Modern techniques for Exoplanet detection

Brief review of the most relevant methods

Robotic Vision Presentation 2024

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Outline

What is an Exoplanet?

An exoplanet is a planet
that orbits around a star-like object
that has the conditions necessary for ***life***.

- Rocky composition
- Mild temperatures
- Biomarker elements

First steps

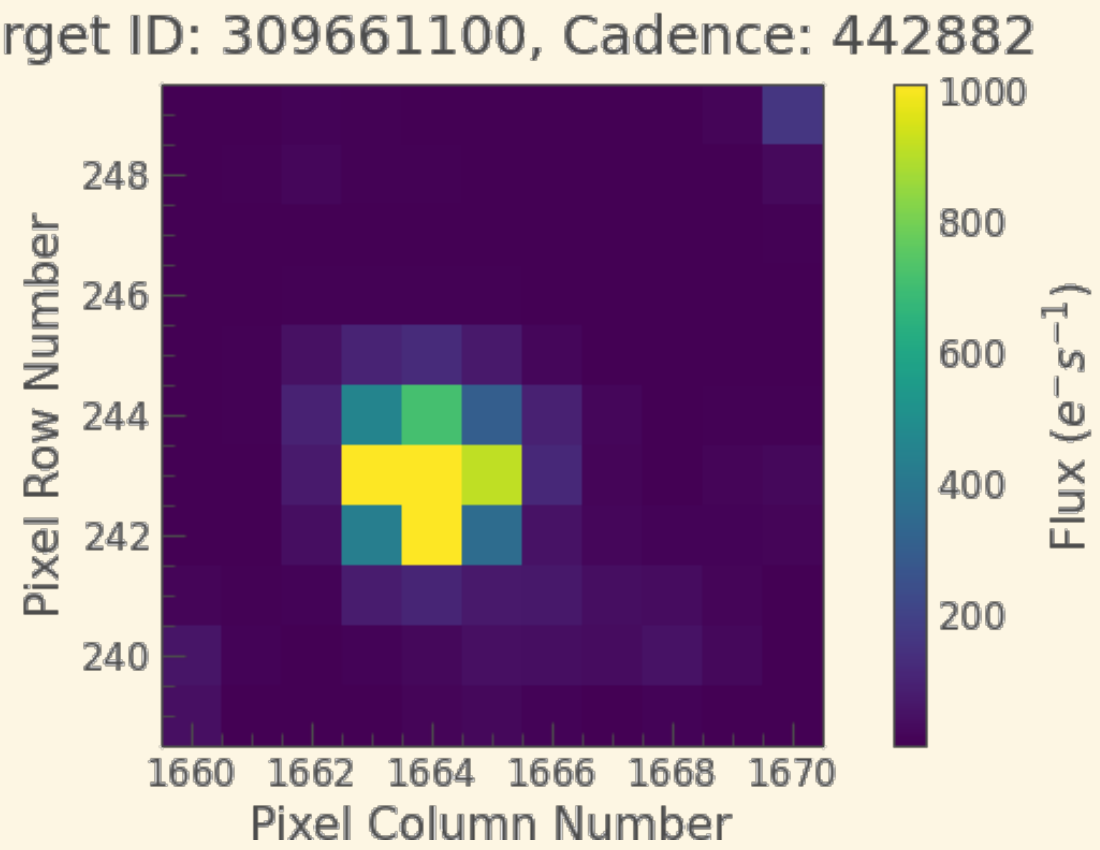


Figure: Single-frame Star luminosity

Detection Methods[1]

Direct Imaging

Photo like pixel analysis.

Radial Velocity

Gravitational wobble on stars, Doppler effect.

Transit Method

Time and size of planet occlusion.

Gravitational Microlensing

Lensing by space-time warping with secondary stars

[1] There are also other methods related with machine learning that go over the scope of this presentation, although their work is centered around classification. [Terry, 2023]

Direct Imaging

Coronograph

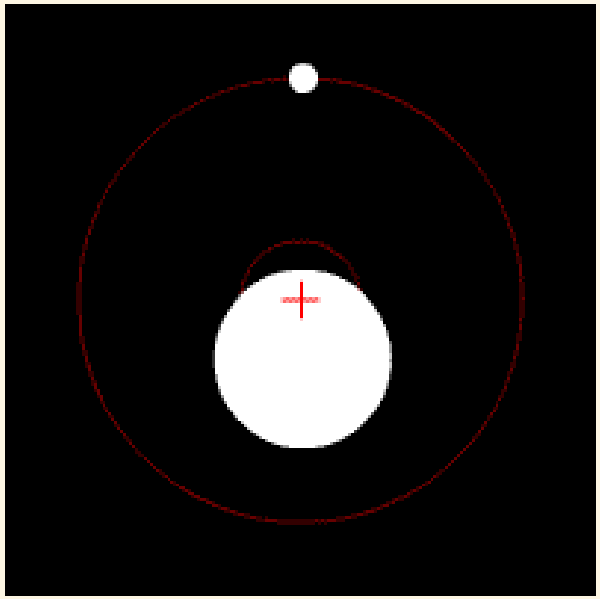
Small object used to occlude light source's beams.

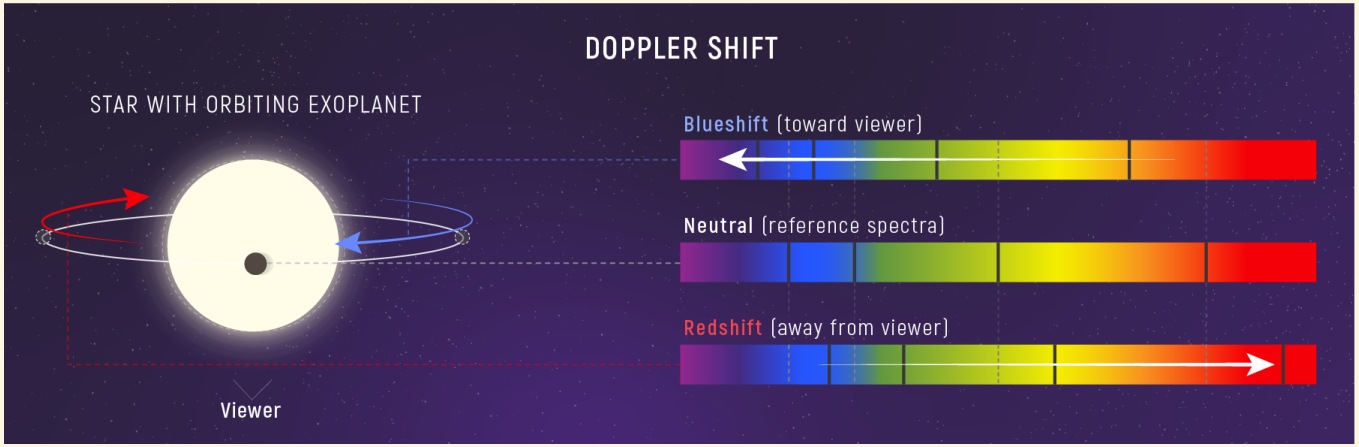
- Requires proximity
- Requires decent size

Space-shade project. [NASA University of Colorado, 2017]

Radial Velocity

Astrometry [ESA, 2019]





Transit Method

[Hans J. Deeg, 2024]

- Easiest to analyze
- Very cost effective
- Demo

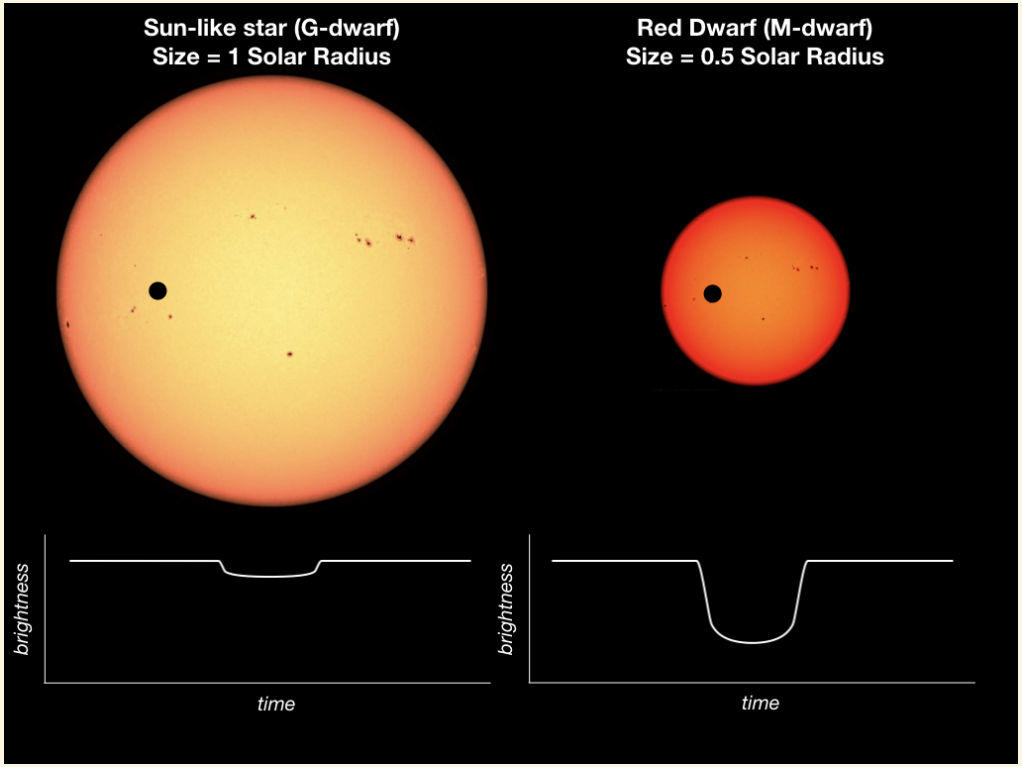


Figure: Exoplanet transit occlusion

Habitability

- Only in our galaxy there is an estimation of ***10 billion*** exoplanets.
- Earth-like size does not guarantee atmosphere.
- Elements associated with life are very hard to detect.
- Magnetic field pressence is unkwnown.
- Planets may ***outnumber*** stars in the sky.

References

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  Earth and Planetary Astrophysics.
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- Terry, J. P. (Feb 2023).
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