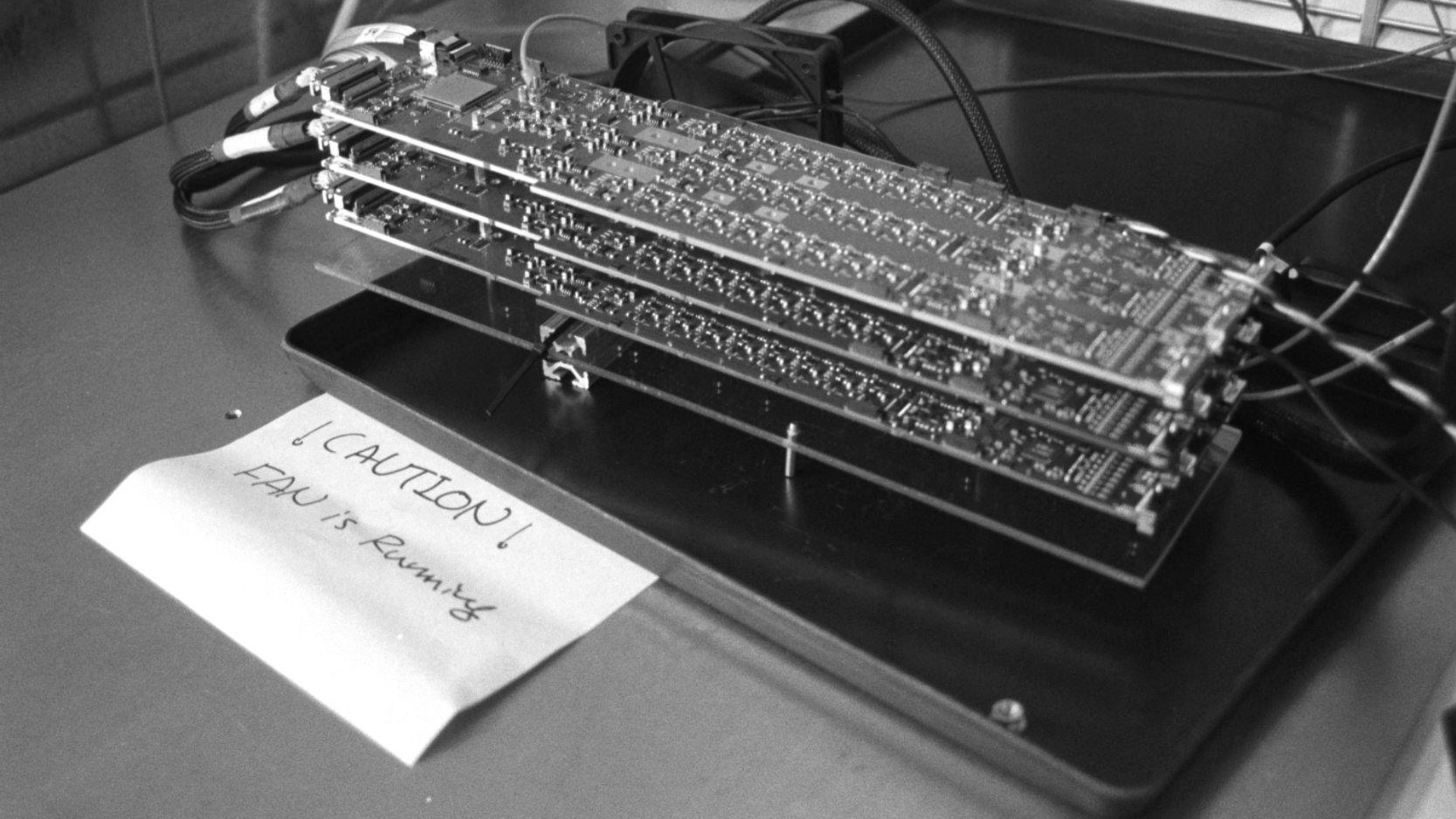


CRJ0 CON 24C Temperature Controller

Channel B t Chann C
Mo 38.694 c ||
R Channel D D Channel D
-41.000 c -29.6 c

PDU15

192.168.2.2



! CAUTION!
FAU is Running



