WSO Simulator

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JCUVA / AEGORA Group – 26th October 2017

WSO-UV instrumentation

- WUVS: WSO Ultraviolet Spectrographs
  - VUVES: Far UV 1020-1800 Å, R~55000 ✓
  - UVES: Near UV 1740-3100 Å, R~55000 ✓
  - LSS: Long Slit 1020-3200 Å, R=1500-4500 ✓
- FCU: Field Camera Unit
  - UVO Channel: 1740-3100 Å CCD ✓
  - FUV Channel: 1150-1750 Å MCP

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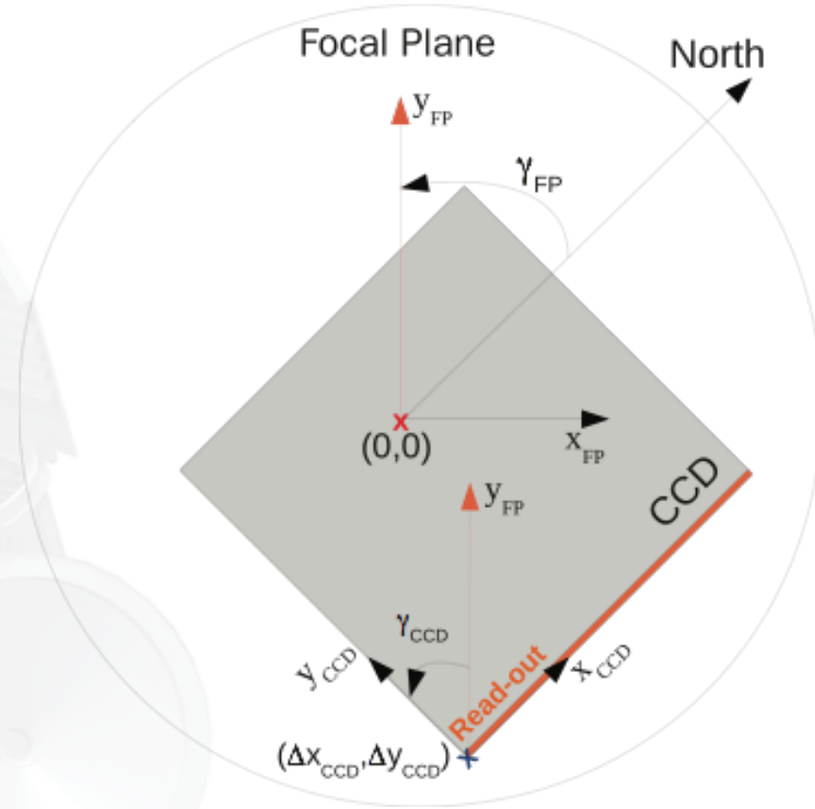
How does it work?

- Executable from command line, takes:
  - Simulation parameters
  - Star catalogue (α, δ, m)
  - Photometry parameters

- Includes realistic models of:
  - the telescope optics,
  - stellar mapping on focal plane,
  - detector and its electronics,
  - the ACS jitter movements of the spacecraft,
  - and all important natural noise sources.

- Perform post-processing photometry of the images



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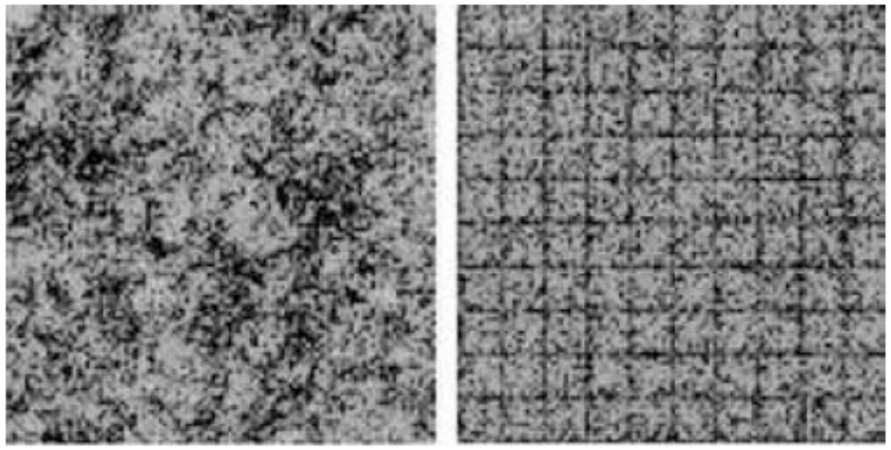
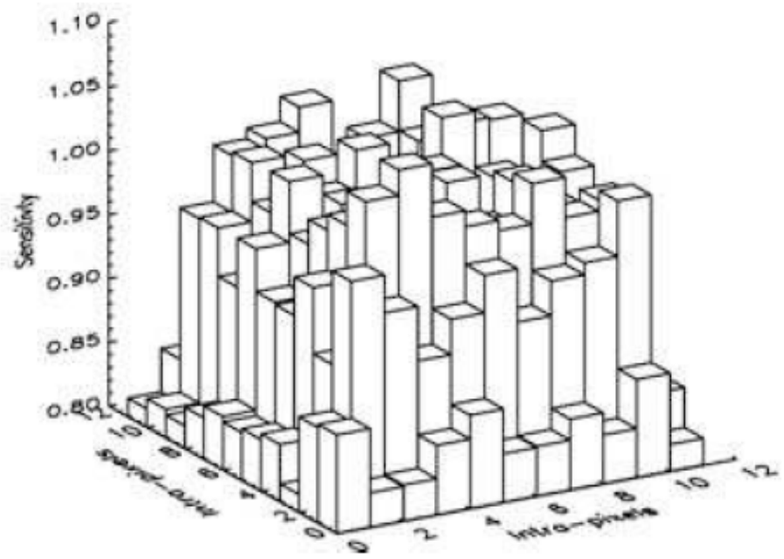
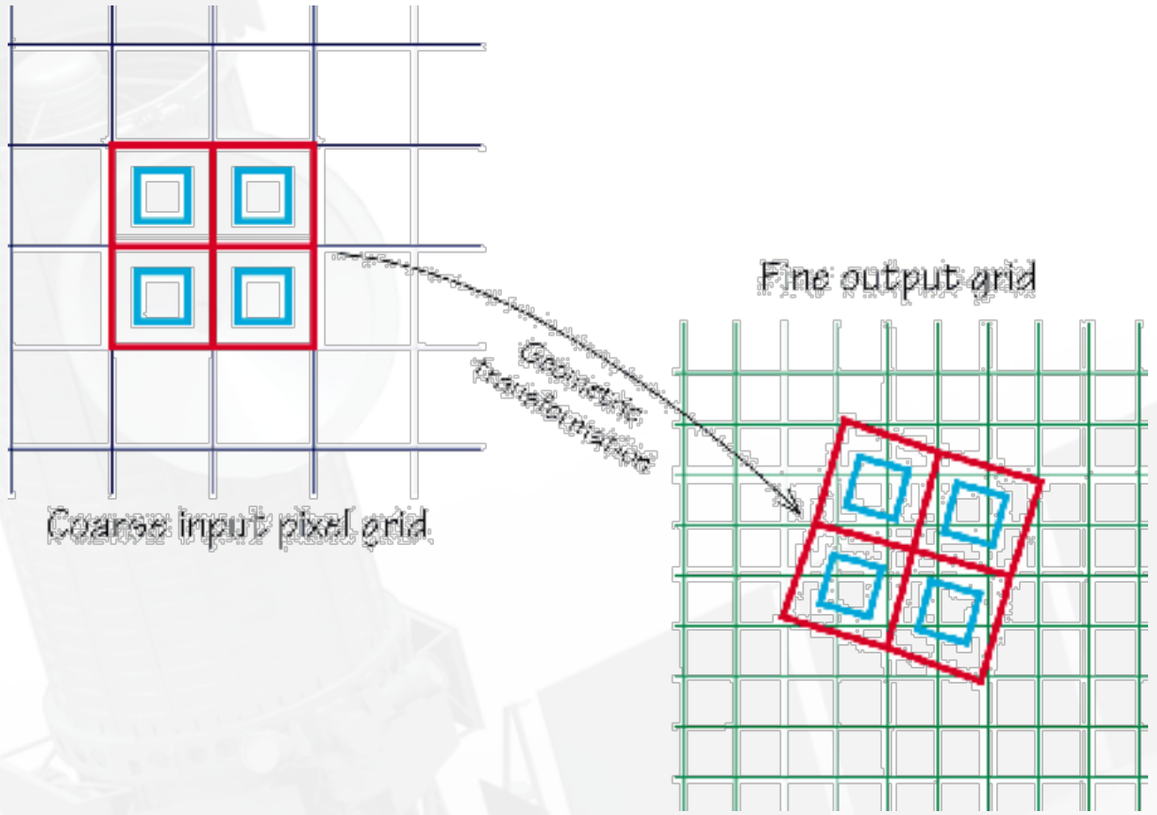
Intrapixel resolution





Credit: De Ridder et al.

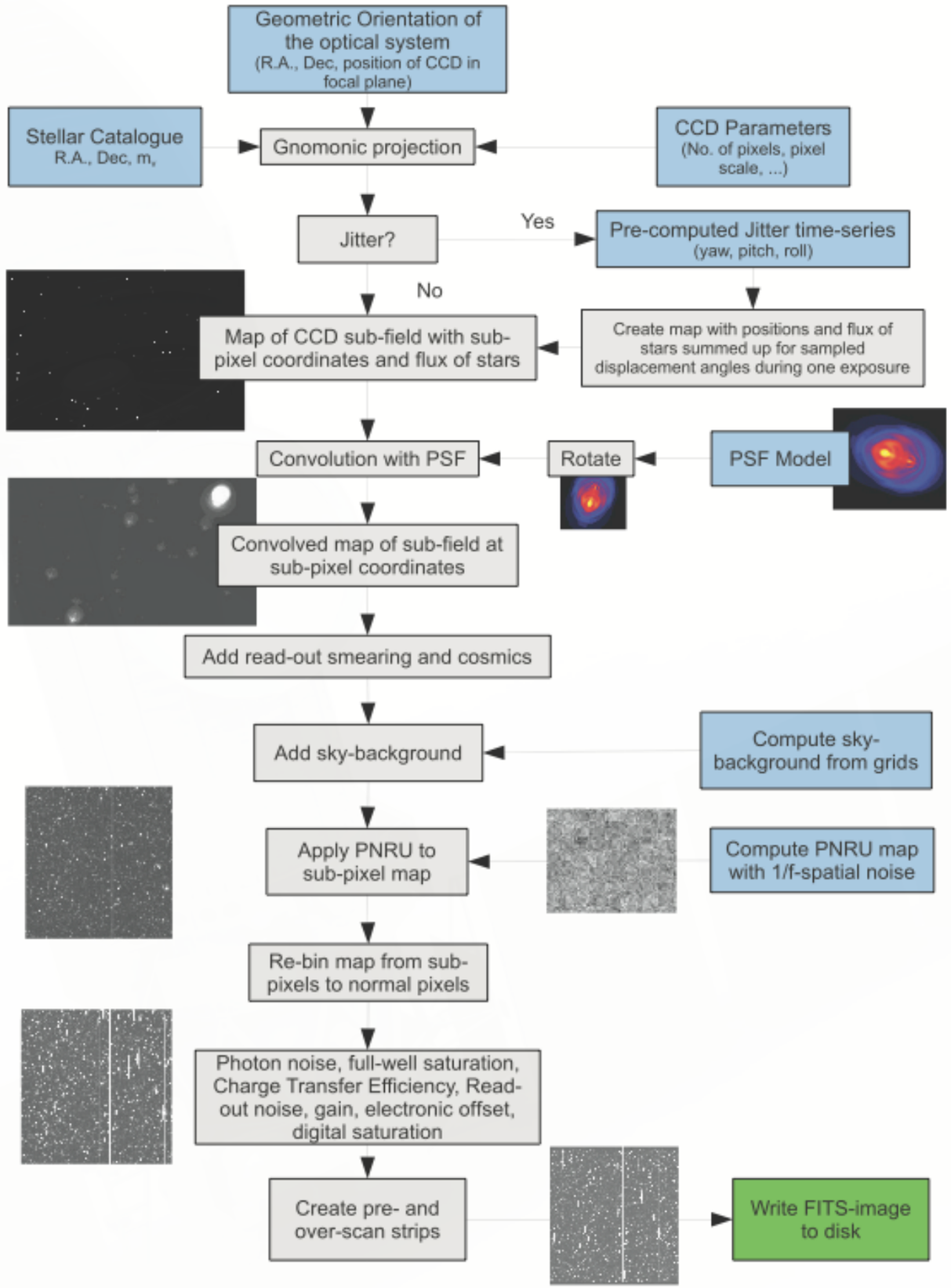


Credit: Hook et al.

How does it work?

Noise sources:

- PSF Convolution;
- High-energy particle hits;
- Charge-transfer smearing;
- Sky background;
- CCD Sensitivity variations;
- Photon noise;
- Full-well saturation;
- Charge-transfer efficiency;
- Read-out noise;
- Gain;
- Electronic offset;
- Digital saturation.



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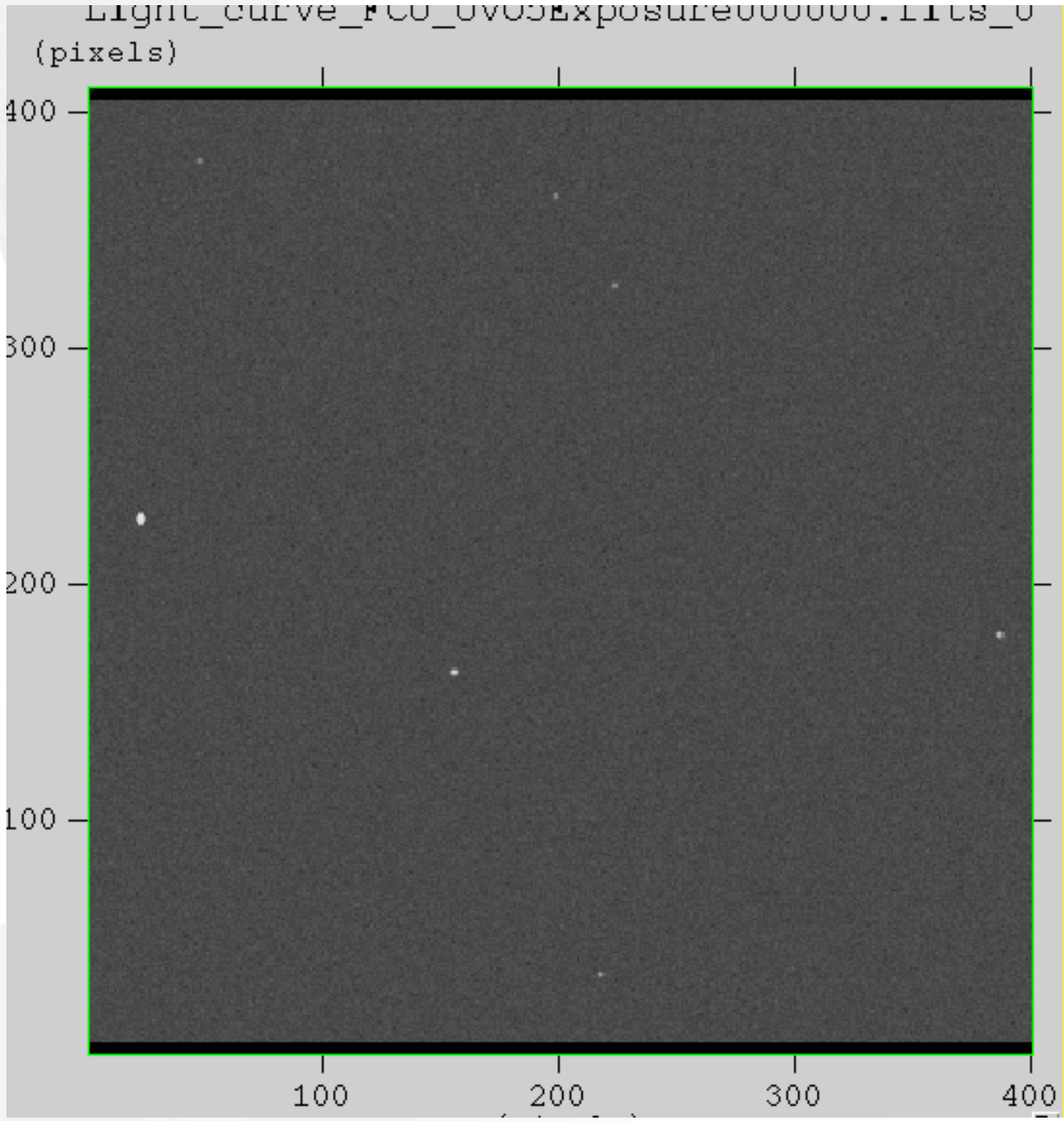
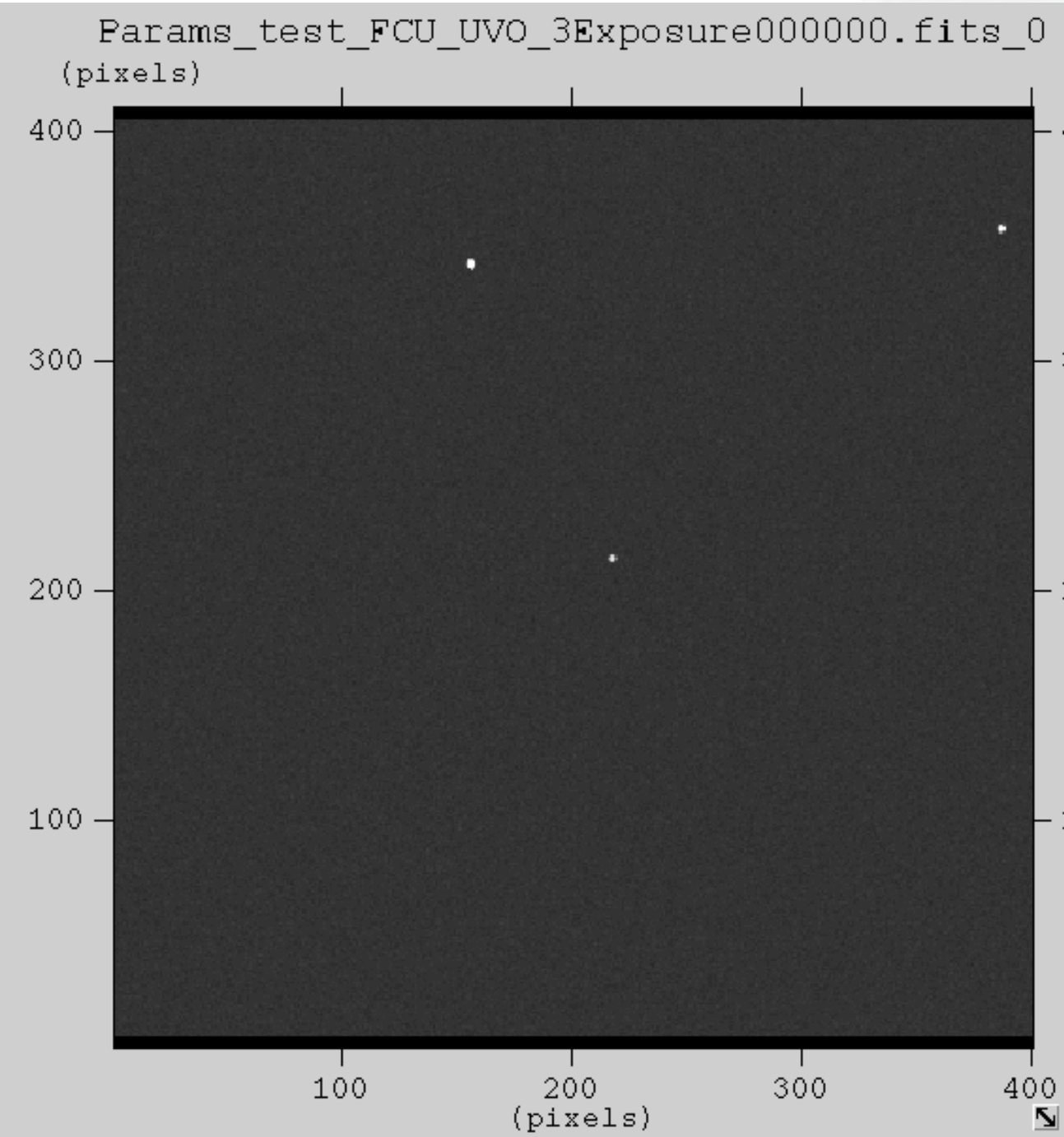
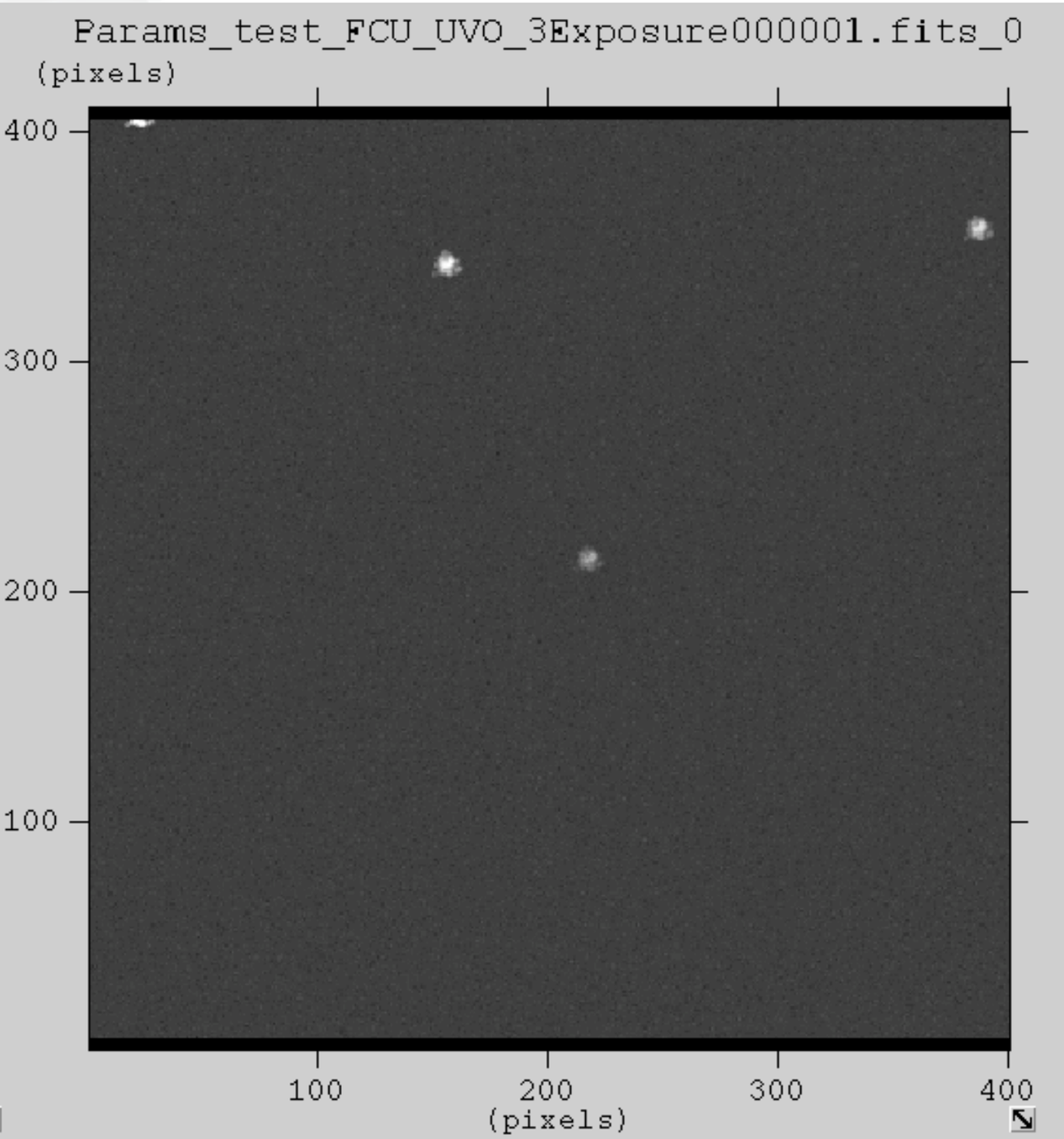
FCU performance evaluation

- UVO Channel:
  - Estimation of observable stars at specific noise levels



FCU performance evaluation





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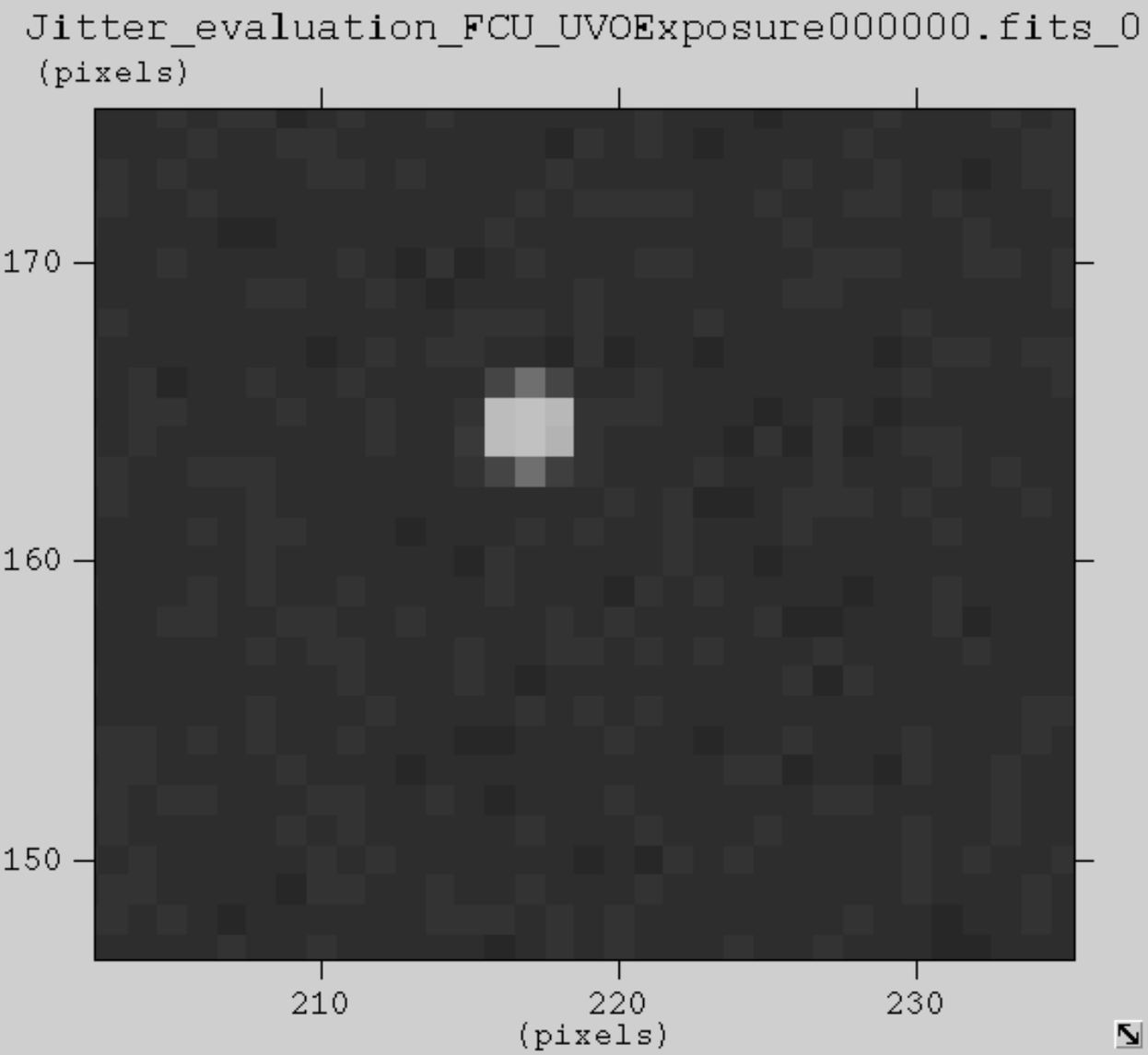

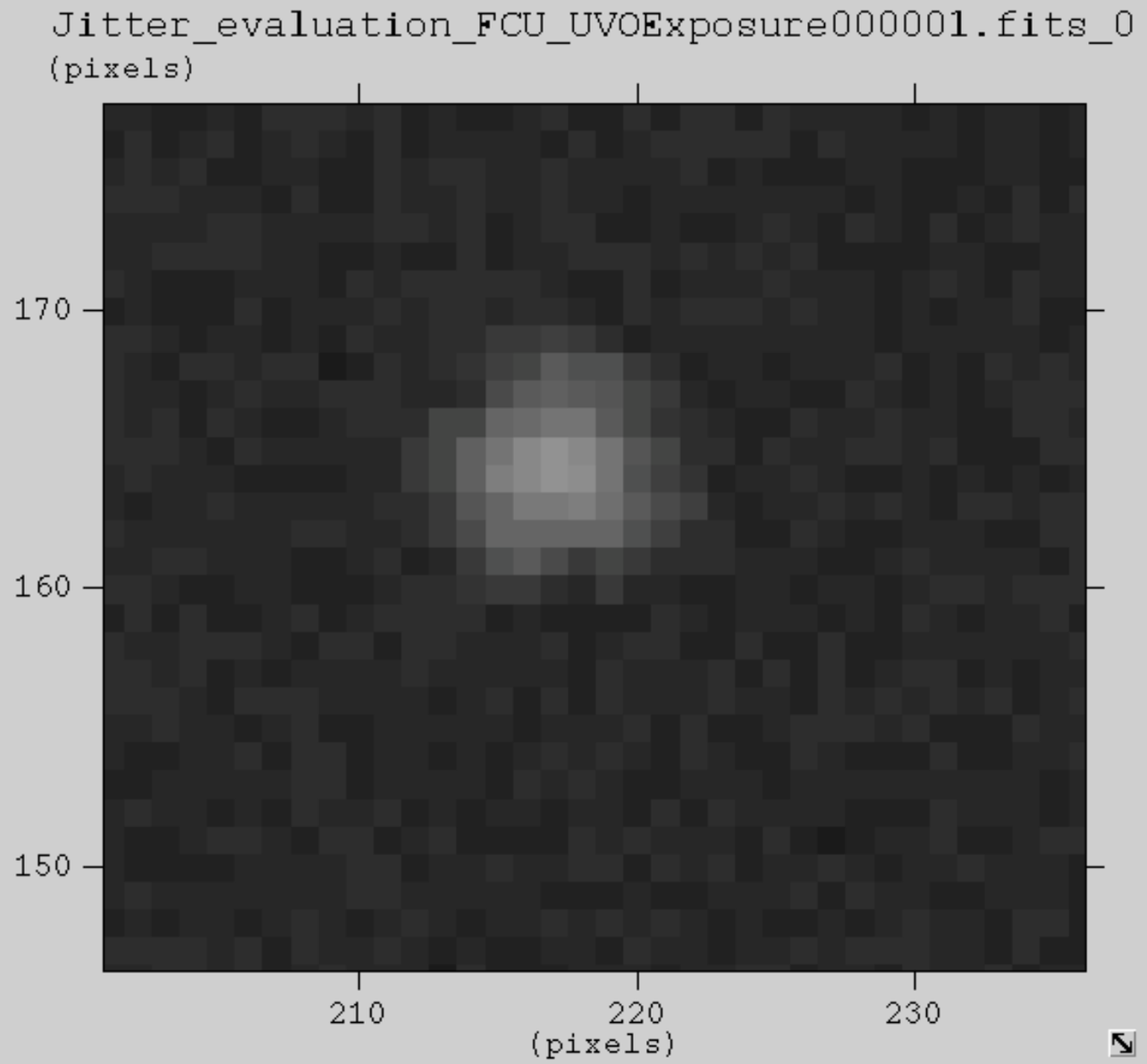

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FCU performance evaluation

- UVO Channel:
  - Estimation of observable stars at specific noise levels
  - Jitter effect on the overall noise budget
  - Performance test of prototype detectors
- Optical design performance
- Exoplanets transits

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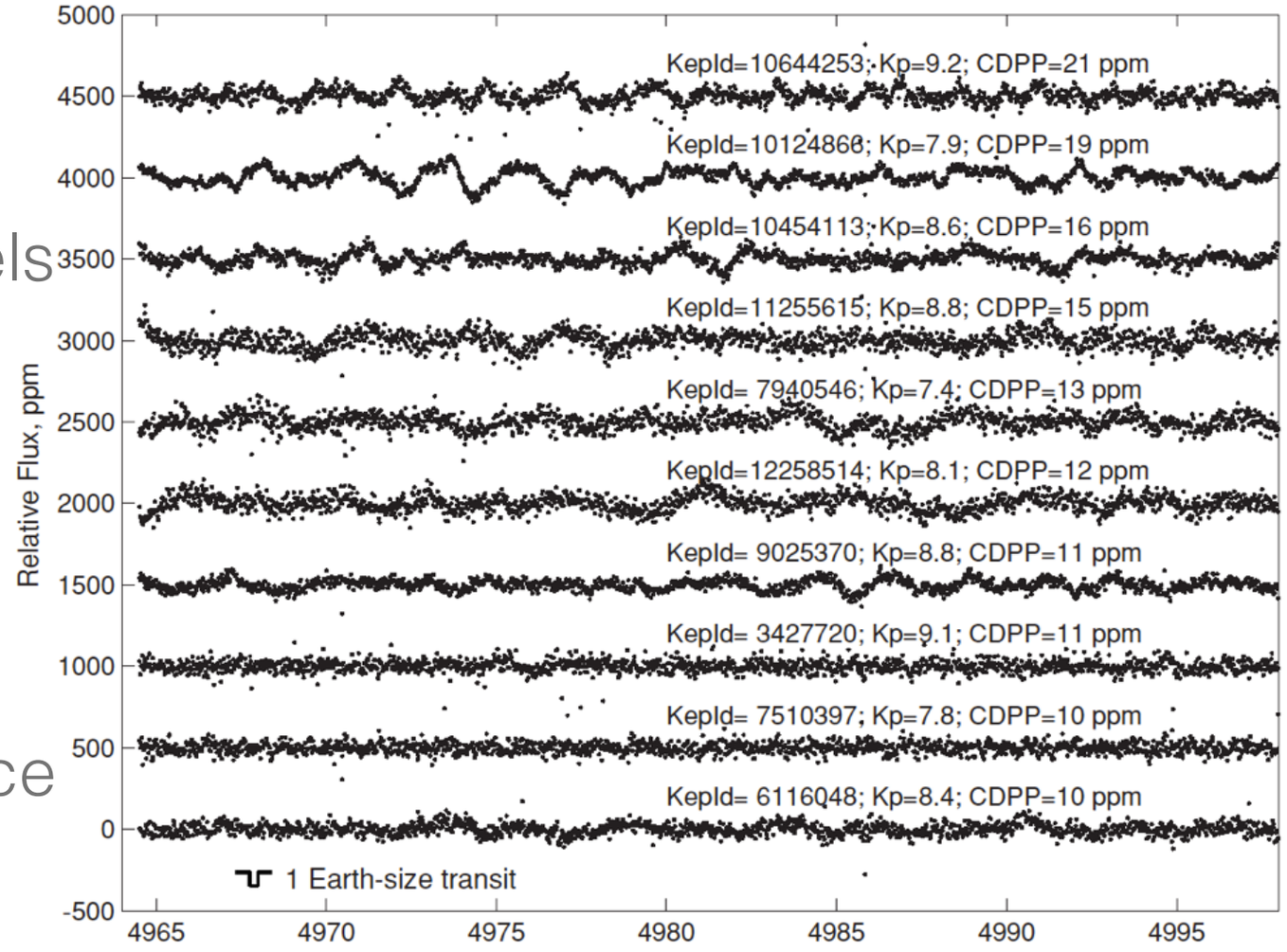

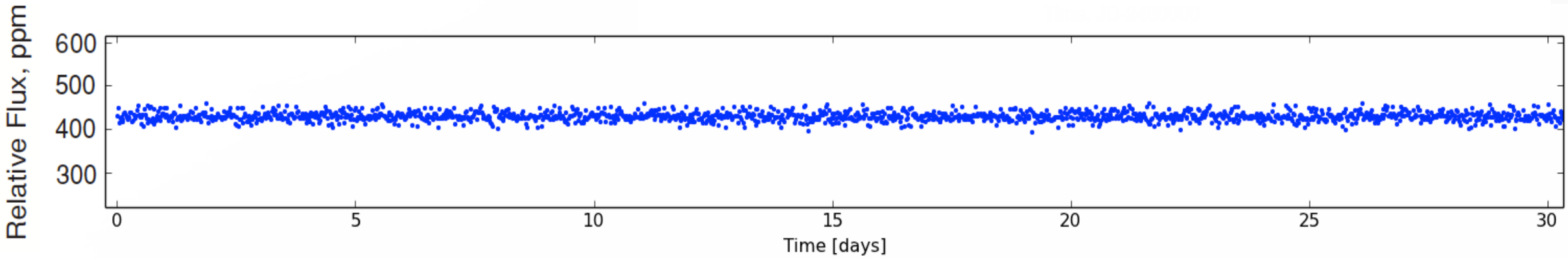

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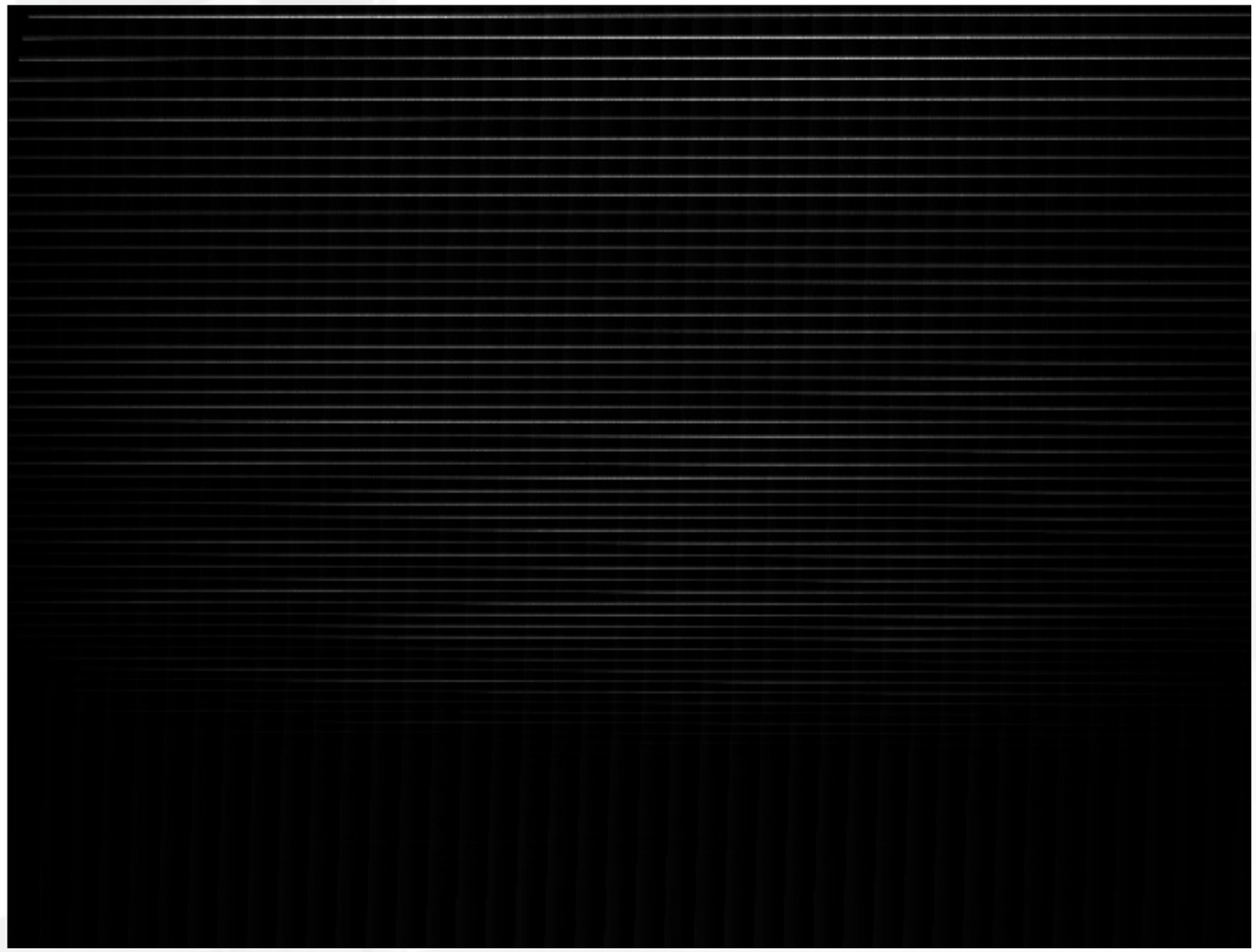
- FUV Channel:
  - MCP Detector (work in progress)

WUVS Simulations

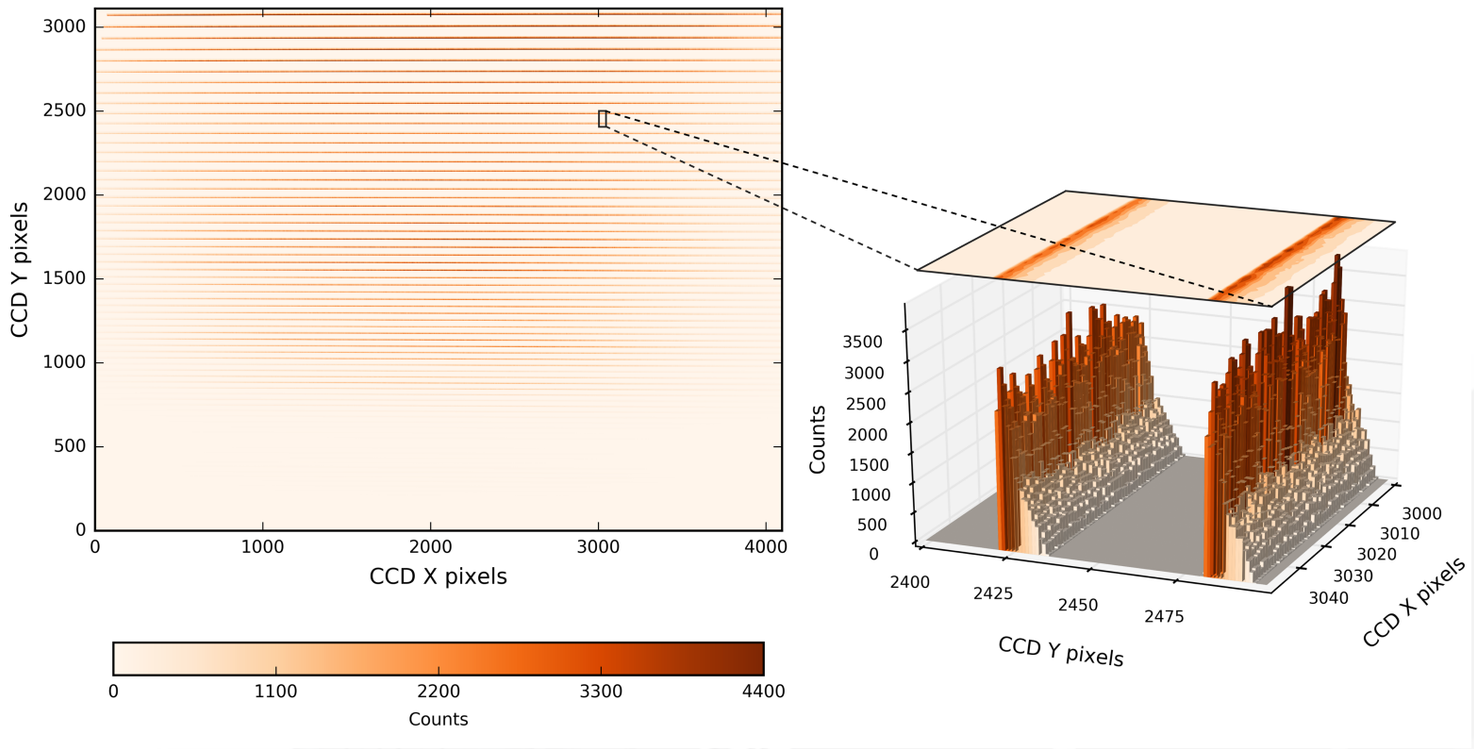
- Input method: Flat energy distribution image provided by instrumental team
- Spectral model
- Similar actual instrument for validation and comparison



Input file: Flat spectrum

WUVS Simulations

- Application: spectral lines detectability
- Select actual spectrum
  - STIS E140 grating similar spectral wavelength and resolution
  - Resampling STIS spectral resolution to WUVS spectral resolution
  - Setting the STIS orders into the WUVS pixel map

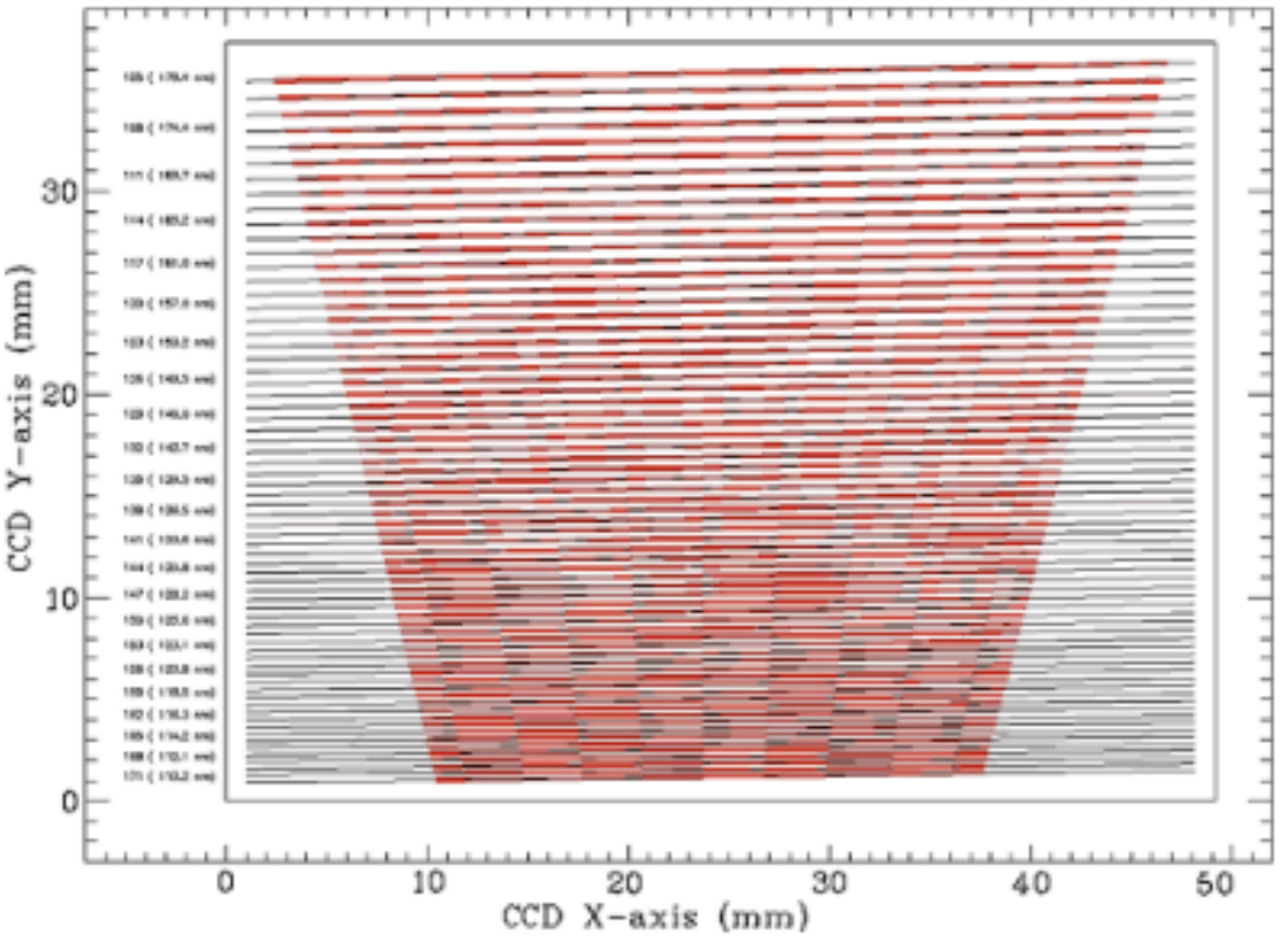


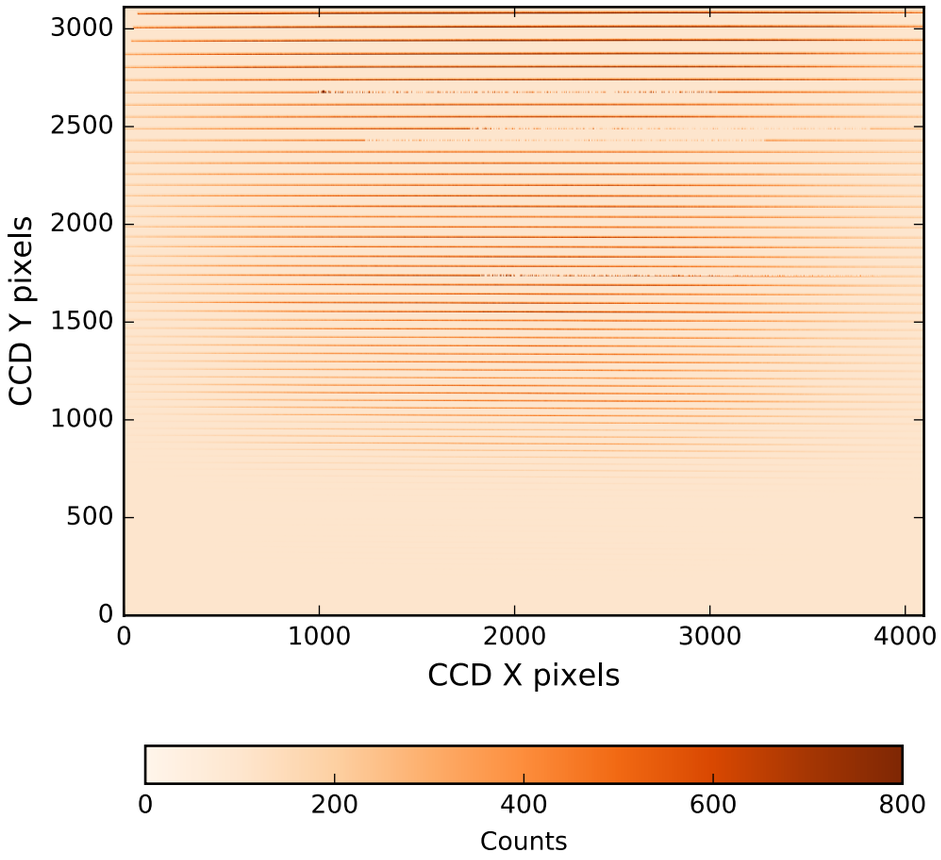
Input file: Flat spectrum

DG Tau spectrum from STIS in WUVS pixel map

WUVS Simulations

- Input image

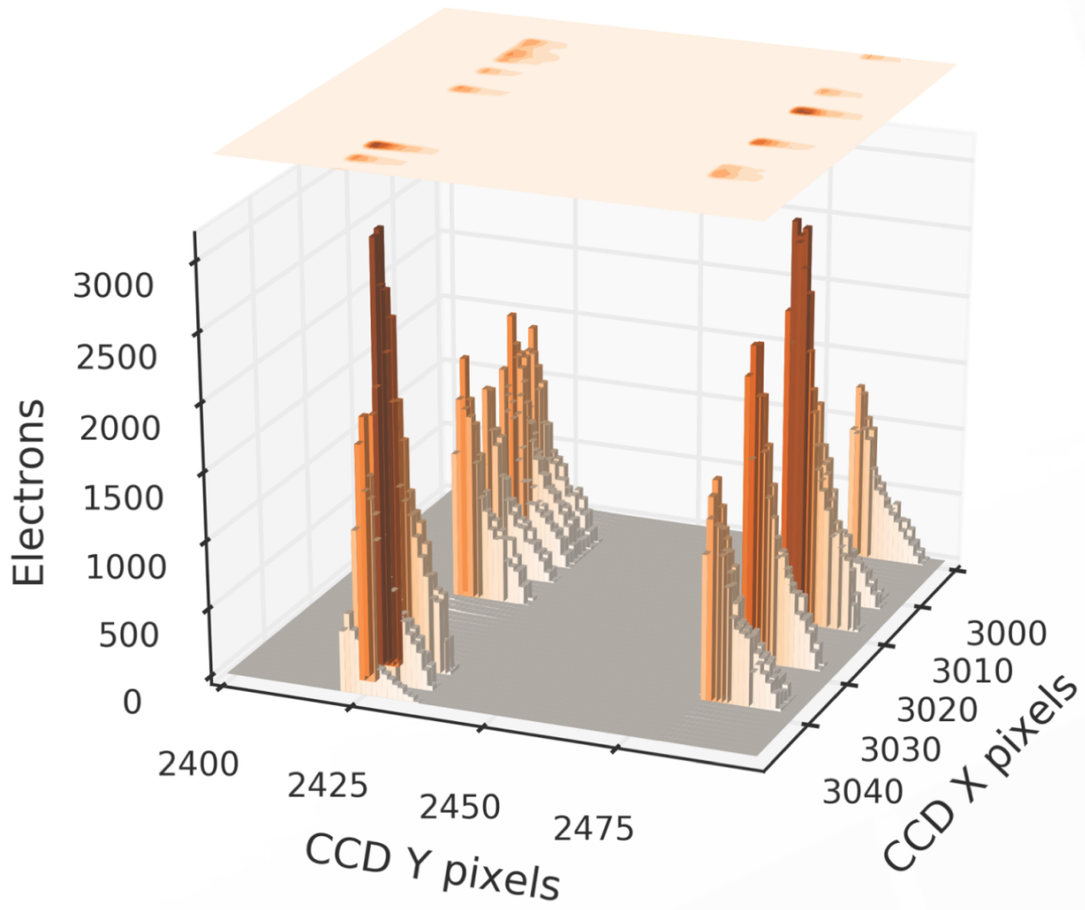




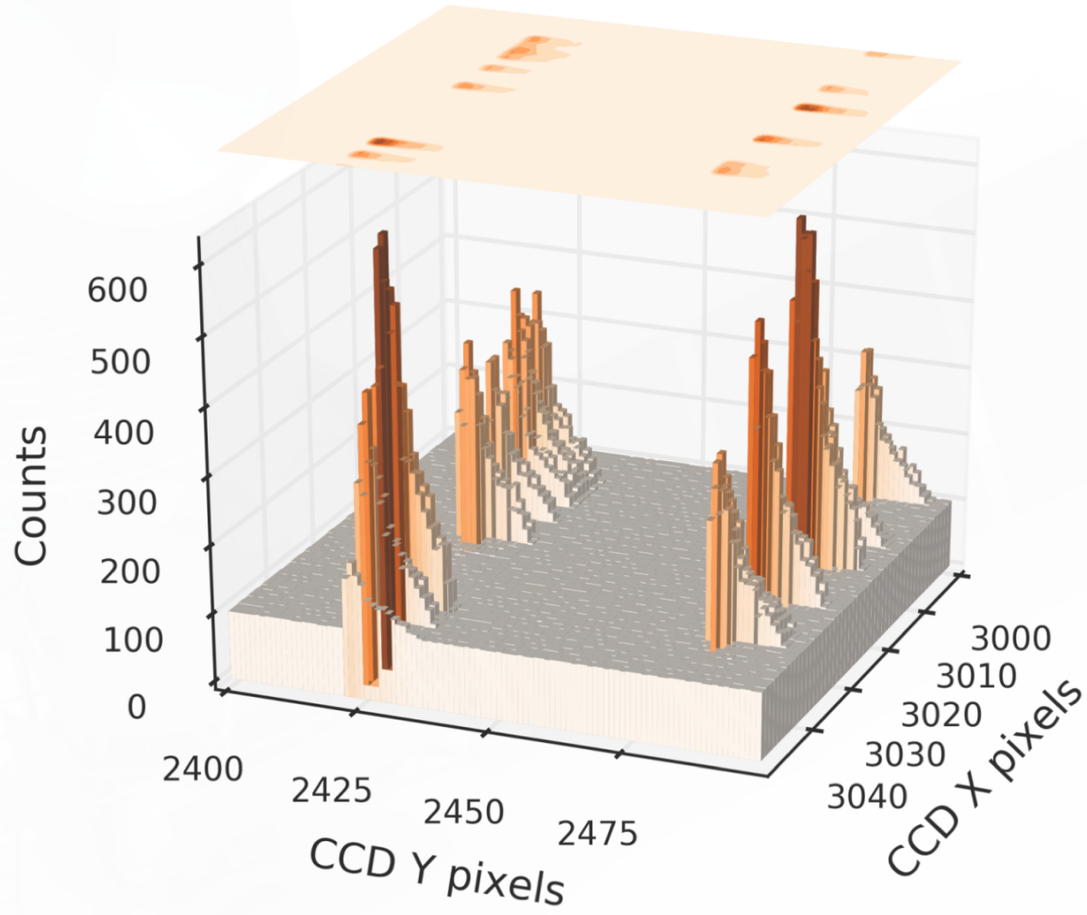
WUVS Simulations

- Input image vs Simulated image

A)



B)



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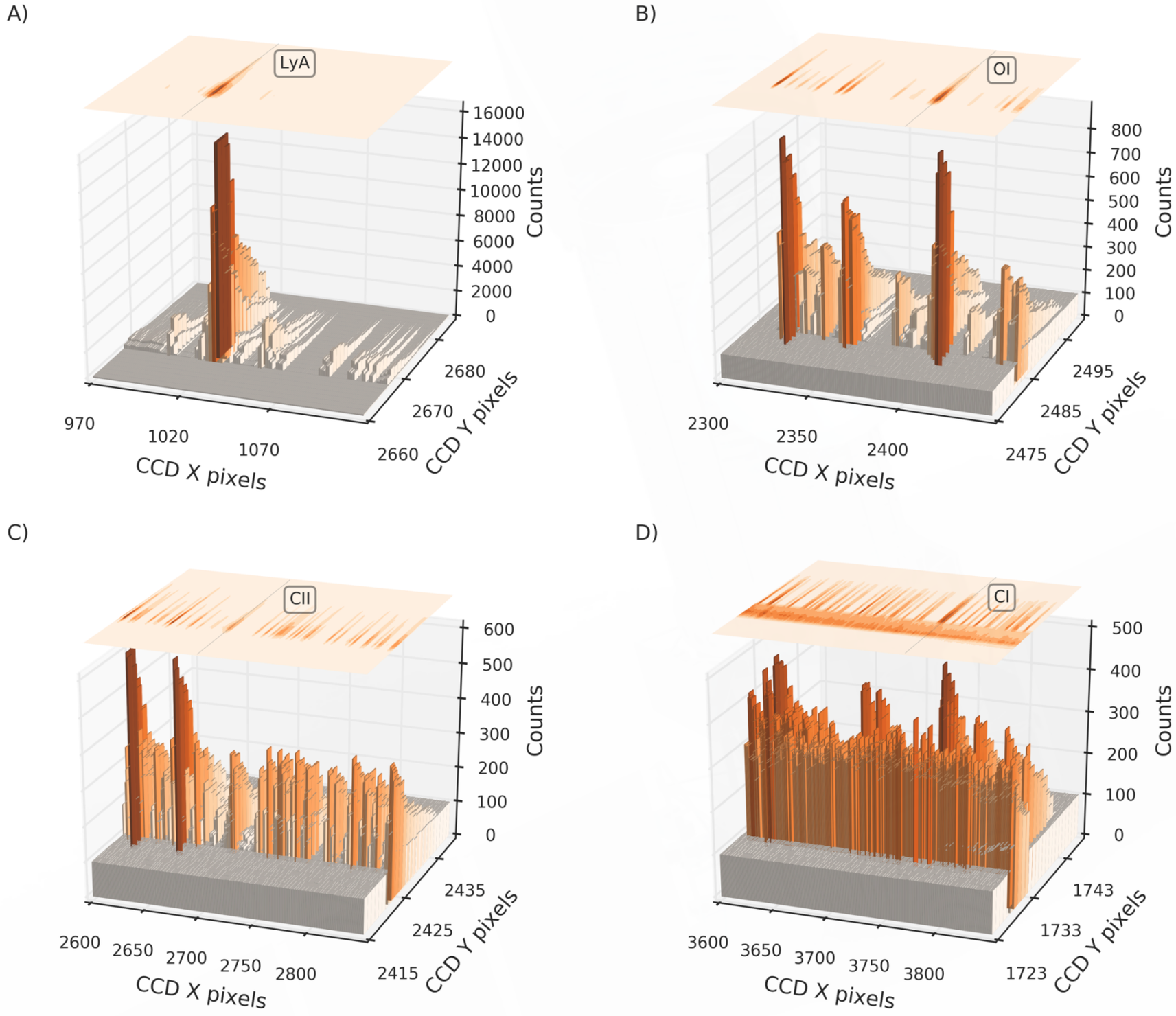
WUVS Simulations



(Marcos-Arenal et al. 2017)

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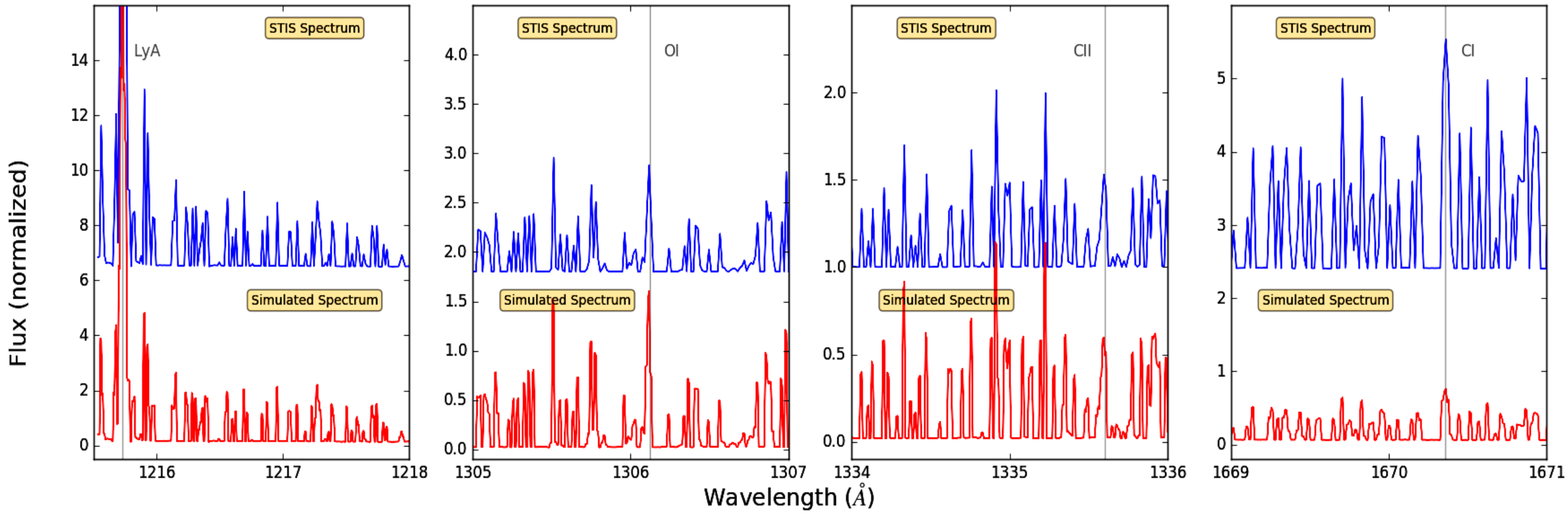
WUVS Simulations

- Original vs simulated spectra



(Marcos-Arenal et al. 2017)

Simulations outcome

- Evaluation of the instrument performance
- Noise level expected to be present in the observations
- Data quality
- Fine-tuning of the instrument design
- Observing strategies
- …

Final remarks

- Validation of the WSO-UV instrumental behaviour
- Transiting exoplanets simulations
- Photometry post-processing workbench
- Detection of spectral lines in WUVS

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Thanks for your attention!