# Aperture Calculation

Spitzer Space Telescope: Star Imaging Data

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# Project Dataset and Goals

- *Spitzer Space Telescope* data of a star-plus-planet system
- Problem: background noise disrupts star analysis, and finding optimal aperture/mask by hand is tedious
- Solution: automate process using image processing and signal-to-noise ratio calculations
- Overall goal: find intelligent time-dependent apertures that conserves star signal and rejects noise

# Prototype: Computational Methods

- Images processed into 32x32 numpy arrays
- Using midpoint circle algorithm, draw circular masks for different radii
- Calculate weighted ratios of signal flux to noise flux and compare to ratios of labeled data
- Output optimal mask radius and save image to file (currently png, in the future will opt for the original FITS format)

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| 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 70.0 | 96.0 | 53.0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | |
| 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 69.0 | 454.0 | 756.0 | 136.0 | 51.0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | |
| 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 67.0 | 135.0 | 1404.0 | 2788.0 | 550.0 | 108.0 | 59.0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | |
| 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 49.0 | 530.0 | 4357.0 | 5854.0 | 1855.0 | 273.0 | 48.0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | |
| 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 71.0 | 279.0 | 709.0 | 807.0 | 604.0 | 238.0 | 79.0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | |
| 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 88.0 | 66.0 | 89.0 | 78.0 | 45.0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 91.0 | 14.0 | 39.0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | |
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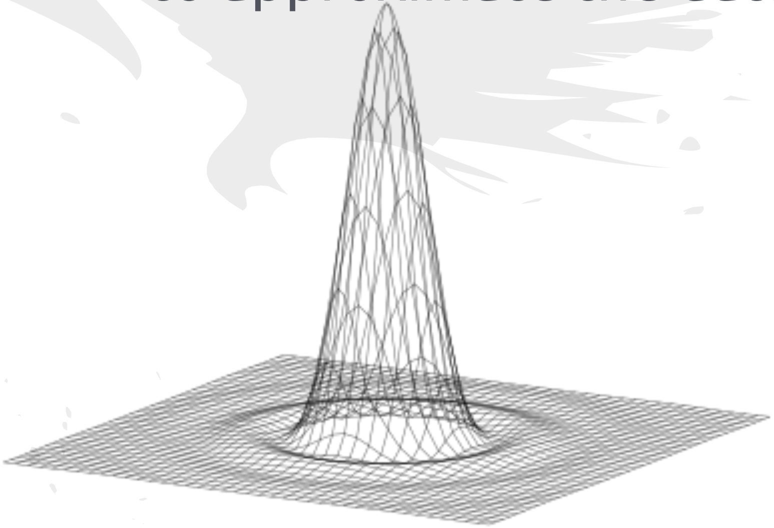
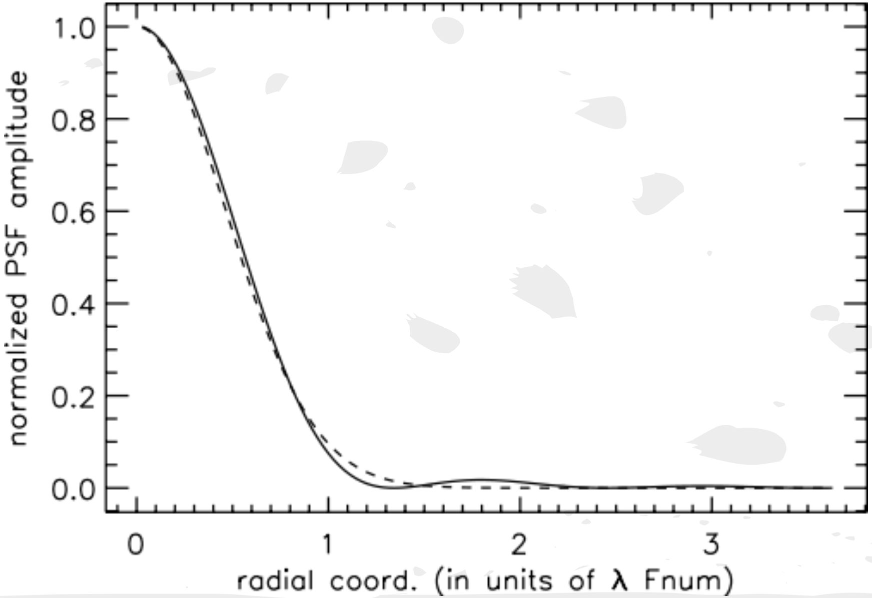
# Developing an Algorithm

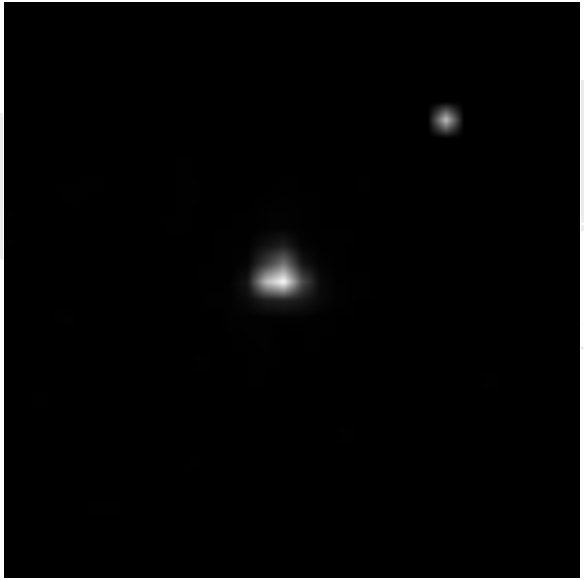
- Subject of the data is a star
- Have to understand how light from a star behaves and how to approximate the data



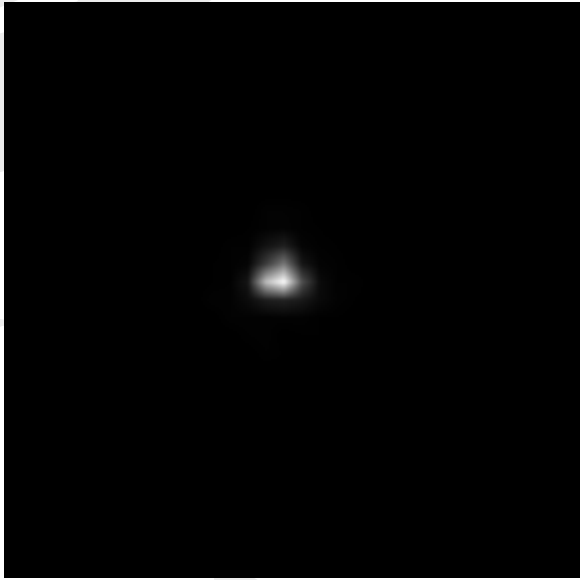



Images on this slide from: Wikipedia user Sakurambo

# Progress & Results



Spitzer image of HD 209458



Output of prototype: aperture radius = 2 pixels; noise spike is masked

# What's Next

- ➢ Revise algorithm to use and learn from pre-masked images (labeled data)
- ➢ Extend algorithm to operate on ~1000 FITS files; each FITS file contains 64 frames
- ➢ Parallelize with MPI library for Python

# Timeline

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|---|---|
| May 12 | Complete algorithm revisions, numpy optimizations, use of labeled data |
| May 17 | Complete small scale implementation of MPI |
| May 25 | Complete parallelized implementation on RCC cluster |
| May 29 | Test on new datasets - different star systems |
| June 3 | Complete debugging, speed improvements and accuracy of output |