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Characterizing Backgrounds in PHANGS-JWST Cycle 2 Data

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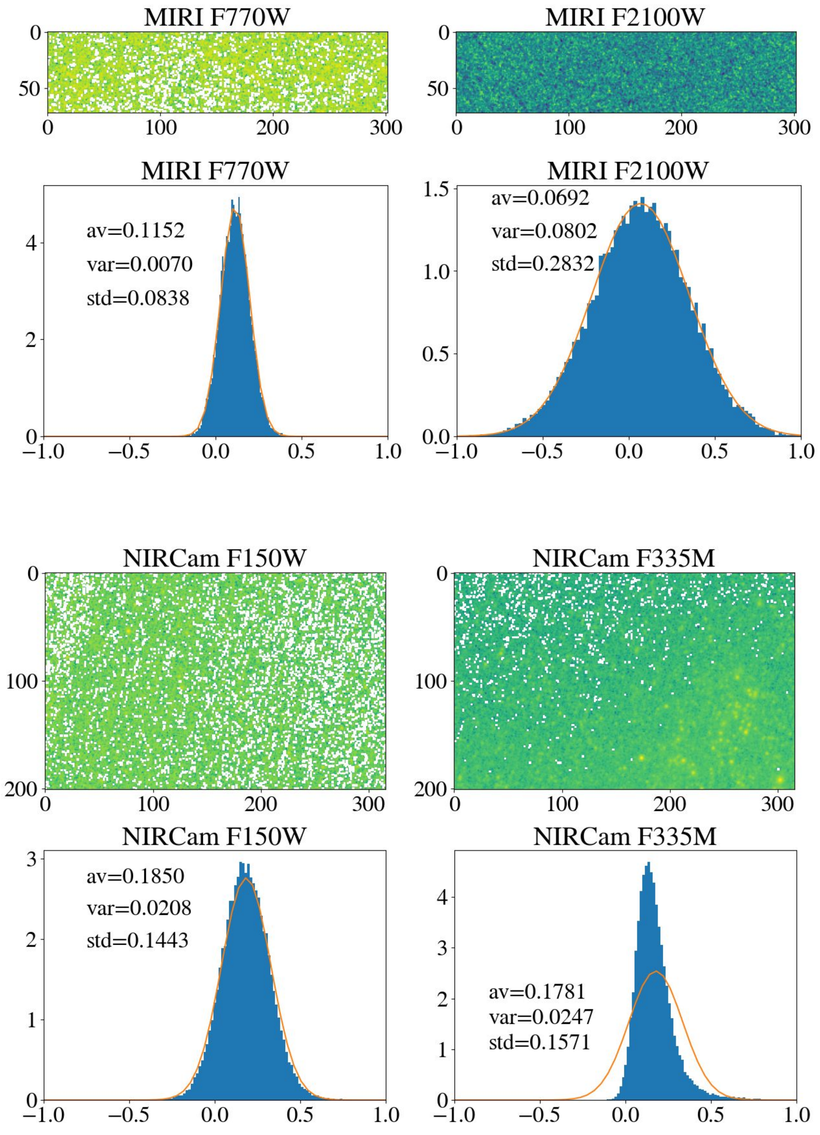
Abstract

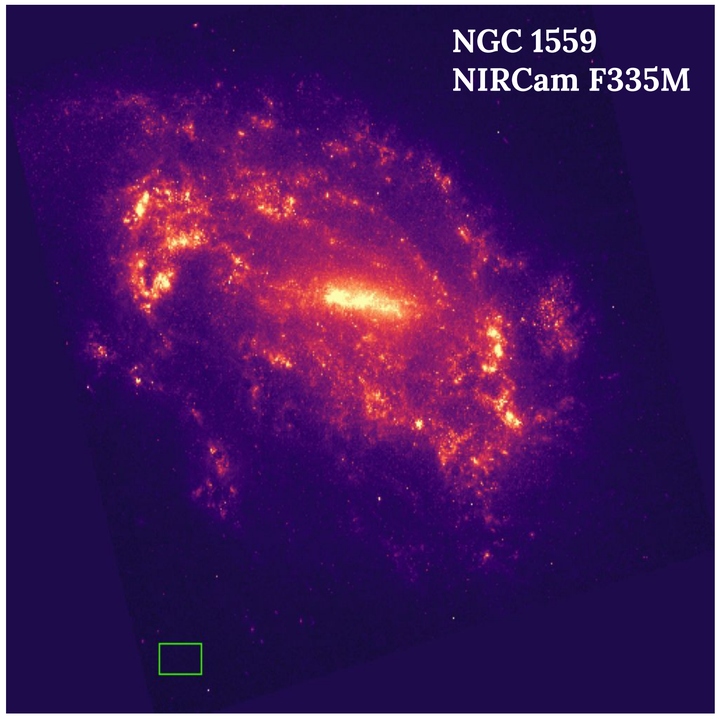
In this study, I analyzed the empty background regions within the JWST Cycle 2 data, focusing on the Near Infrared Camera (NIRCam) F150W and F335M, and the Mid-Infrared Instrument (MIRI) F770W and F2100W wavelengths, corresponding to 150μm, 335μm, 770μm, and 2100μm, respectively. I determined the zero-level values of these background regions in both the MIRI and NIRCam datasets, and examined their pixel statistics, as illustrated by the histograms. The data analyzed originates from NGC 1559, a spiral galaxy approximately 63 million light-years away. The analysis indicates that the pixel values in the empty regions have mean values of 0.11 for F770W, 0.07 for F2100W, 0.19 for F150W, and 0.18 for F335M. Additionally, I provide the standard deviation and variance for each dataset. This methodology was also applied to an additional 11 galaxies within the JWST Cycle 2 dataset.

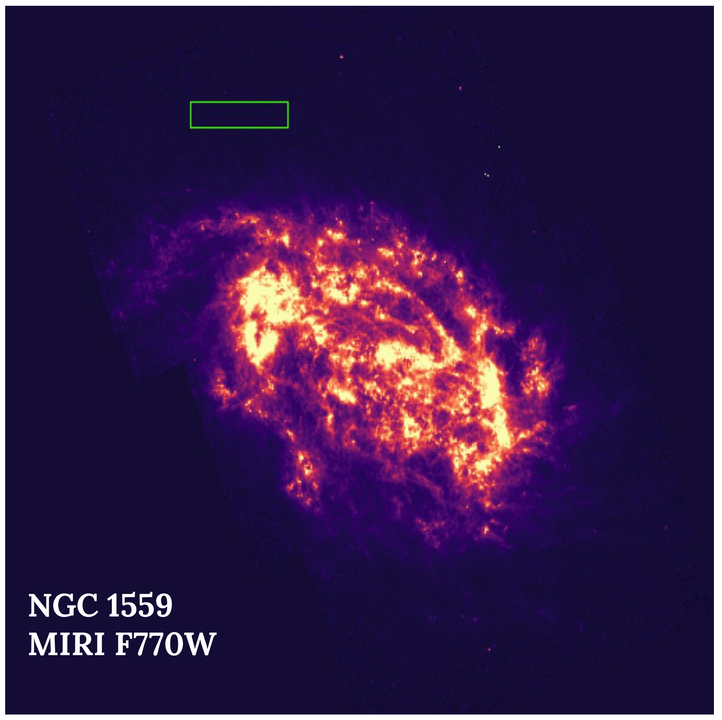
Background

The Physics at High Angular resolution in Nearby GalaxieS (PHANGS) team is working with the second cycle of data form the JWST, launched in December 2021, focusing on observations of 55 local galaxies. Their aim is to address challenges specific to the study of nearby galaxies, such as removing instrumental noise, accurately matching background levels, and calibrating astrometry for extended sources. Near-and mid-infrared wavelengths are crucial for exploring star formation and the interstellar medium (ISM) in galaxies. Stars form deep within dusty molecular clouds, making infrared observations more effective than optical ones for detecting these initial stages of star formation. Additionally, emissions from polycyclic aromatic hydrocarbons (PAHs) occur at these wavelengths, providing essential insights into the PAH’s size, charge distribution, and how they evolve within the ISM, which is key to comprehending their overall lifecycle. (Williams 2024)



Figures: Background Regions and Histograms of each region





Summary & Future Work

Characterizing and analyzing the background zero levels in 55 nearby galaxies obtained through Cycle 2 of the JWST data is pivotal for several reasons. It significantly enhances image quality, signal-to-noise ratio, spectral analysis, and the ability to detect diffuse emission (such as PAHs). Future work will include more galaxies from the nearby universe, with variations in galaxy mass and star formation rate, as well as finding the optimal resolution that increases the signal-to-noise ratio without losing the small structures that only JWST can observe.
More in Williams 2024 and Leroy 2023.