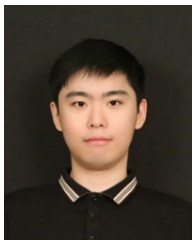


SUPERBACK

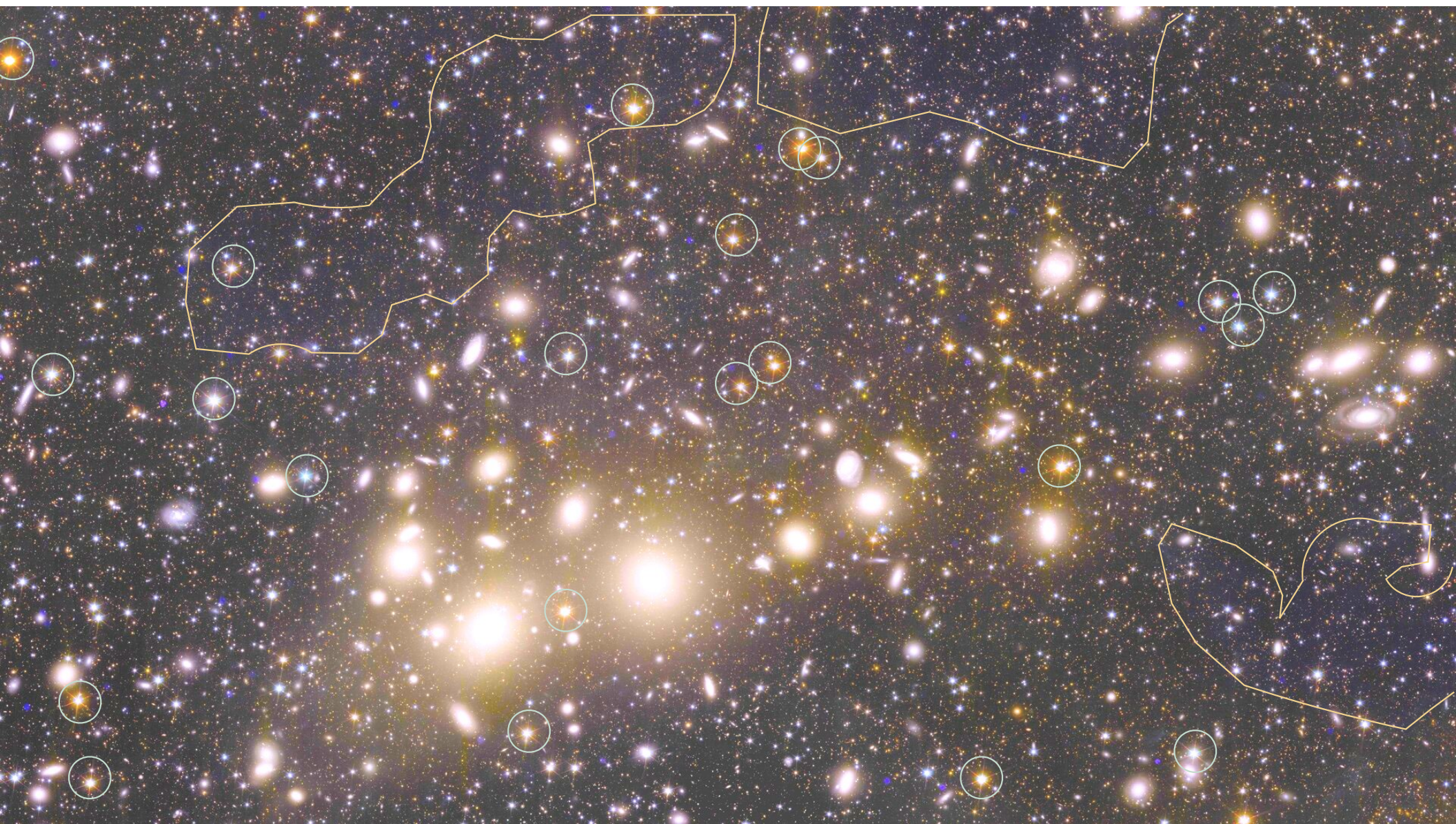
A WFS Program for Large-Scale Background Modeling

Tim Carleton with

Qing Liu, Rosalia O'Brien, Seth Cohen, Russell Ryan, Rogier Windhorst, Rolf Jansen, Brenda Frye, Rafael Ortiz III, Alex Pigarelli



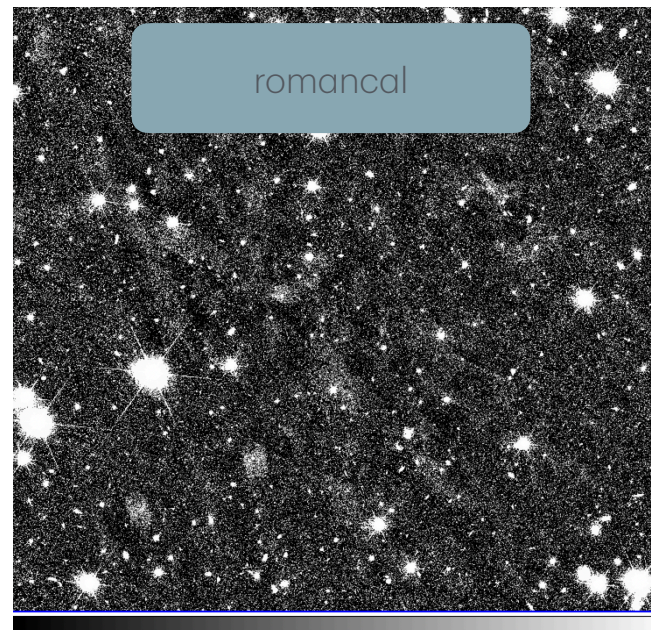




Background Estimation vs. Background Modeling

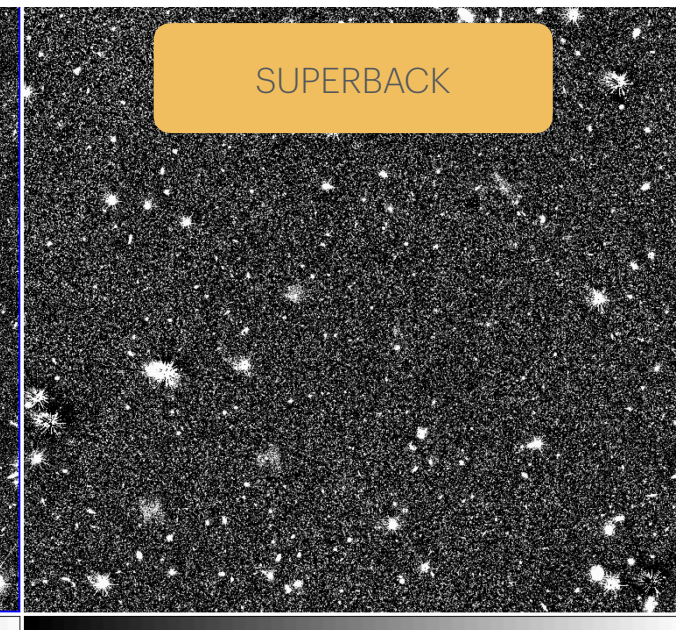


Empirical estimation of background using image data



- Primarily sensitive to smooth variation
- Does not separate different components
- No wide-field background science
- Efficient and usually good enough

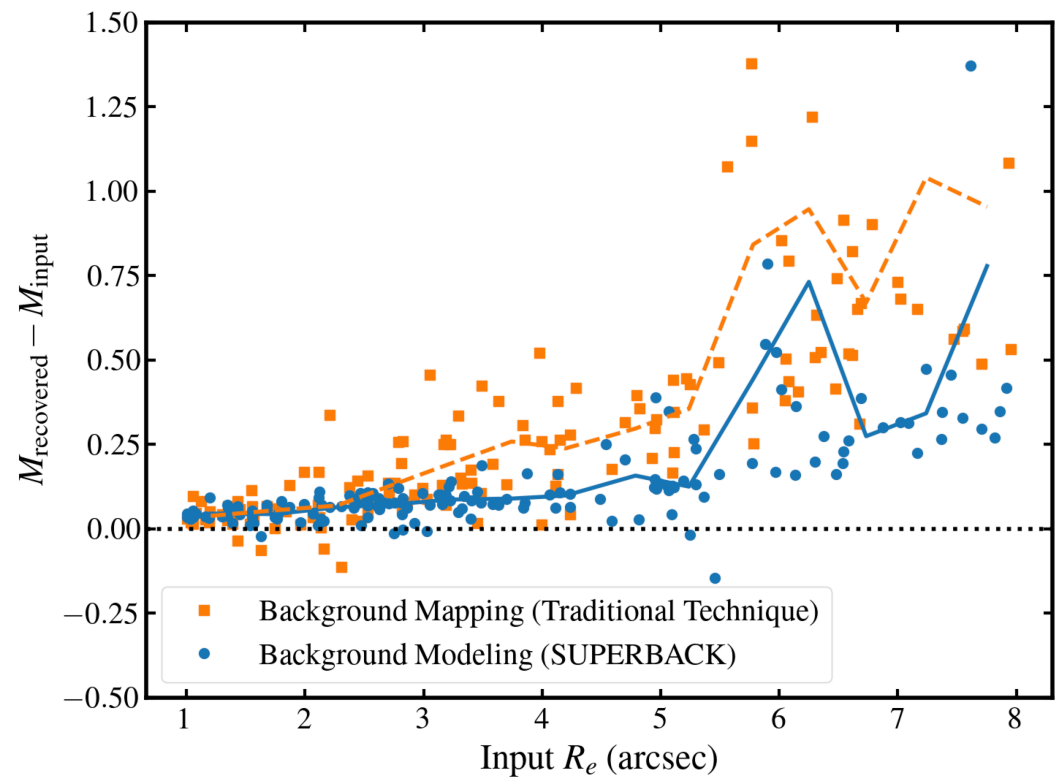
Physically-motivated model of background using both image and ancillary data



- Sensitive to smooth and sharp background variation
- Separates various foreground components
- Opportunity for wide-field background science
- More resource-intensive

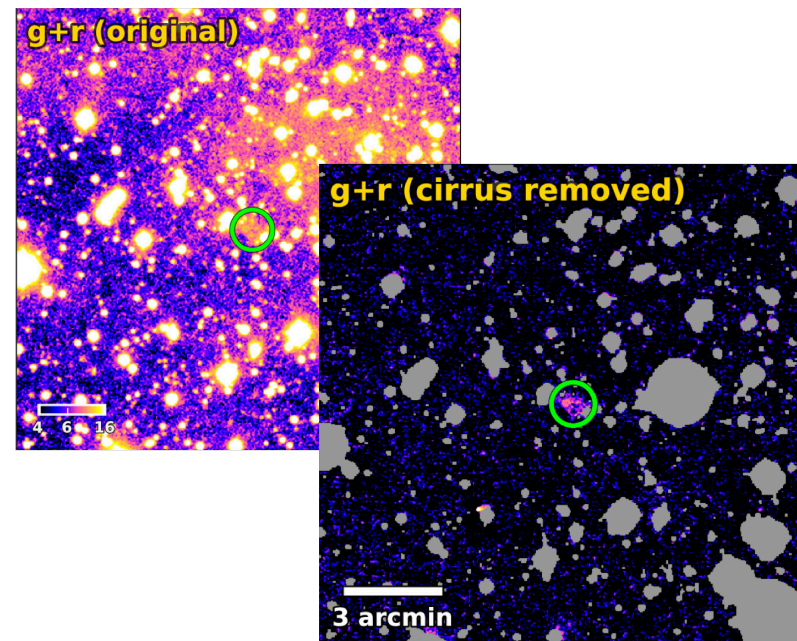
SUPERBACK Benefits

- Flatter images and better photometry for large ($\sim 4''$) galaxies



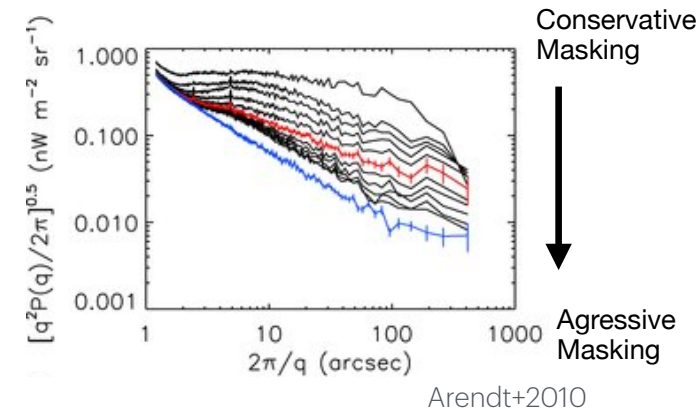
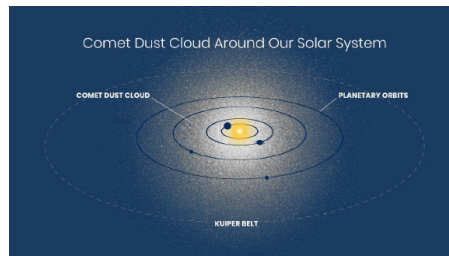
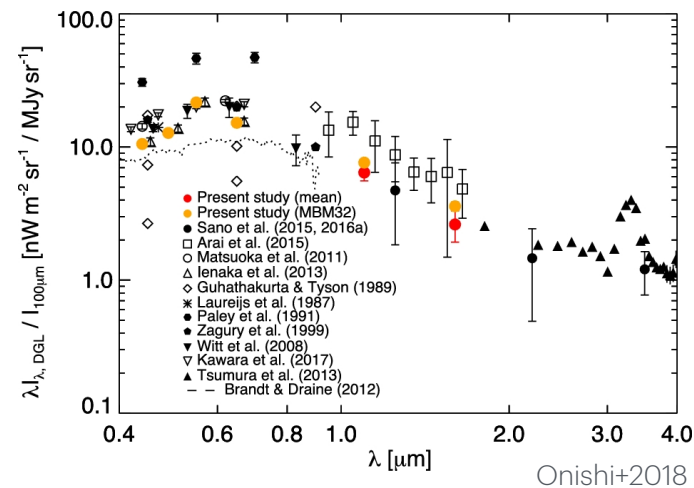
SUPERBACK Benefits

- Flatter images and better photometry for large ($\sim 4''$) galaxies
- Increased sensitivity to Ultra-Diffuse/ Low Surface-brightness Galaxies



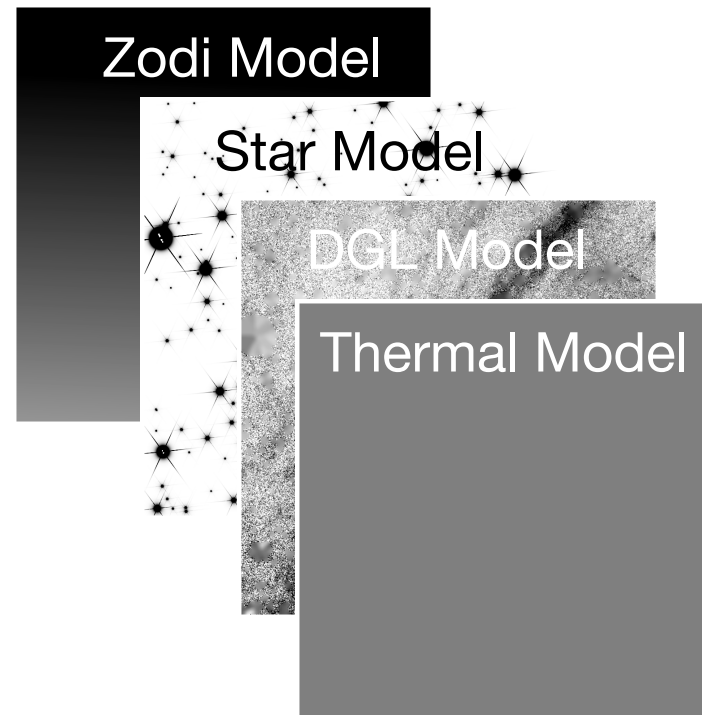
SUPERBACK Benefits

- Flatter images and better photometry for large ($\sim 4''$) galaxies
- Increased sensitivity to Ultra-Diffuse/ Low Surface-brightness Galaxies
- Ability to probe the physics of Galactic Cirrus, Zodiacal Dust, and Extragalactic Background Light

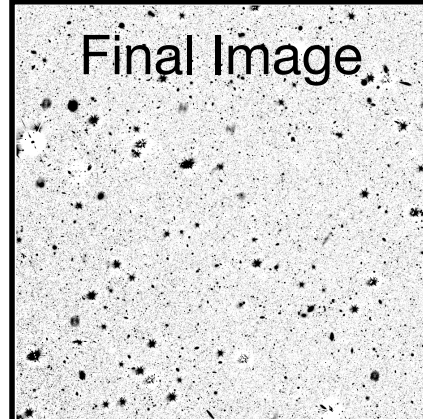
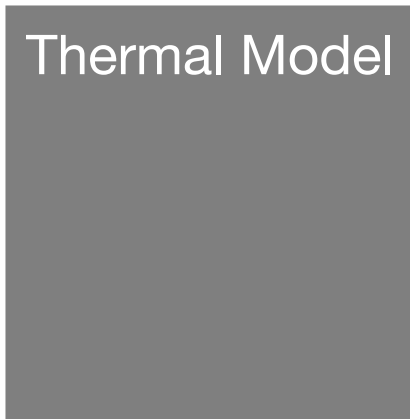
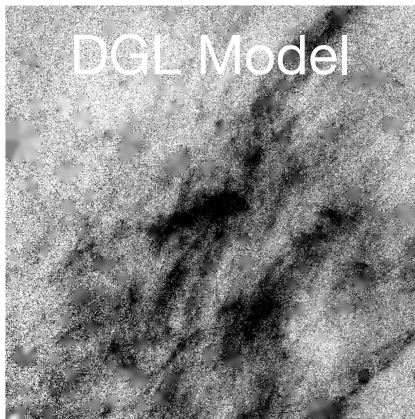
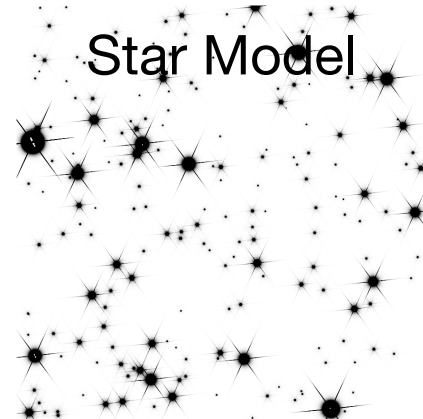
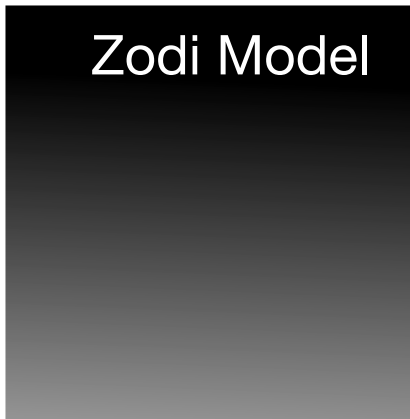
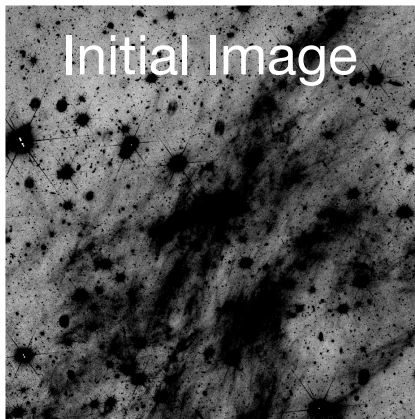


SUPERBACK Modeling

1. Zodiacal Light (based on SKYSURF O'Brien+26 model)
2. Bright Stars (with custom wide-angle PSF model)
3. Galactic Cirrus (based on Liu+25 prescription)
4. Telescope Thermal Emission (possibly varying over orbit; Ryan+23, McIntyre+25)



SUPERBACK Modeling

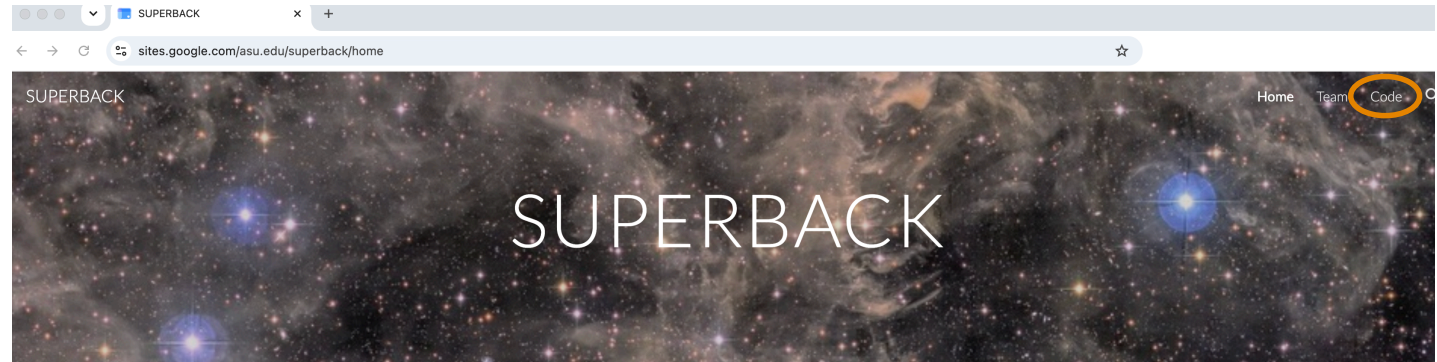


SUPERBACK

SUPERBACK will release code to:

A. Simulate more complex backgrounds for WFI images

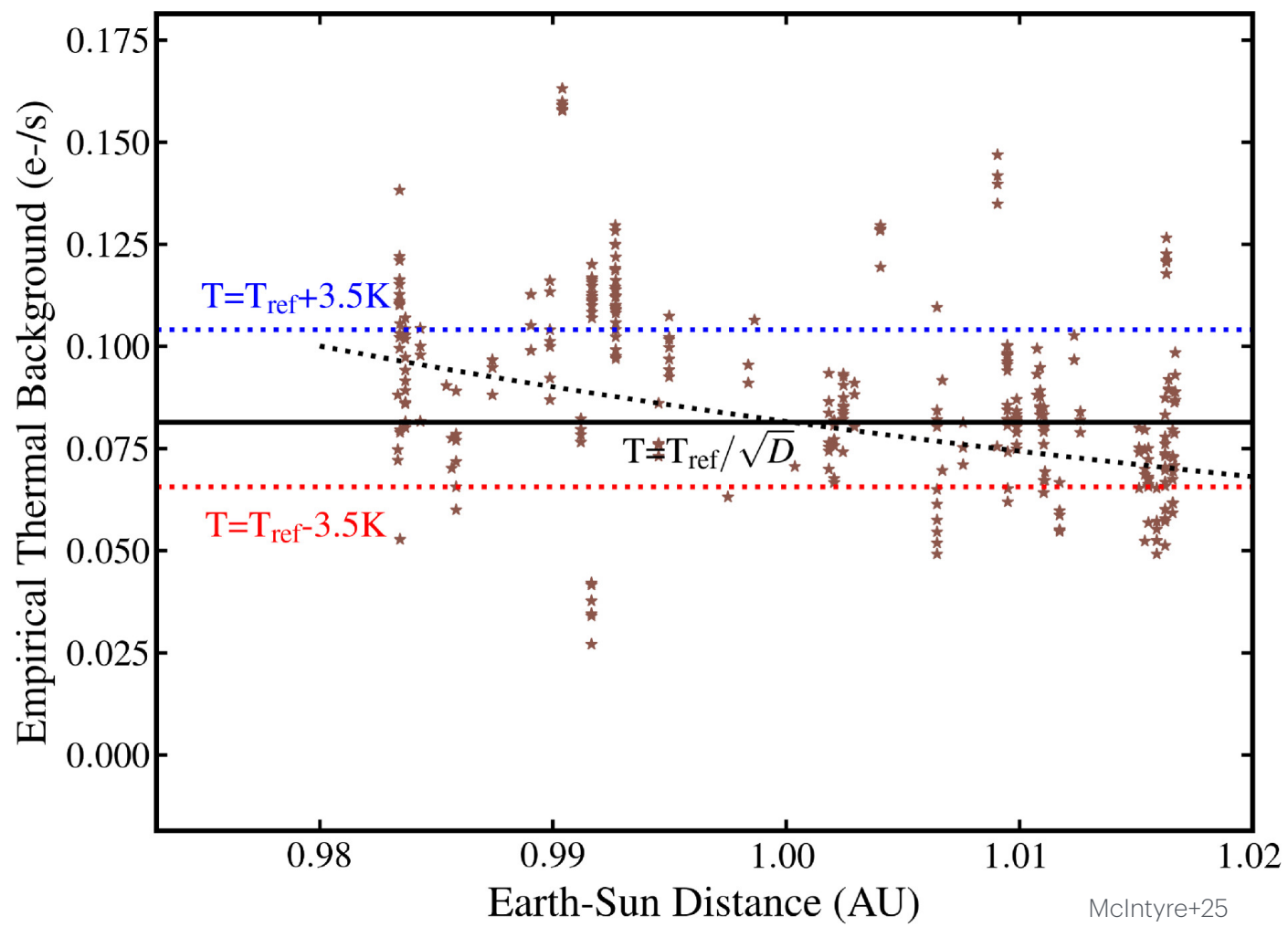
B. Model the backgrounds of WFI images

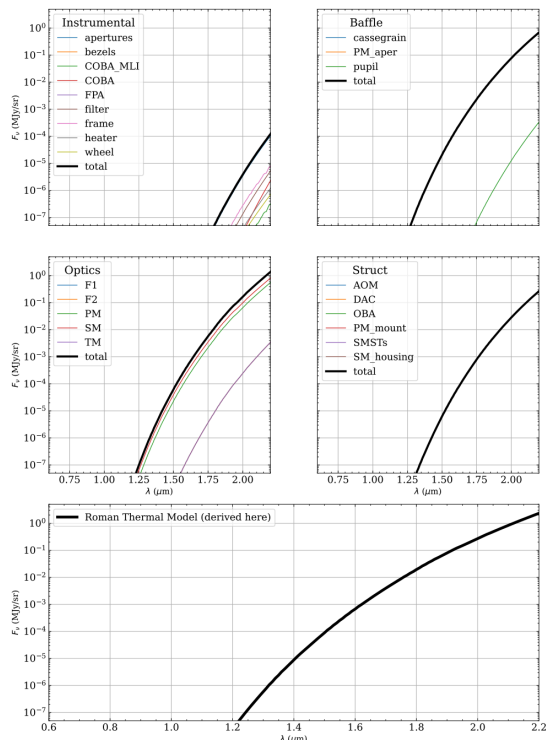


SUPERBACK is a WFI science program designed to model the large-scale backgrounds expected to be seen in Roman WFI data.

The Wide Field Instrument on the Roman Space Telescope is poised to transform extragalactic astronomy by surveying the sky degrees at a time. A new paradigm of sky subtraction is needed to fully utilize data in this new era of precise wide-field imaging. Rather than empirically estimating backgrounds using filtering techniques, SUPERBACK attempts to fully model the backgrounds, such that images are flatter and less susceptible to background-subtraction issues. Additionally, by modeling each background component, the physics of wide-field backgrounds can be further analyzed.

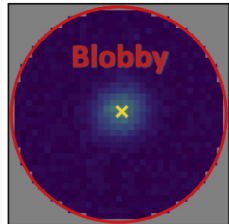
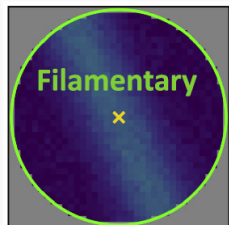
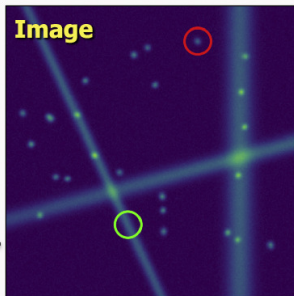
Questions?



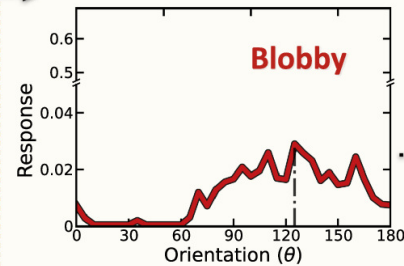
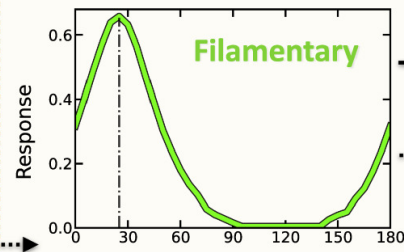
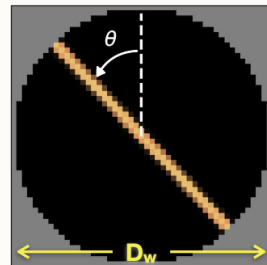


Ryan+23

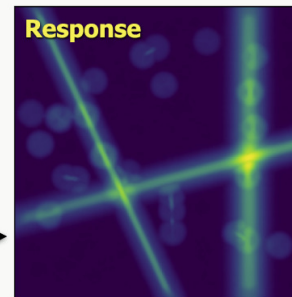
1. Extract a disc of D_w around every pixel on the image



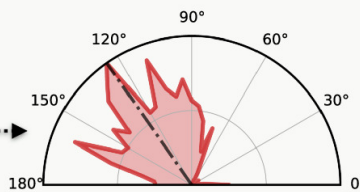
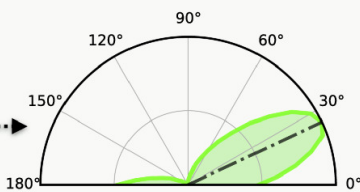
2. Apply Hough Transform at $\rho=0$ using a rotating kernel



Response



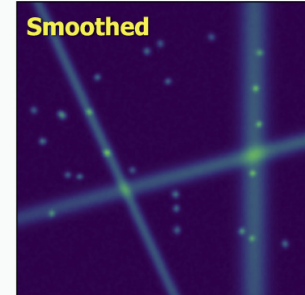
3. Calculate response at $R(\theta)=R_{\max}$ at each pixel

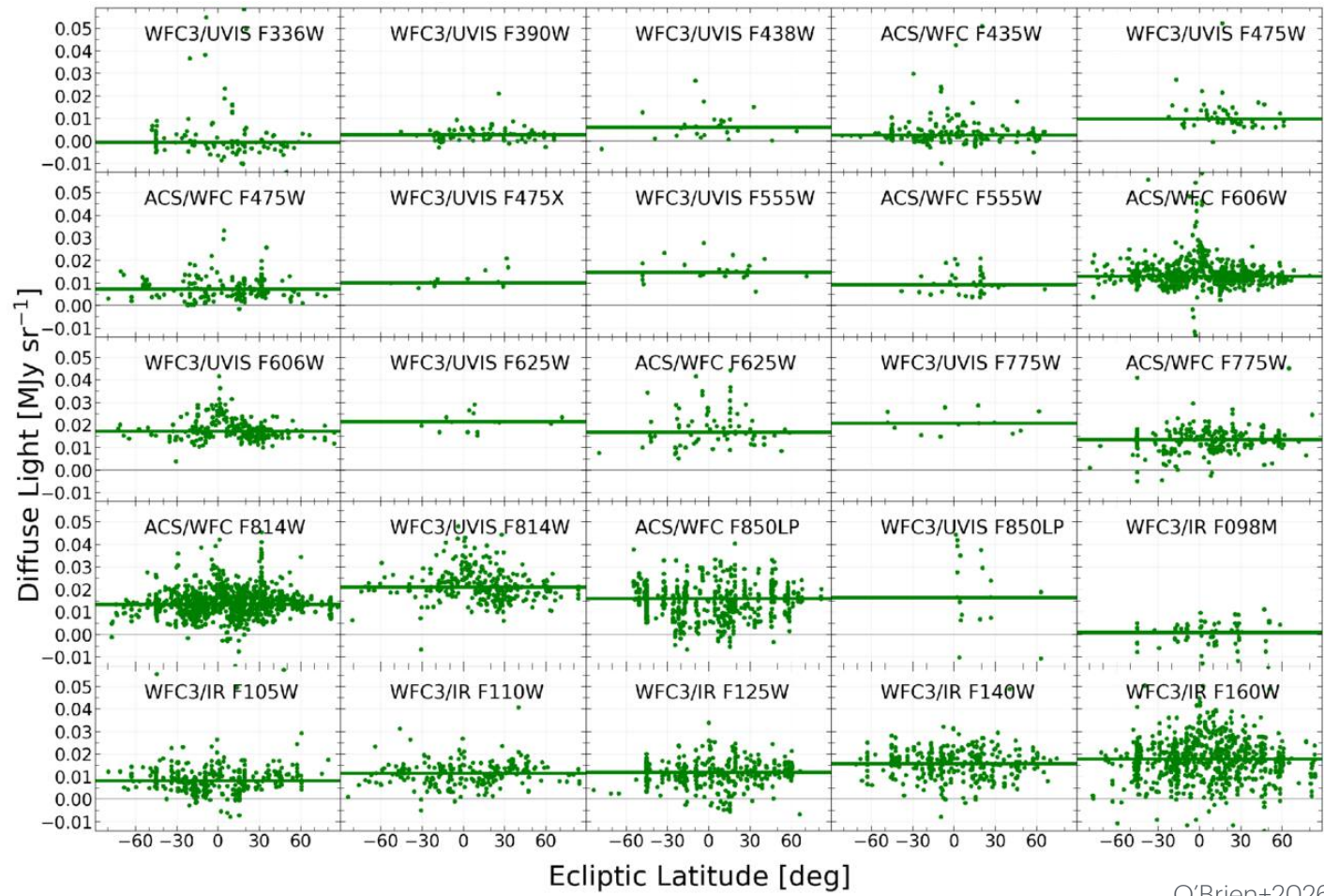


5. Run blob detection with cleaning on the output image



4. Smooth the input image by a $[D_M \times D_M]$ median filtering





O'Brien+2026

