

# Meet the Goldiloxs!

A cartoon thesis by: Niyati Desai

The Goldiloxs are an alien family looking for a new home!



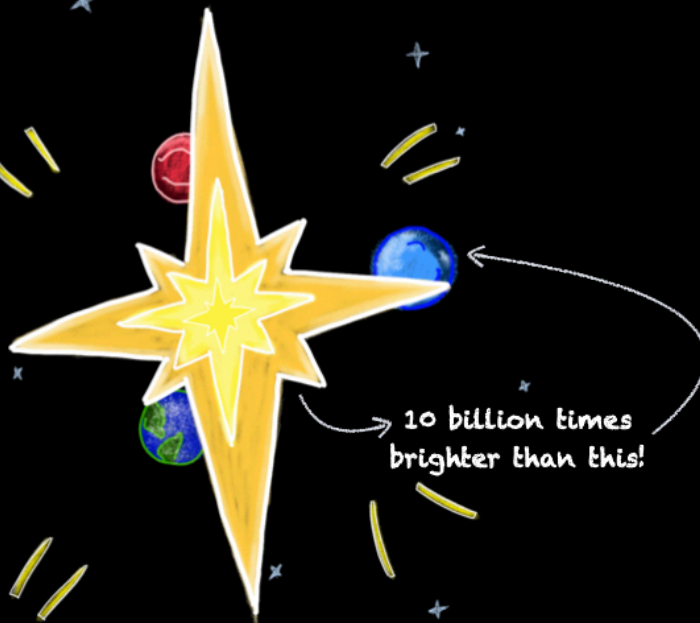
They're all packed and ready to go.

Now the only question is where to? They don't want somewhere...

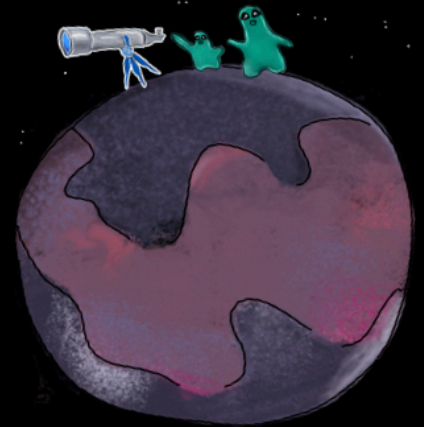


They want somewhere 'just right'!

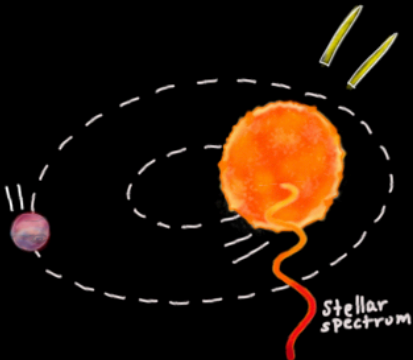
Each night on their home world, the Goldiloxs set their telescope up in their backyard...



But whenever they try to look for planets, they're blinded by bright starlight.



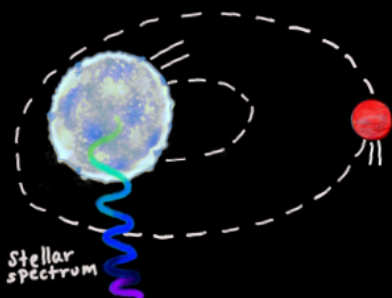
Because of this, 98% of the exoplanets known today have been detected indirectly:



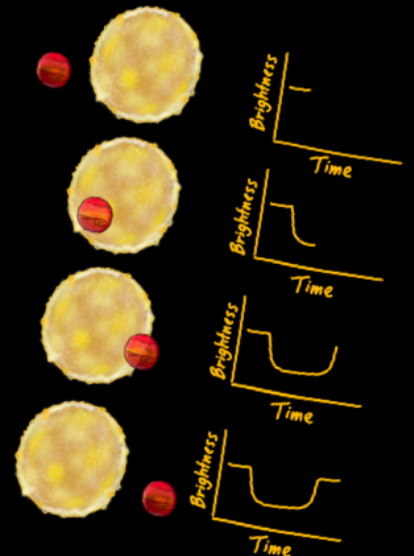
by noticing a star wobble

or

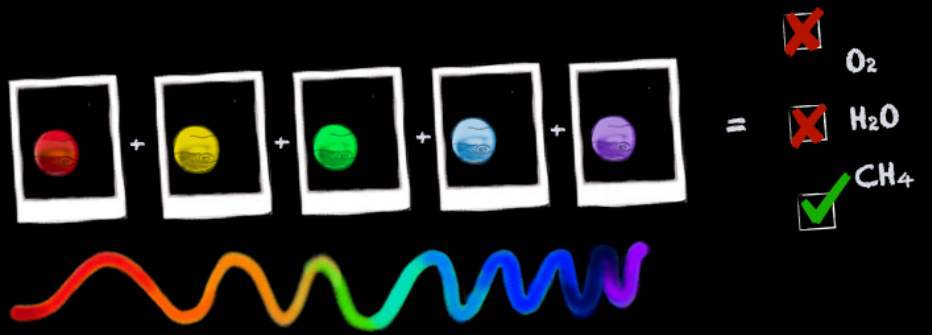
get dimmer, then brighter again



But that's not enough to learn about a planet's atmosphere.



Light directly from a planet in multiple wavelengths is needed to reveal if the planet's atmosphere is 'just right'!



To block the starlight the Goldiloxs need a...

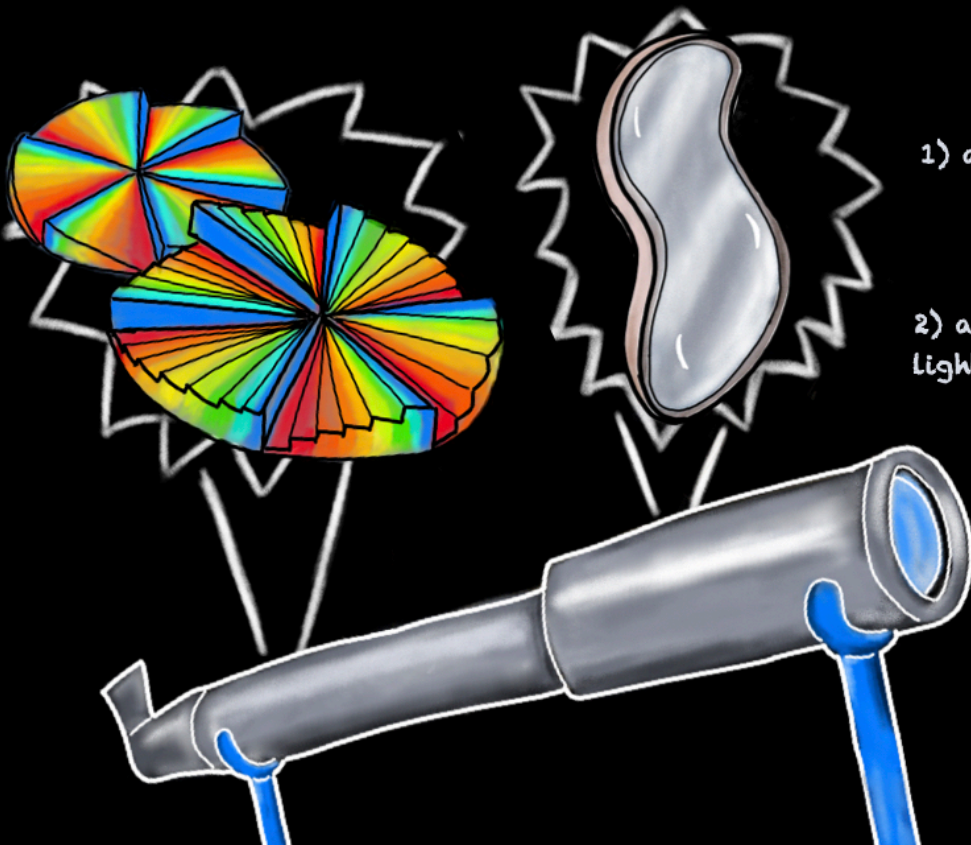
## CORONAGRAPH!

But current coronagraph designs are chromatic, meaning they work well in only one wavelength.

This research aims to design better coronagraphs which can reach contrasts of  $10^{-10}$  across many wavelengths.

$$\text{Contrast} = \frac{\text{brightness (planet)}}{\text{brightness (star)}}$$

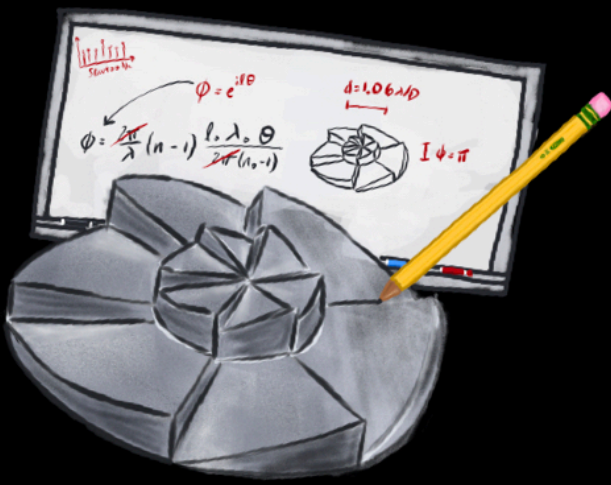
There are 2 main parts of a coronagraph that allow stars to be blocked and planets to be imaged:



1) a geometric vortex mask shaped to filter out a star's light

2) a bendy mirror that helps direct the light so it lands perfectly on the mask

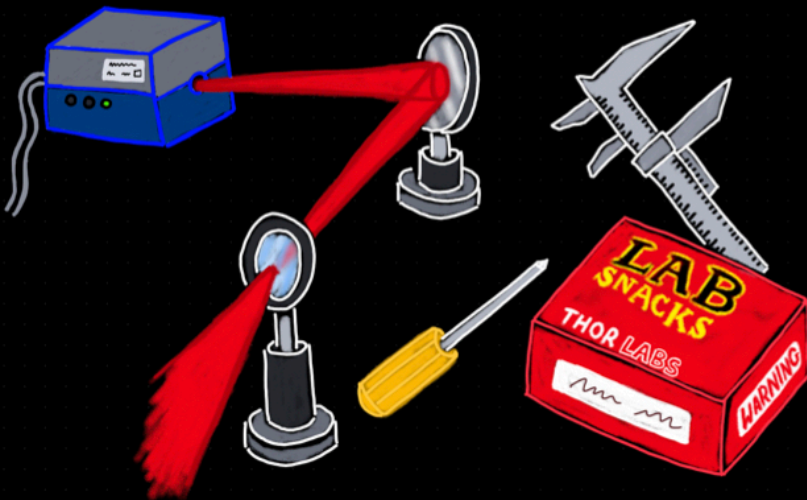
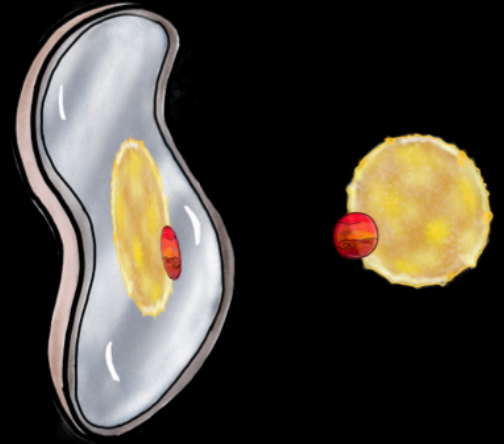
This thesis explores both!



This thesis designs new vortex patterned optics that block starlight in broadband light.

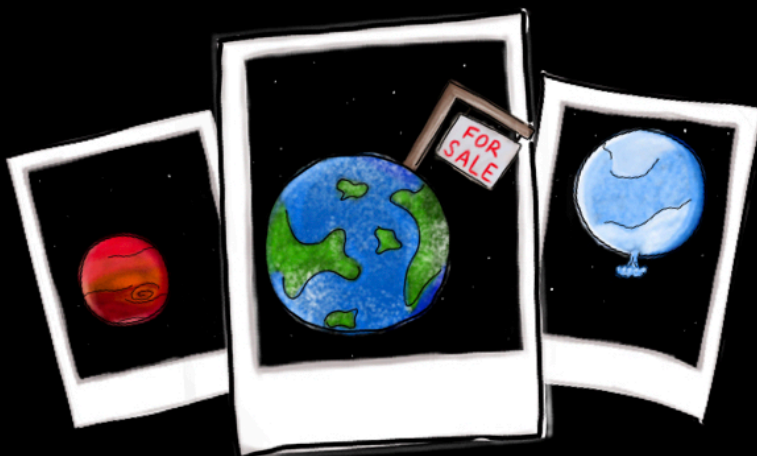
It also explores ways to shape a coronagraph's bendy mirror to improve performance.

These ideas are investigated first in simulation by modeling the path of a star's light through the telescope.



Then they are tested in laboratory experiments to see which coronagraph designs work best!

Much like the Goldilocks, I've been searching for the 'just right' combination of vortex design and bendy mirror shape!



Thanks to this research, the Goldilocks will be able to find their new home!



## ABOUT THE AUTHOR

Niyati Desai is defending her PhD dissertation from Caltech on May 21st, 2024. She found doodling her thesis in *Meet the Goldiloxs* was a brilliant way to combine her passion for research with her love for drawing. She hopes it inspires readers.

