FLITECAM Data Process Validation

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FLITECAM Data Reduction Pipeline

The FLITECAM Data Reduction Pipeline (FDRP) is a pipeline program designed to take a series of raw data files of similar parameters, reduce that raw data, and generate a co-added image by subtracting noise and artifacts that are found in the individual data files. Shown below is the flowchart of the pipeline consisting of three object files of NGC 7027 under filter Paschen-Alpha and four dark files, both with thirty seconds of exposure time.

Validation of FDRP

Once a file is produced, it is up to the astronomer to validate the file by using a calibrated star from the catalogue of standard stars. Observing standard stars allows for the measured magnitudes from the objects in the data to be calibrated to this standard photometric system.

Aperture photometry is a technique for measures the instrumental magnitude of the object. This begins by choosing a circular region that encloses the image of the star and sums the flux inside the aperture, while another aperture is made in a region containing no stars to give the flux from the background. Subtracting the two yields the flux of the object.

Once the Instrumental Magnitude of the star ($m_i$) has been determined astronomers use:

$$R = m_i - C \times B - Z + k \times A$$

where:

- $C$ = color transformation coefficient
- $B$ = color magnitude offset
- $Z$ = camera's zero point offset
- $k$ = atmospheric extinction coefficient
- $A$ = air mass of star

To calculate the "real" flux of the source.

The same calibration parameters will be used on other sources to calculate their "real" flux. Comparing these with the online, published values will validate the data.

Data Reduction

Even after removing most of the radiation from the background, the raw data still suffers from noise. Data reduction is a method of removing as much noise as possible. The FLITECAM Data Reduction Pipeline (FDRP) is a program, developed at SOFIA Science Center, to subtracts darks, removes flats, and co-adds images. Even though the pipeline uses these processes to reduce the raw data, it is still up to the astronomers to verify the outputs as scientifically meaningful.

Differing

This process of offsetting a telescope between exposures is a crucial aspect of astronomy. The use of dithered exposures allows for both the image defects to be averaged out and for the subtraction of background noise.

Note the slight displacement of the object of interest in each of the images and the dark region that is present in all captured images.

Background

SOFIA and Infrared Astronomy

IR astronomy is an extremely useful bandwidth that can be used to detect astronomical information not visible to the naked eye. First Light Infrared Test Camera (FLITECAM) is an infrared camera operating in the 1.0–5.5 µm wavelength region onboard SOFIA (Stratospheric Observatory for Infrared Astronomy). NEIR astronomy is particularly useful for peering through galactic dust and detecting cooler red stars. As wonderful as this may sound, IR astronomers often face two significant obstacles when observing the cosmos. Any object with a temperature cooler than the background temperature will emit radiation, as predicted by the Stefan-Boltzmann law. In the atmosphere, water vapor and the earth’s surface at a temperature of 15°C emits enough radiation to overwhelm the light from faint celestial objects. This is why high-altitude balloons and orbiting telescopes are beneficial.

SOFIA is a modified Boeing 747SP designed to overcome these challenges of IR astronomy. SOFIA operates at altitudes of over 39,000 feet, well over 99% of the earth’s atmosphere.

Aperture correction

Aperture correction is a feature of the pipeline that helps to reduce the effects of atmospheric distortion and instrument drift.

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