Study of the Linearity of the CCDs of the Vera C. Rubin Observatory

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RECA Internship 2022 - LSSTC Enabling Science Award 2021-51
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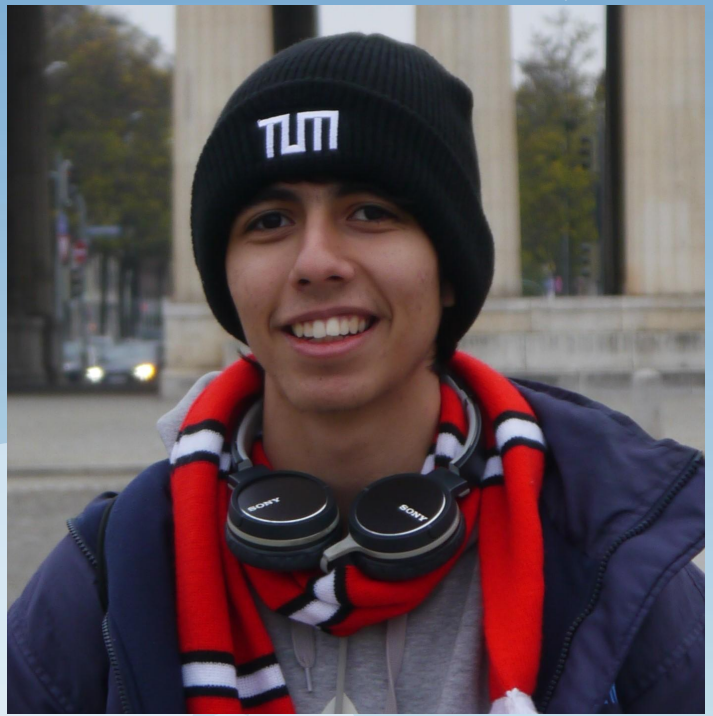
VERA C. RUBIN OBSERVATORY

01 INTRODUCTION

Jerónimo Calderón Gómez



UNIVERSIDAD DE ANTIOQUIA

Final year student at the Astronomy undergraduate program at Universidad de Antioquia, in Medellín, Colombia.

RECA Intern 2022, project: **Study of the Linearity of the CCDs of the Vera C. Rubin Observatory**. Under the guidance of Dr. **Craig S. Lage** (UC Davis) and Dr. **Andrés Plazas** (SLAC).

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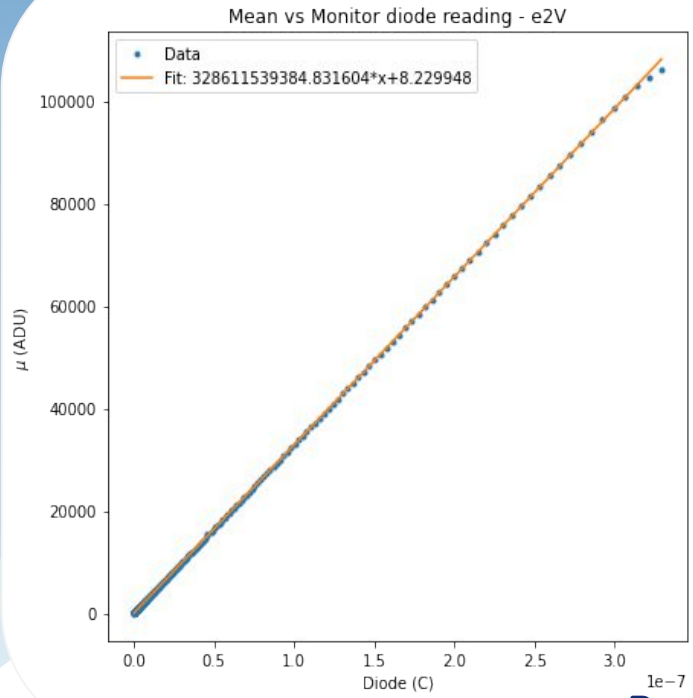
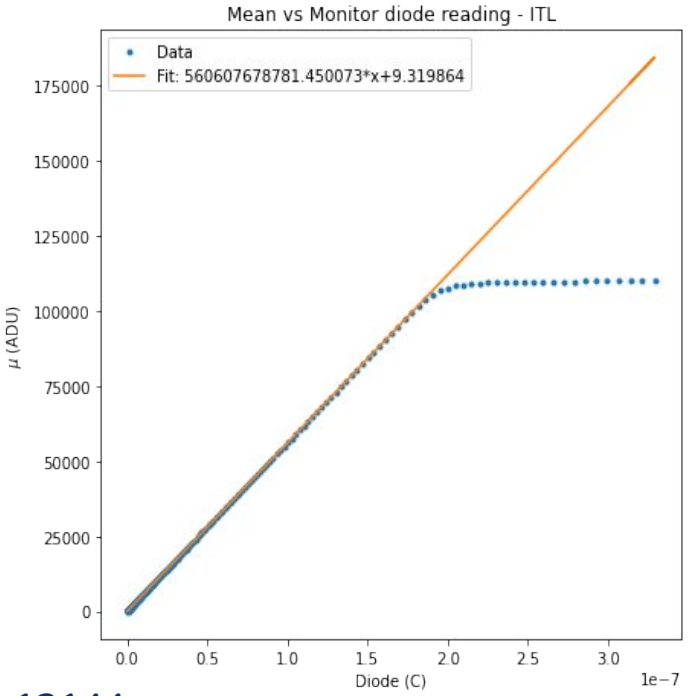
Linearity of a CCD





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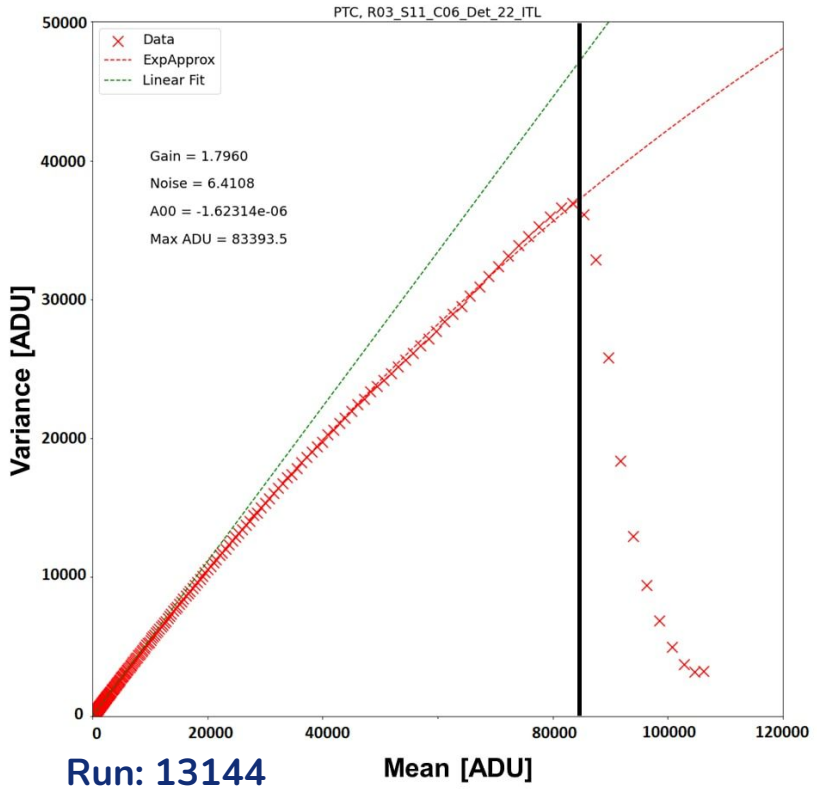
Photon Transfer Curves

We worked with PTC data from the LSSTCam detectors, exploring it using the RSP.

ExpApprox refers to Eq. 16 from Astier et al. (2019).



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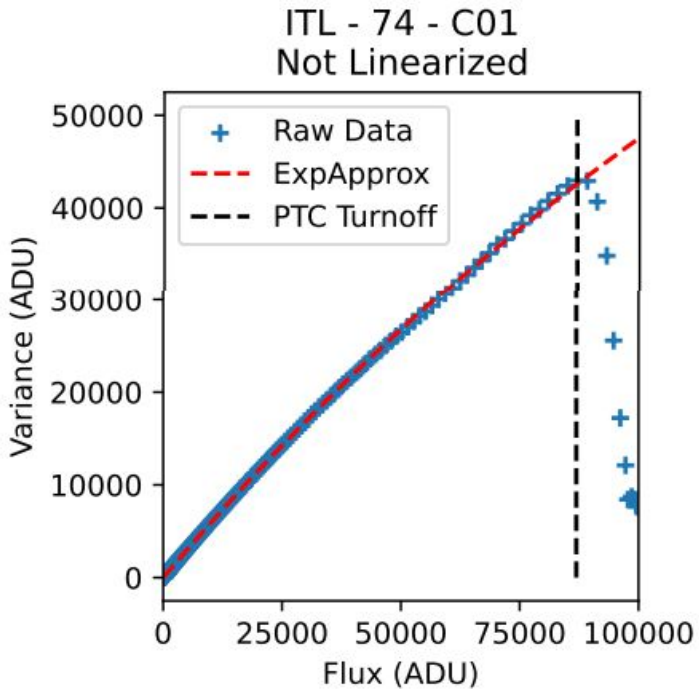
Objectives

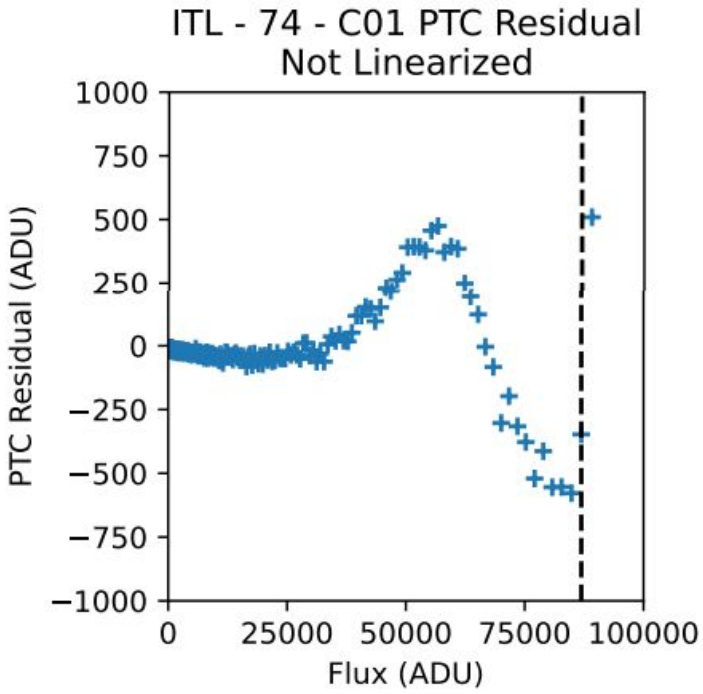
- To get familiar with the data available, the RSP workflow, and the DM Stack's pipetasks.
- To explore the use of pipetasks to handle the calibration images taken with the LSSTCam and generate PTC data for a pair of detectors.
- To try different parameters for the linearization algorithm and check which may work best for the available data.
- To write an internship report and construct a tutorial explaining how to handle PTC data with the linearization algorithm.

02
LINEARITY OF THE LSSTCam

Our work using the linearizer

PTCs of the LSSTCam

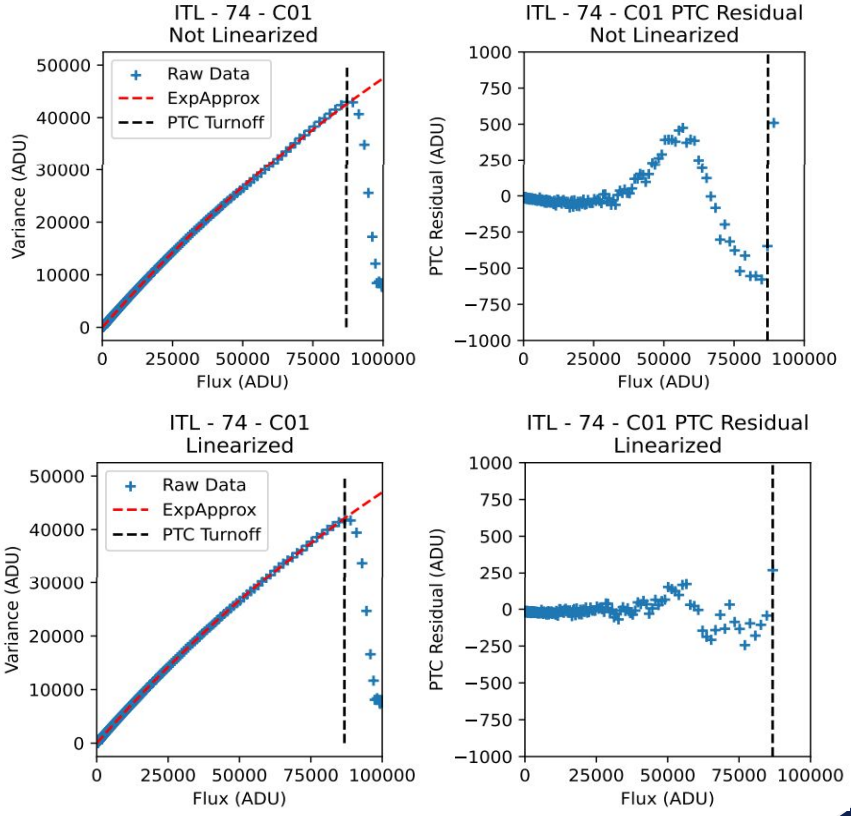




Linearization with the DM Stack:

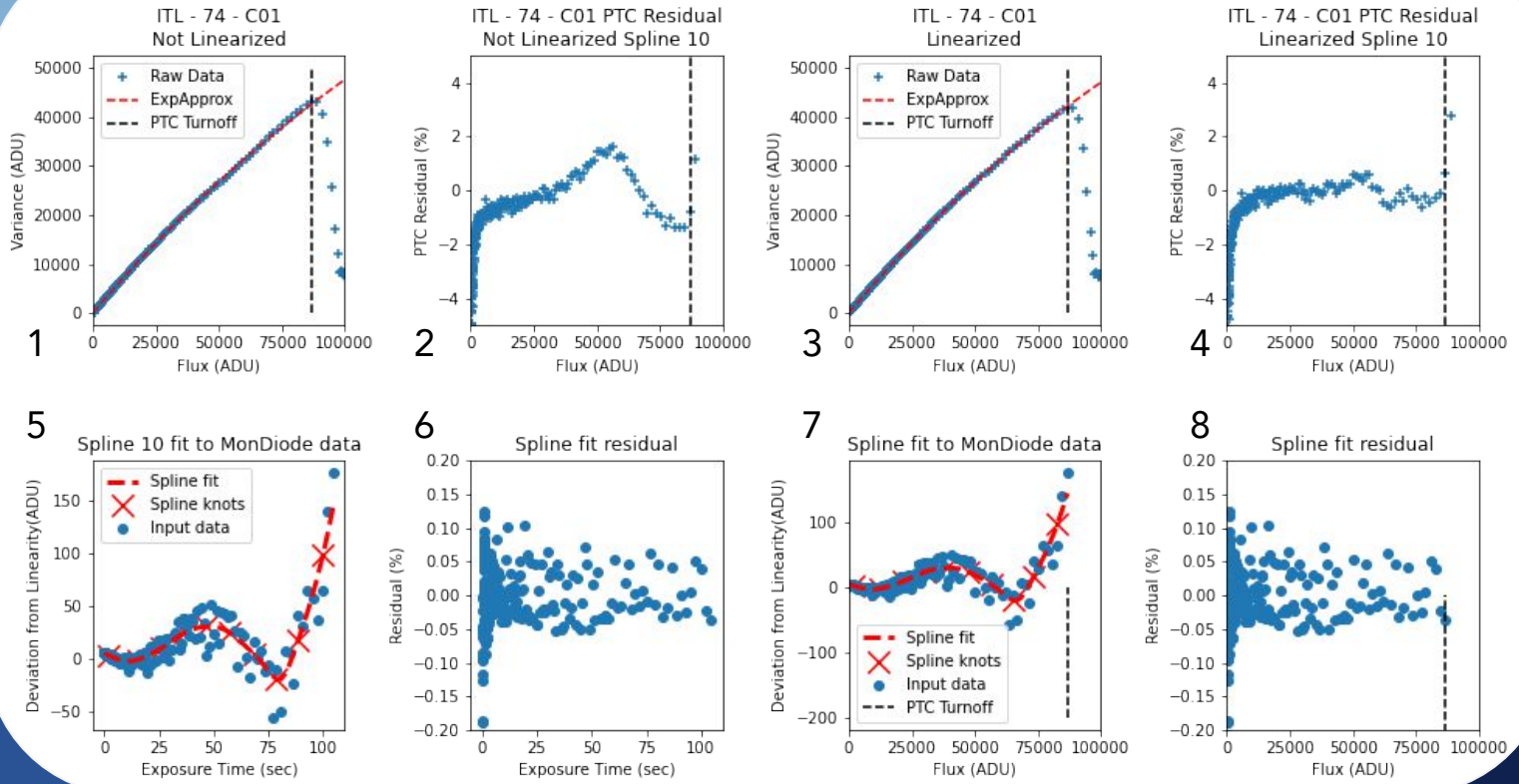
We are working with a total amount of **3024** CCD segments (189 CCDs, 16 amps/CCD), each with its own **linearization function** to be determined.

DM stack version: w_2022_32



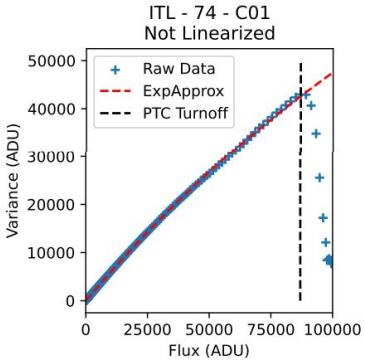
Linearization with the DM Stack: Spline Fits

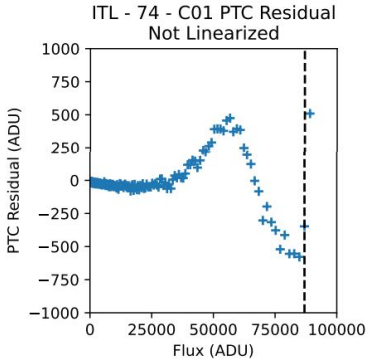
DM stack version: w_2022_32

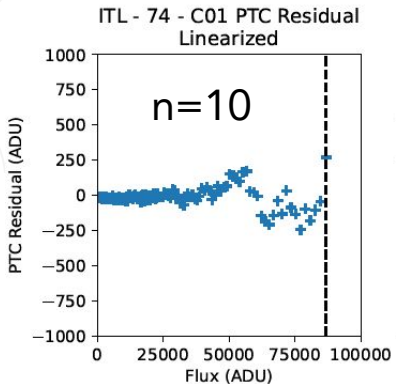


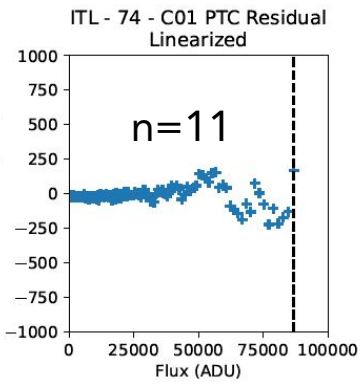
Linearization with the DM Stack: Spline Fits

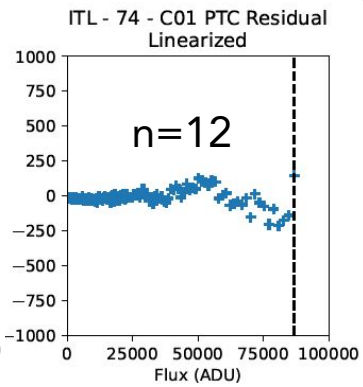
DM stack version: w_2022_32

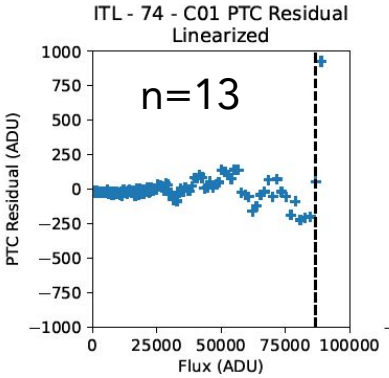


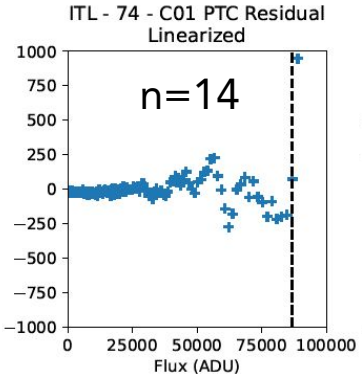


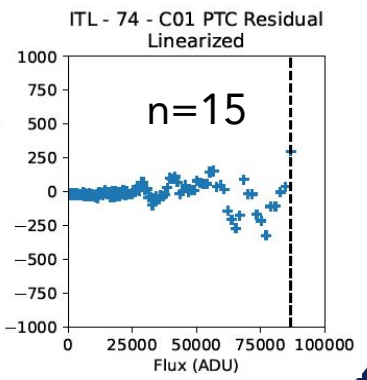






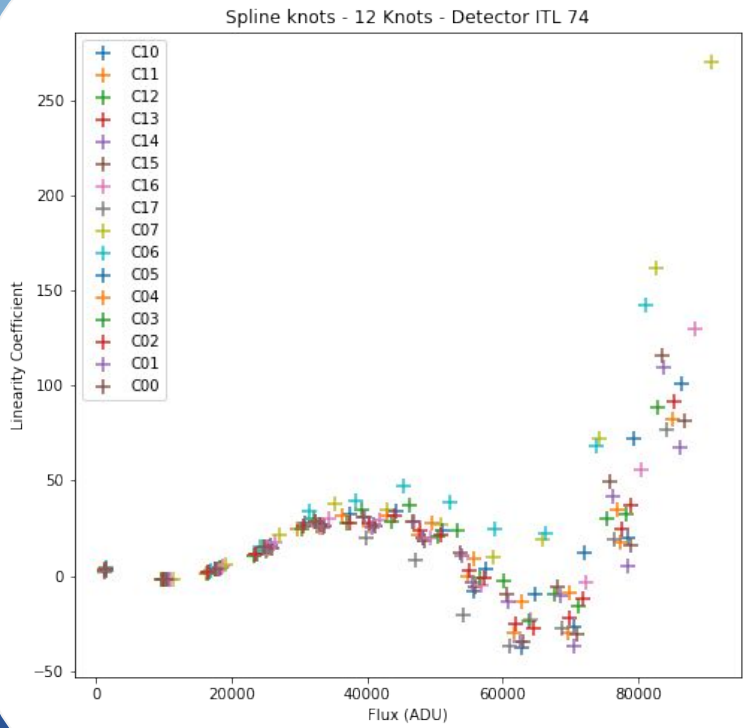


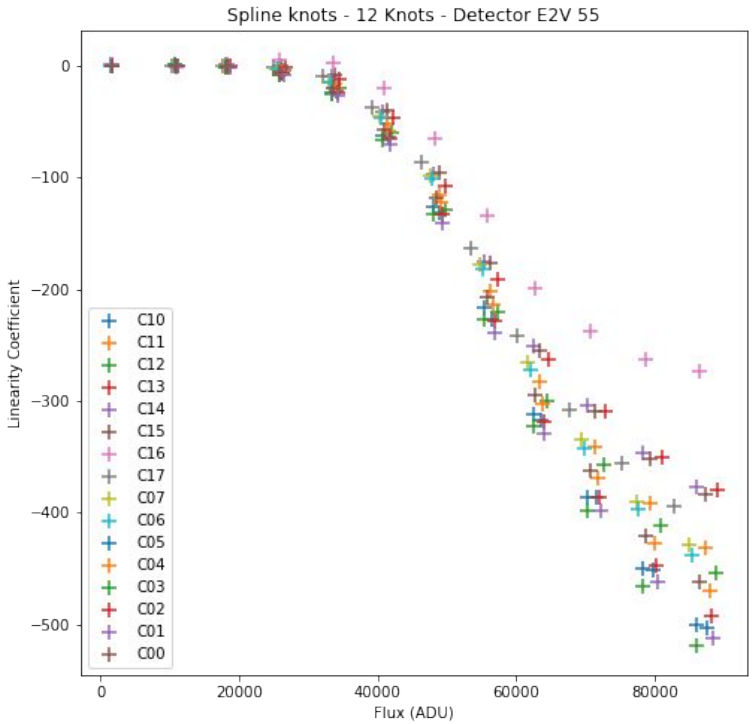




Linearization with the DM Stack: Spline Fits

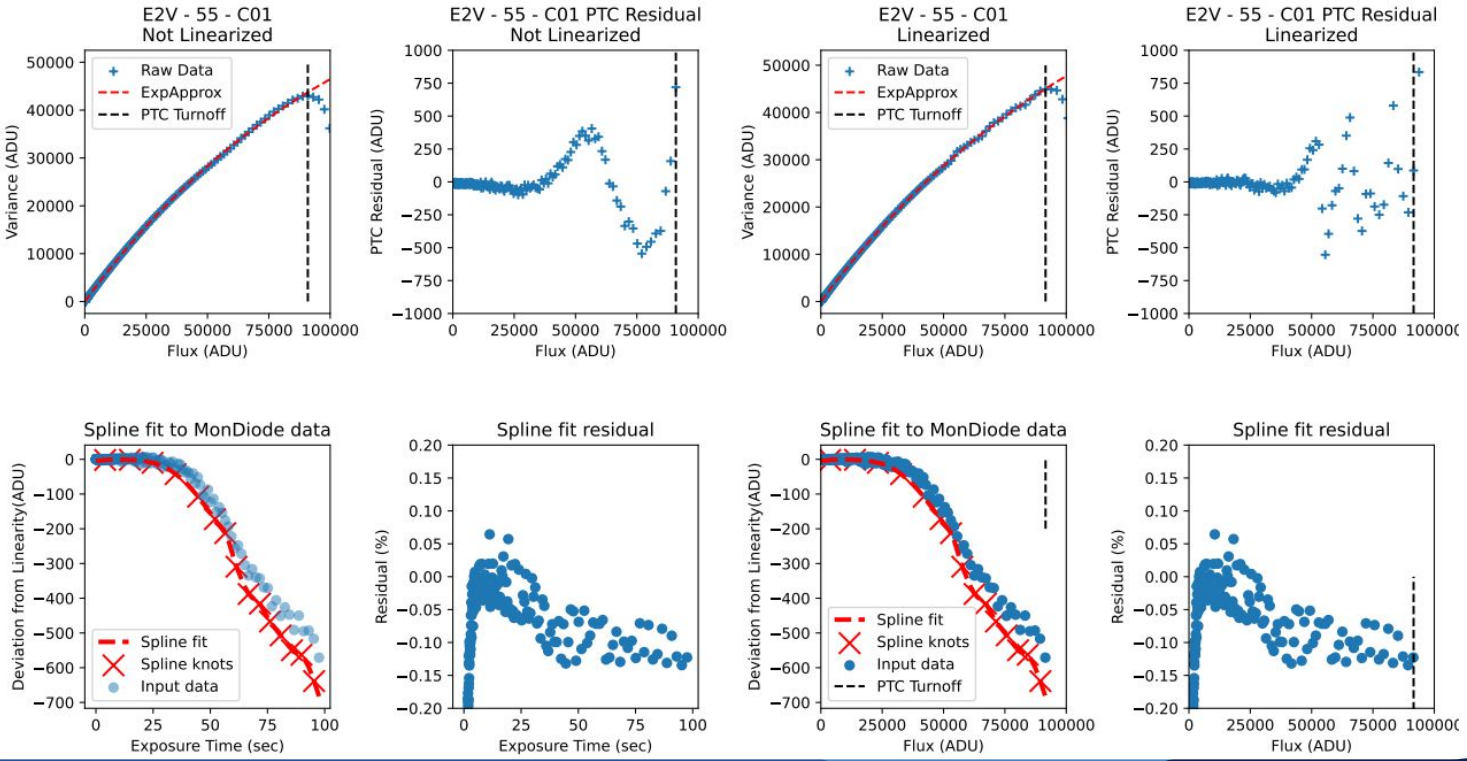
DM stack version: w_2022_32





Spline Fits + Knot redistribution

DM stack version: w_2022_32

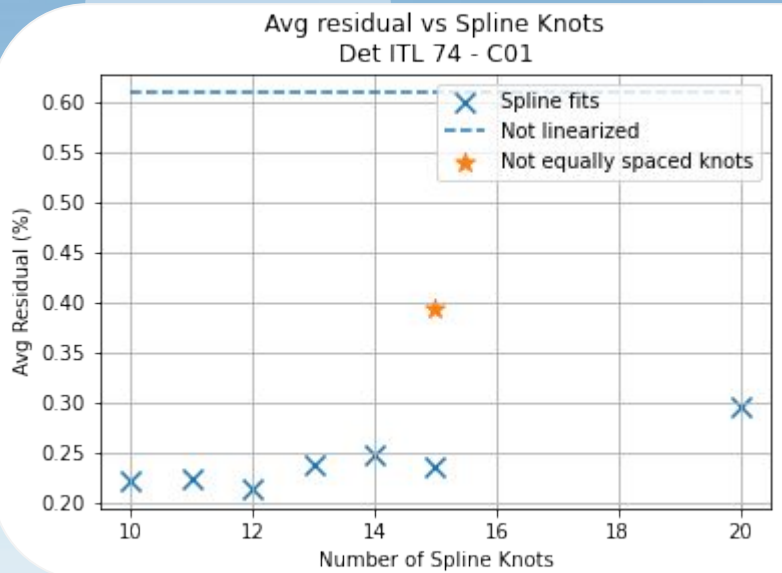


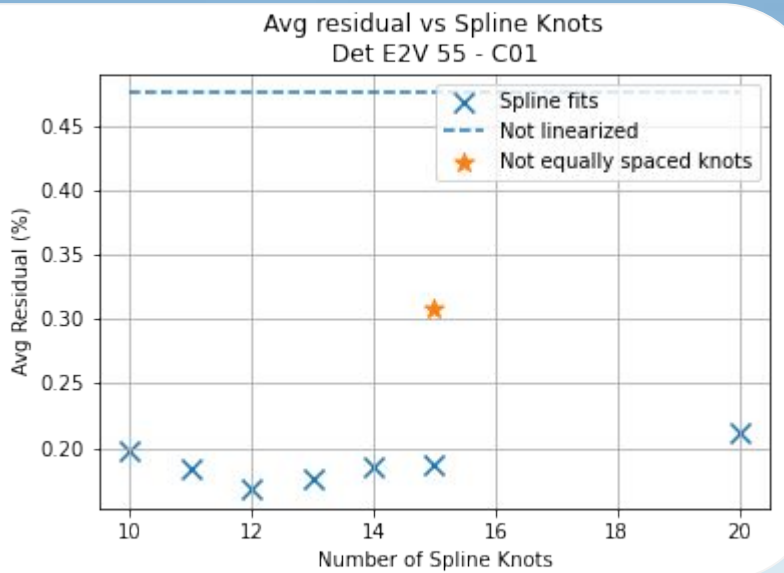
We ran the linearizer with 15 knots (10 evenly-spaced and 5 clustered around the 50000 ADUs bump).

03
RESULTS AND CONCLUSIONS

Conclusions

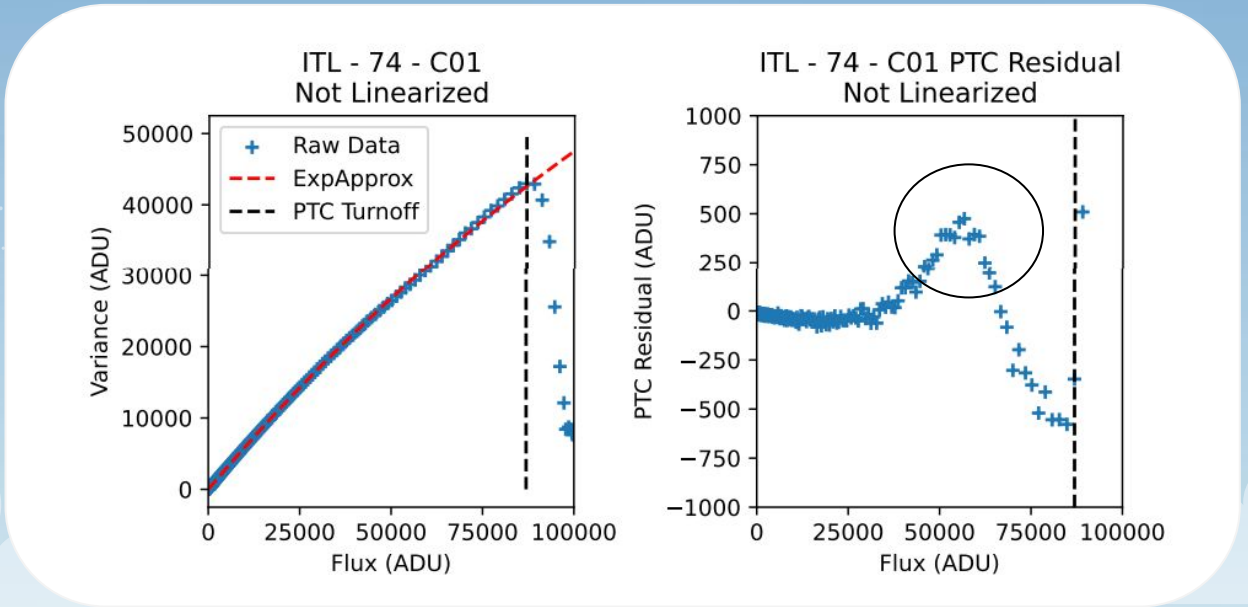
- We note how although the best linearization was obtained using 12 Spline knots, we must emphasize on how **linearizing with any of the studied parameters is better than not linearizing at all**.





Conclusions

- For future and more detailed studies we recommend exploring methods to **change the Spline knots distribution** around the regions where linearity is lost more severely. Exploring algorithms like **LOESS** is recommended to get optimal locations for the knots.



Extra Material

The full **report** and the **tutorial** to access the RSP and explore PTC and linearizer data are available at:
https://github.com/jerocalderong/LinearityRubinObservatoryCCDs

This material is publicly available so that anyone looking forward to learn to work with the RSP can use it.

Study of the Photon Transfer Curve in the CCD detectors of the Vera Rubin Observatory

Lina Giraldo-Murillo

Astronomer and master's student
in physics (2022 - 2024)

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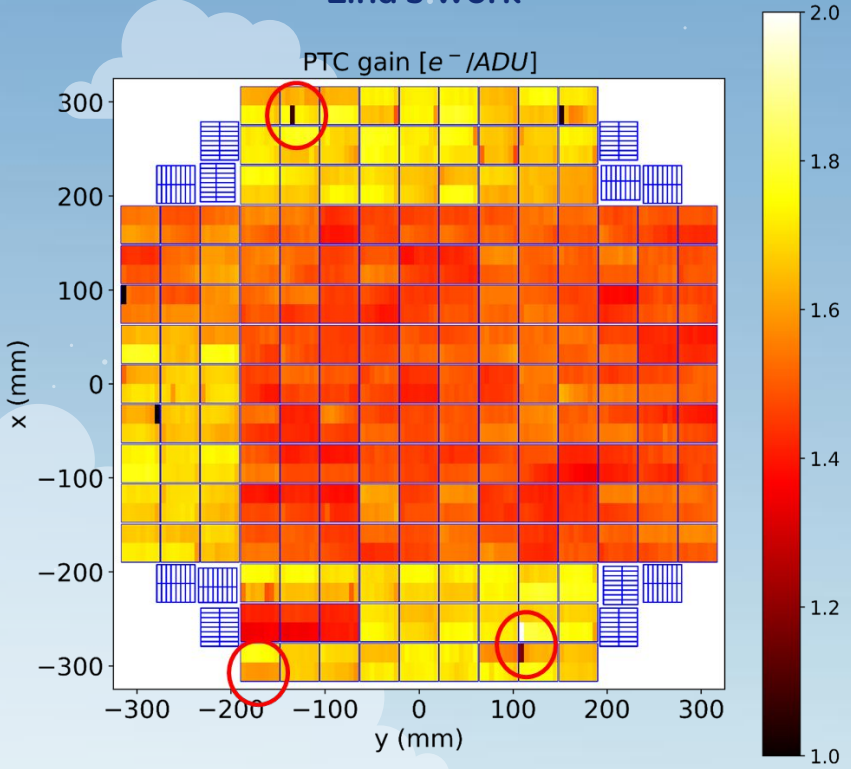
GitHub Repository

PTC gain: run 13144

Lina's work



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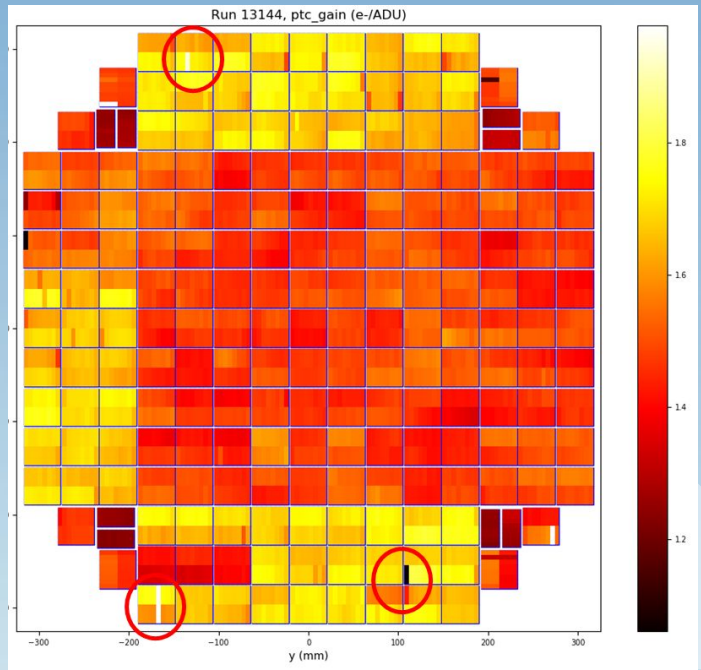
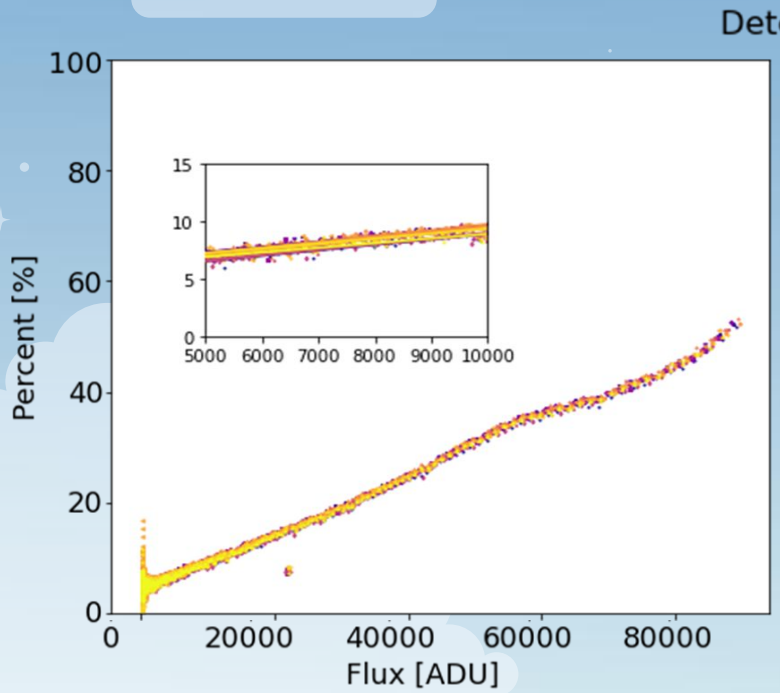


Gain from flat pairs and comparison with PTC gain

DM stack version: w_2022_27



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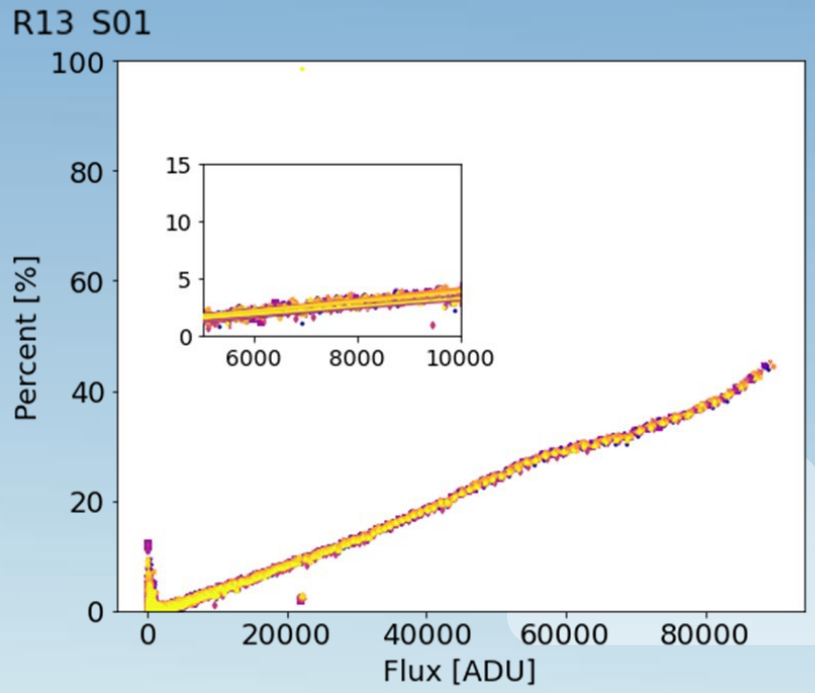
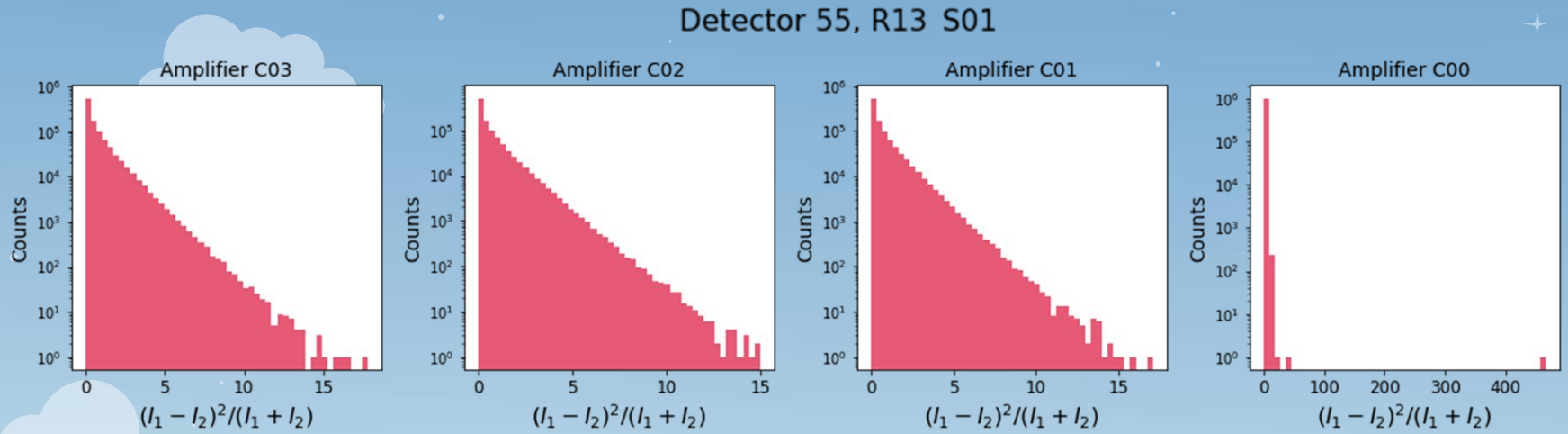


Distribution of Lupton's equation



Jira ticket

https://jira.lsstcorp.org/browse/DM-35790

Acknowledgments

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I would like to thank professors **Craig Lage** and **Andrés Plazas** for their advice and mentoring. Also thanks to my project mate **Lina Giraldo** who provided me with fruitful discussions and explanations that helped me understand better the technical details of the project.

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¡Gracias!

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