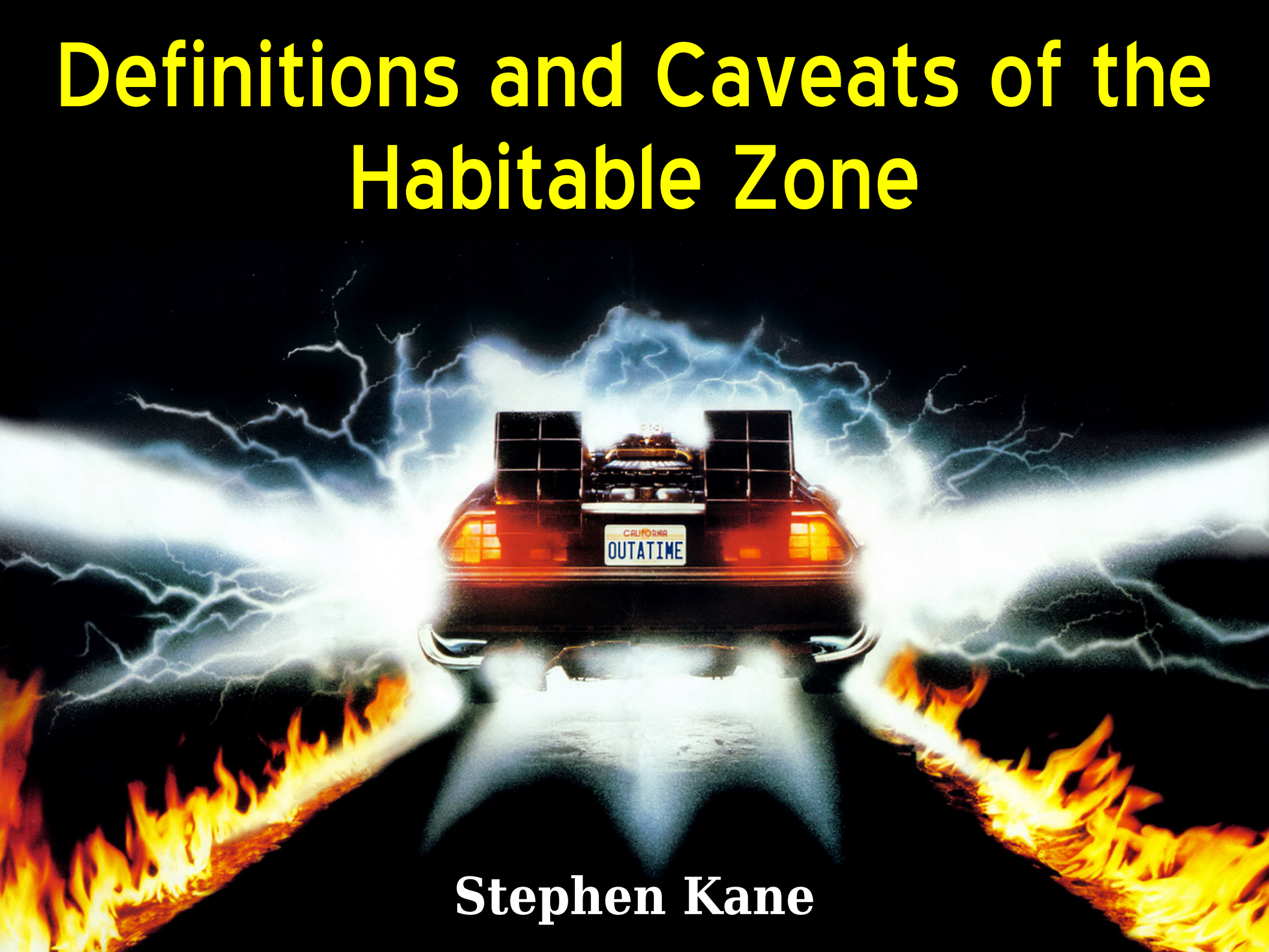
Definitions and Caveats of the Habitable Zone



Stephen Kane

Star

- Effective temperature
- Mass, radius
- Luminosity

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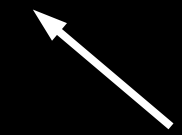
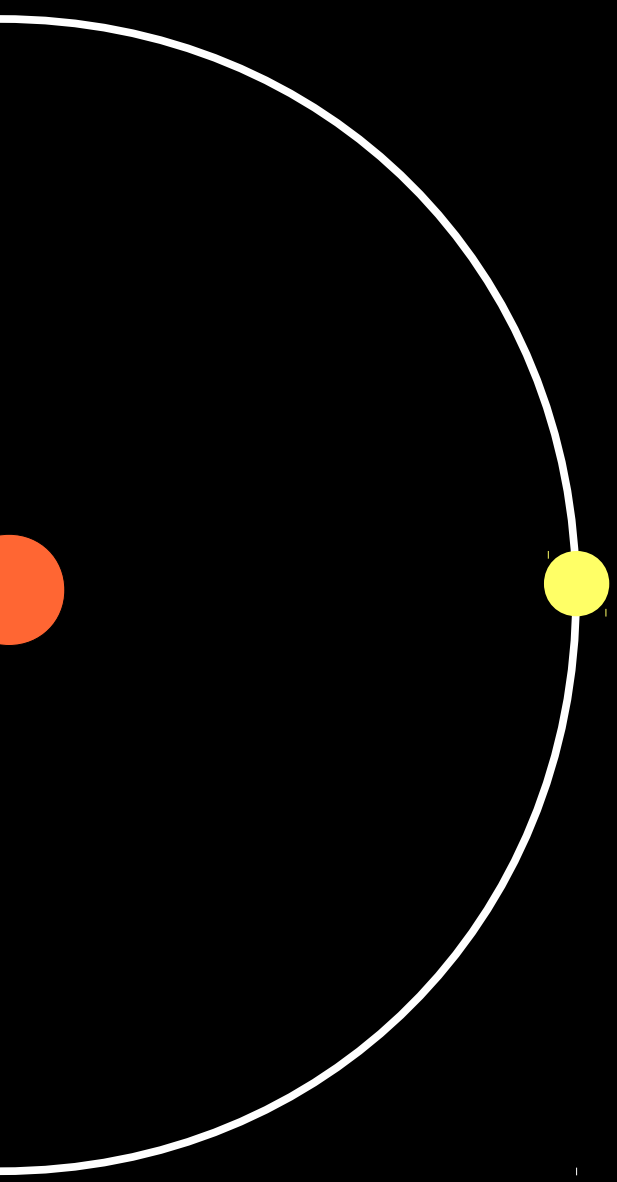


Insert uncertainties here



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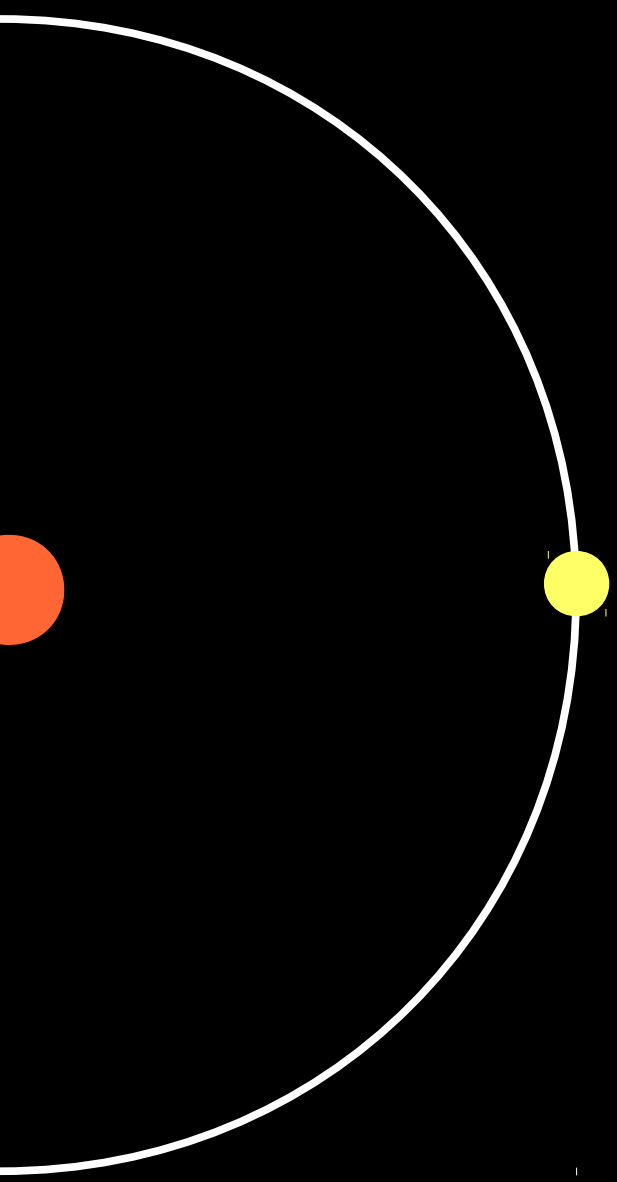
Insert uncertainties here



Star

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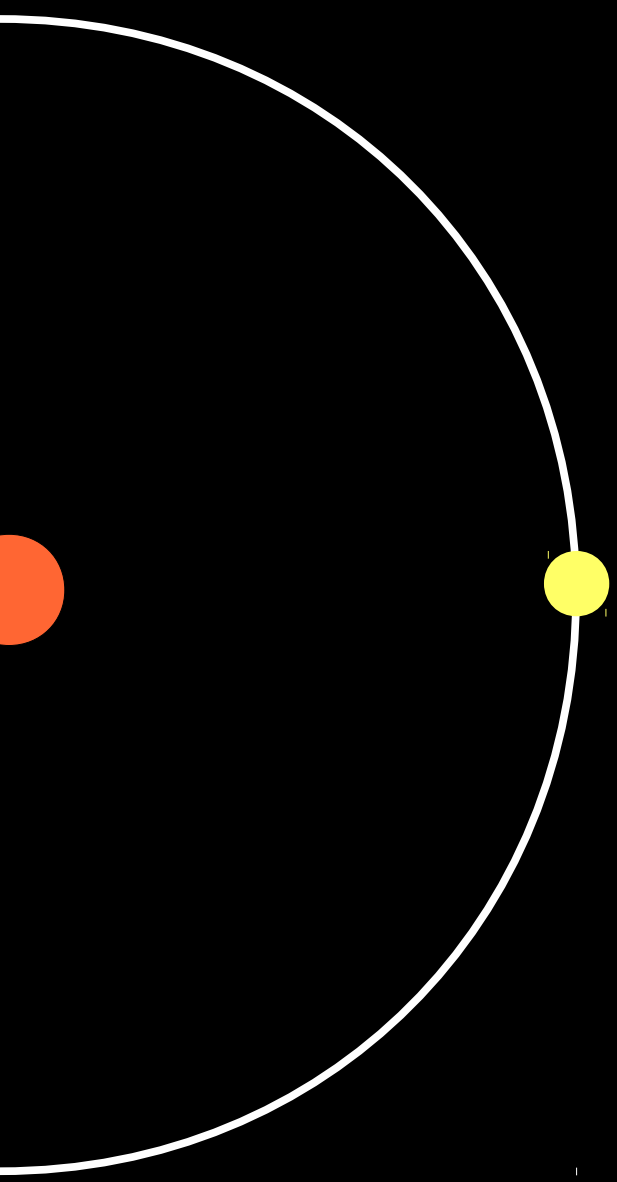
Insert uncertainties here

Planet

- Radius
- Equilibrium temperature
- Mass ?



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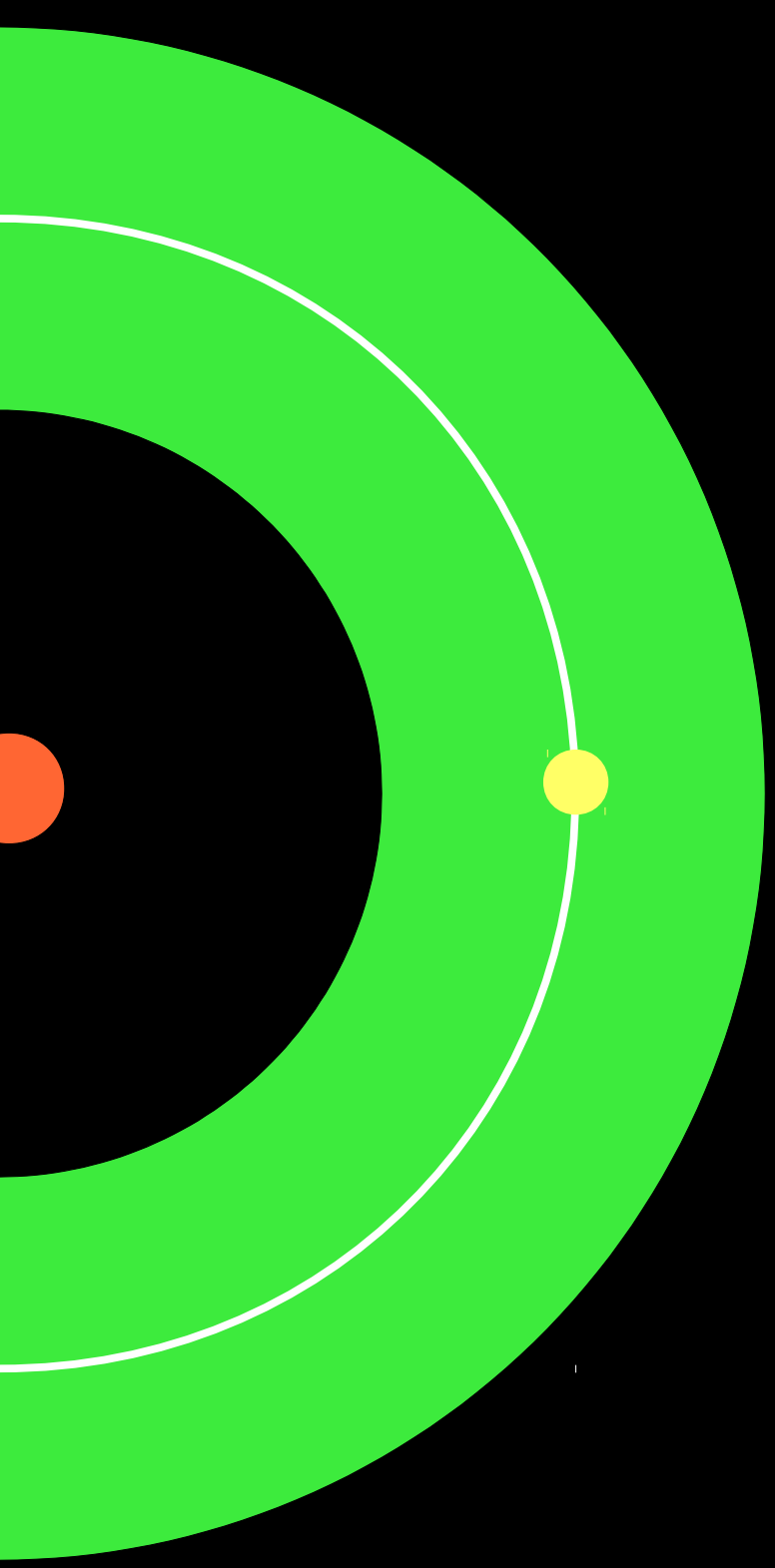

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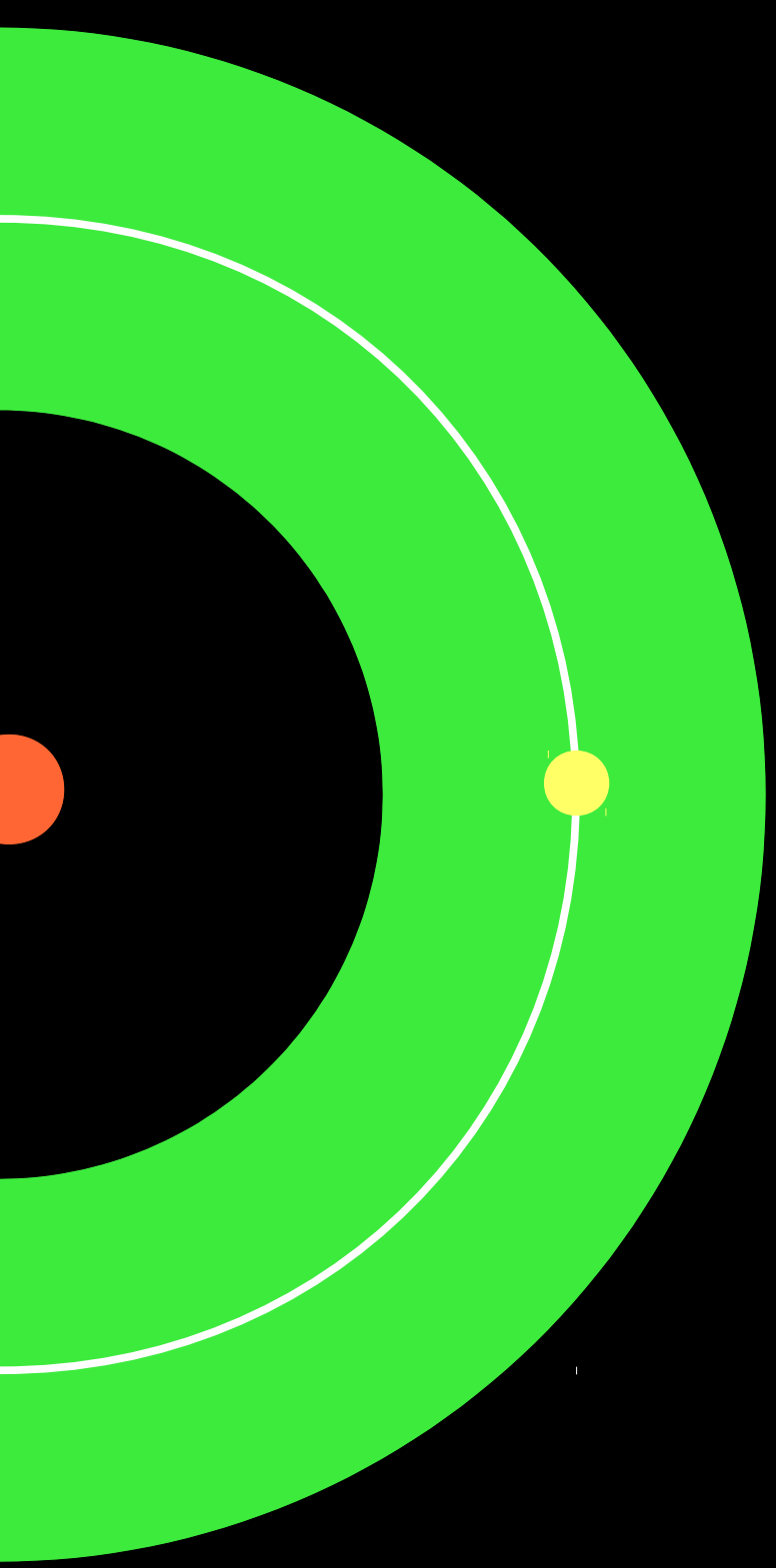

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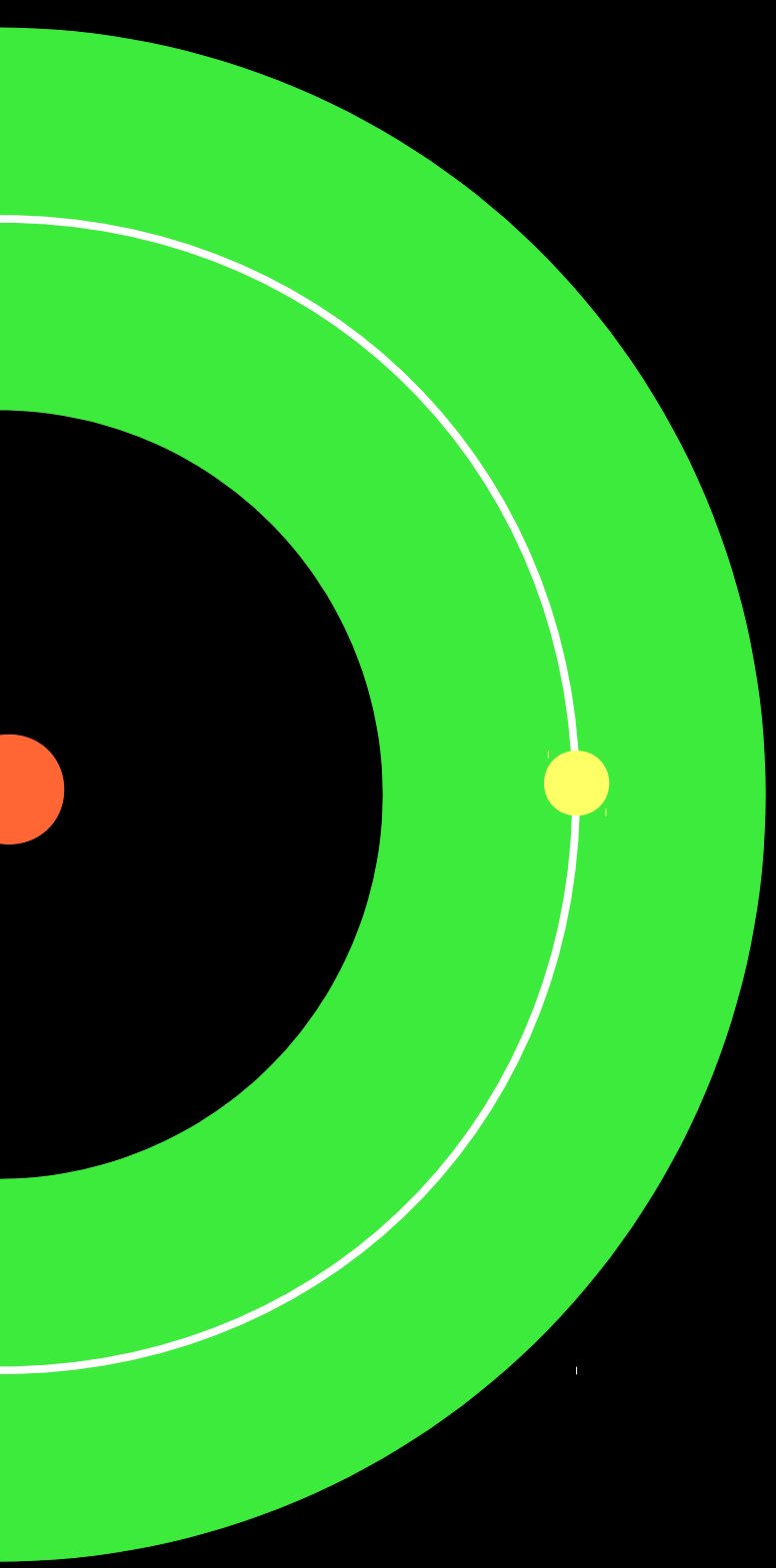
Habitable Planet!!



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Planet

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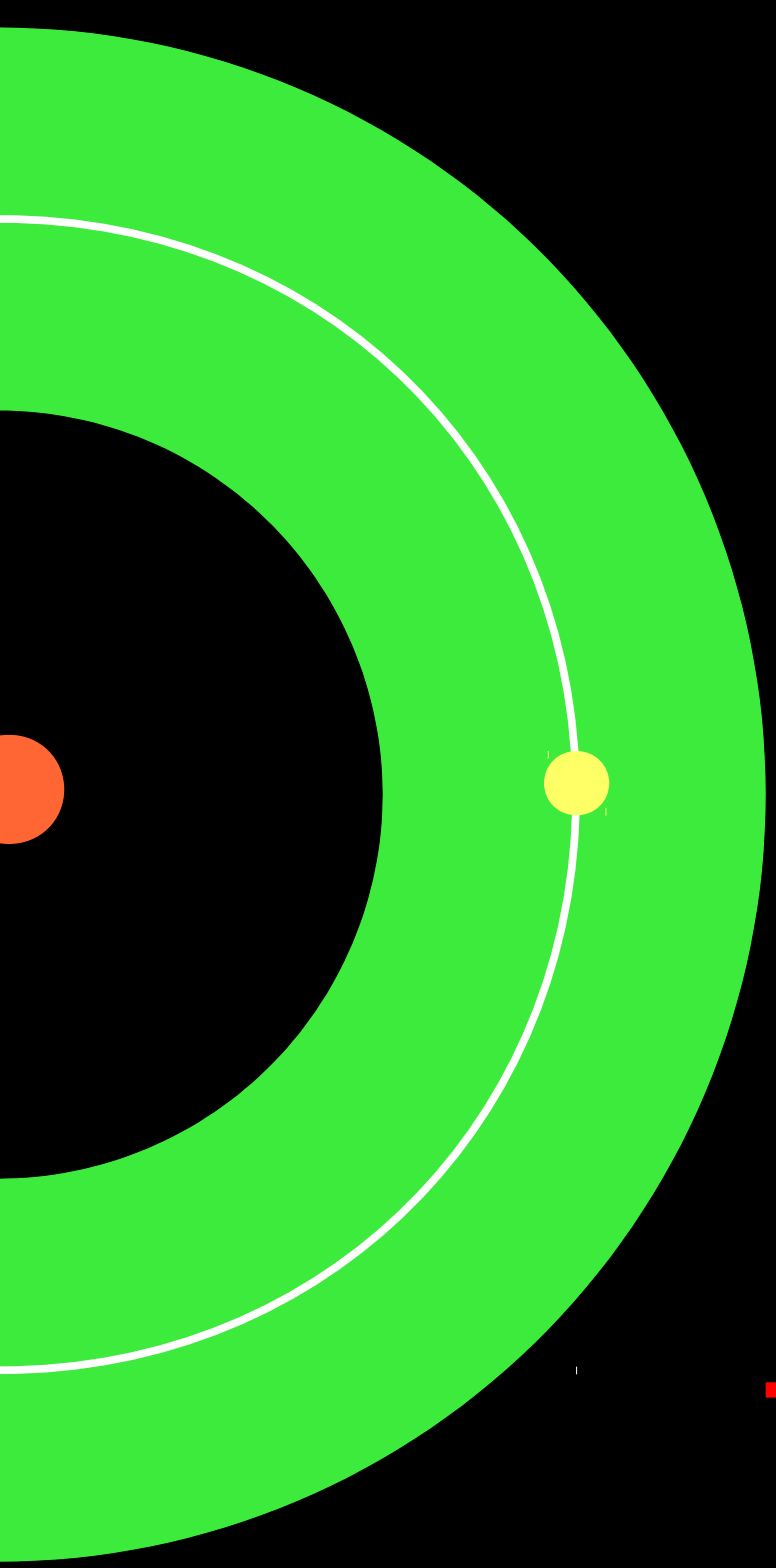
Insert even bigger uncertainties here

Potentially Habitable Planet!!



Star

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- Luminosity

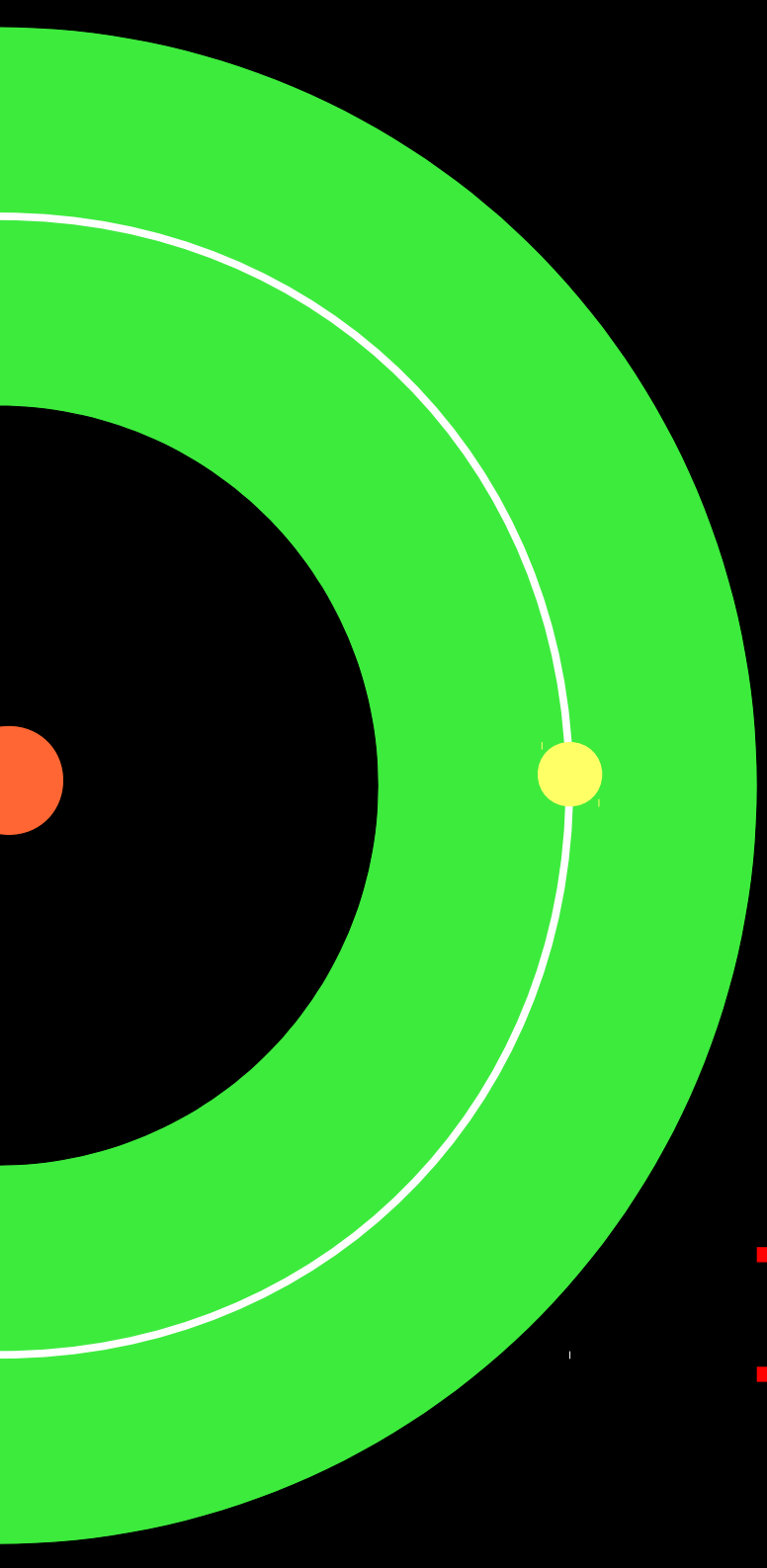
Insert uncertainties here

Planet

- Radius
- Equilibrium temperature
- Mass ?

Insert even bigger uncertainties here

Likely ~~Potentially~~ Habitable Planet!!



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Insert even bigger uncertainties here

~~Likely~~
~~Potentially~~ Habitable Planet!!

SUBMITTED FOR PUBLICATION IN THE NECRONOMICON
Preprint typeset using LaTeX style emulateapj v. 11/10/09

arXiv:1403.8146

A NECRO-BIOLOGICAL EXPLANATION FOR THE FERMI PARADOX

STEPHEN R. KANE[1] & FRANCK SELSIS[2]
[1] Center for Global Extinction Pandemic Control, Subterranean Bunker 32, Union Square, San Francisco, USA
[2] Planetary Defense Institute - Zombie Division, Chateau Morts-Vivants, Bordeaux, France

Submitted for publication in the Necronomicon

ABSTRACT

As we learn more about the frequency and size distribution of exoplanets, we are discovering that terrestrial planets are exceedingly common. The distribution of orbital periods in turn results in many of these planets being the occupants of the Habitable Zone of their host stars. Here we show that a conclusion of prevalent life in the universe presents a serious danger due to the risk of spreading Spontaneous Necro-Animation Psychosis (SNAP), or Zombie-ism. We quantify the extent of the danger posed to Earth through the use of the Zombie Drake Equation and show how this serves as a possible explanation for the Fermi Paradox. We demonstrate how to identify the resulting necro-signatures present in the atmospheres where a zombie apocalypse may have occurred so that the risk may be quantified. We further argue that it is a matter of planetary defense and security that we carefully monitor and catalog potential SNAP-contaminated planets in order to exclude contact with these worlds in a future space-faring era.

Subject headings: astrobiology – planetary systems – zombie apocalypse

1. INTRODUCTION

The detection of planets outside of our Solar System has opened up the possibility of answering several questions which have nagged the minds of philosophers for millennia. These questions include: Is the architecture of our Solar System typical or unusual? How common are planets the size of the Earth? How common is life in the universe? Exactly how many things are out there that can kill us? It is now apparent that the process of planet formation produces an enormous diversity of

Here we discuss how recent exoplanet discoveries combined with studies of infectious diseases indicate that the universe may harbor reservoirs of planets full of biodecay remains where zombie apocalypses have occurred. In Section 2 we outline the dangerous nature of SNAP, quantify the possible numbers of SNAP-contaminated planets, and their proximity to Earth. In Section 3 we describe the decomposition process and the gases released. This process is then used to establish the resulting necro-signatures and their potential for identification in Section 4. The observing window for detecting such signatures is

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Submitted for publication in the Necronomicon

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6. CONCLUSIONS

We have shown that there is a significantly non-zero probability that in the search for life in the universe we will also encounter large amounts of undeath. Any person who has been exposed to even a relatively benign zombie film understands the threat posed by this heinous malady. This is not to be trifled with. Therefore the risk imposed of encountering a SNAP-contaminated planet cannot be overstated.

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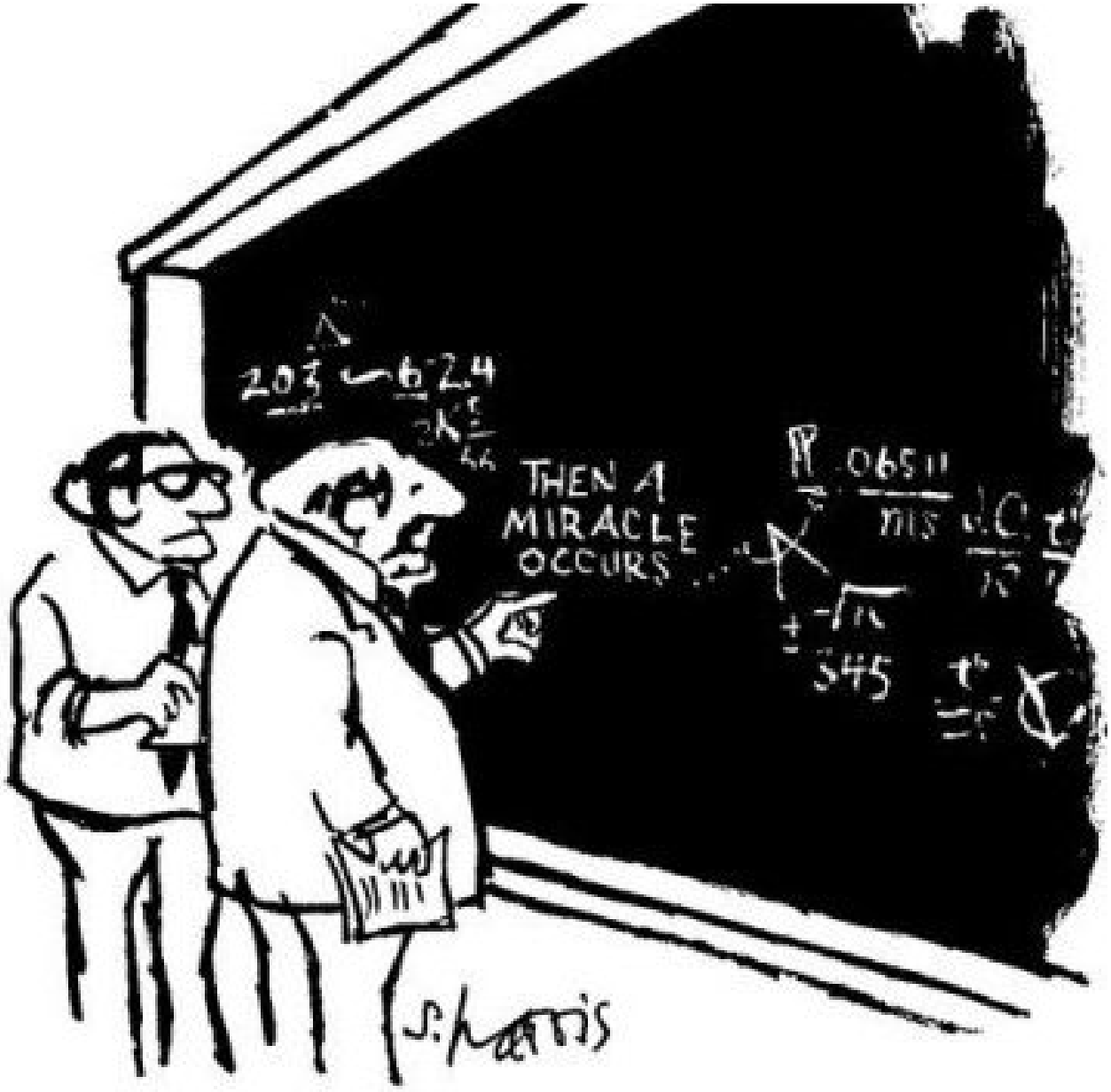
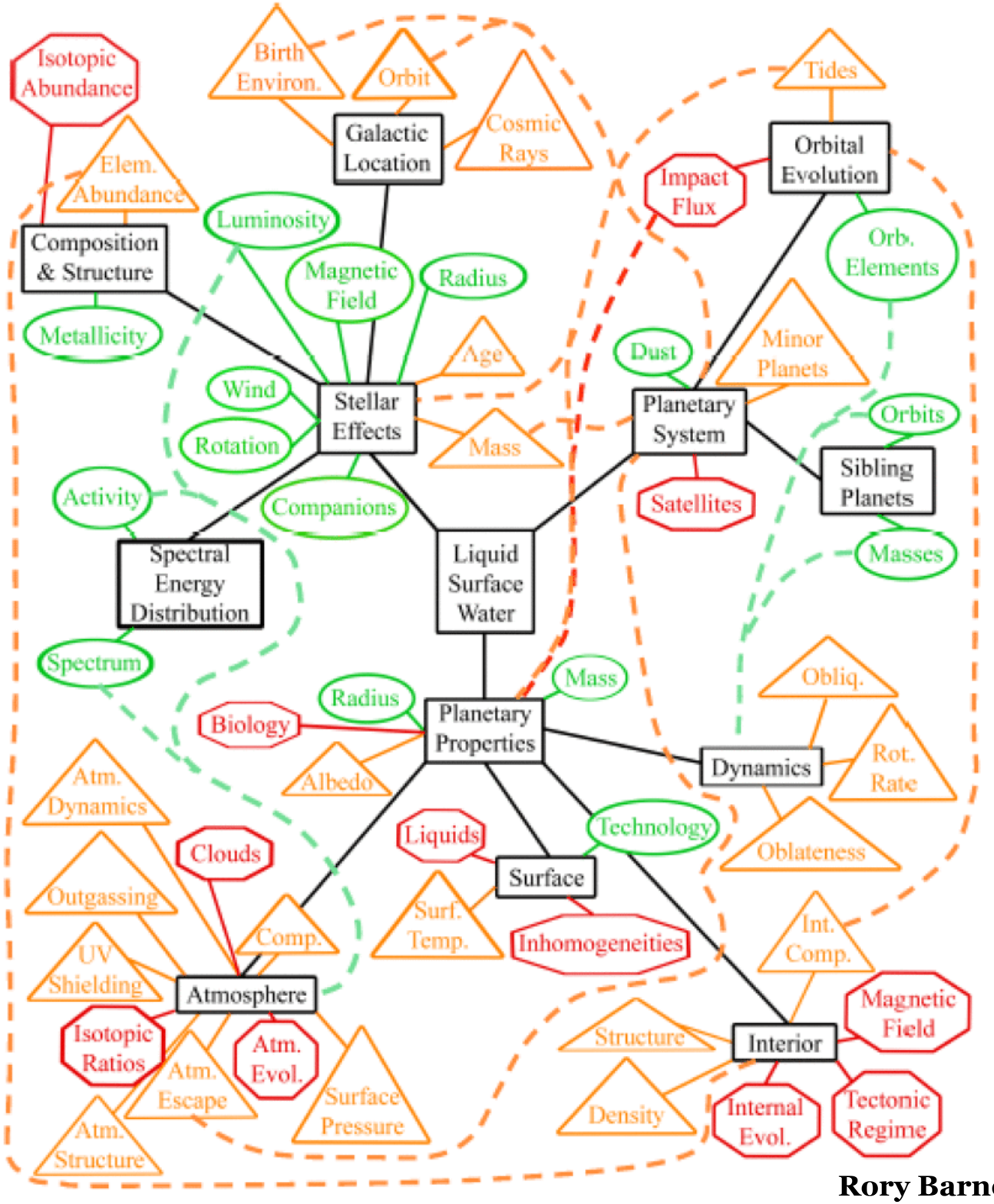


"I THINK YOU SHOULD BE MORE EXPLICIT HERE IN STEP TWO."



Rory Barnes & Vikki Meadows

Is the Habitable Zone a Well-Defined Concept?

- The "Habitable Zone" is the region around a star where water COULD exist in a liquid state on the surface of a planet IF it has sufficient atmospheric pressure
- It does NOT comment on the presence of water
- It does NOT comment on habitability
- It does NOT comment on the presence of life
- Based on one data point

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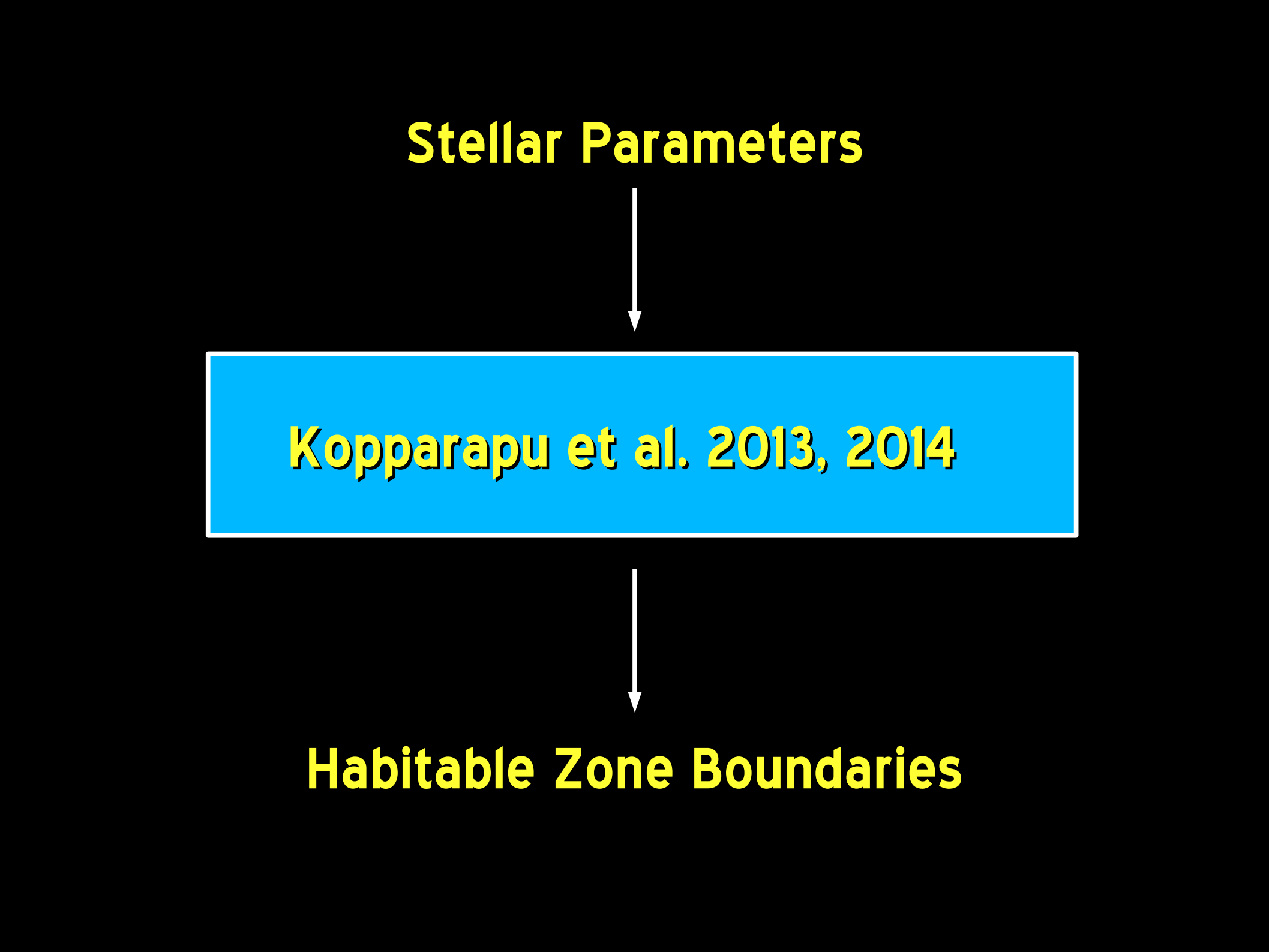
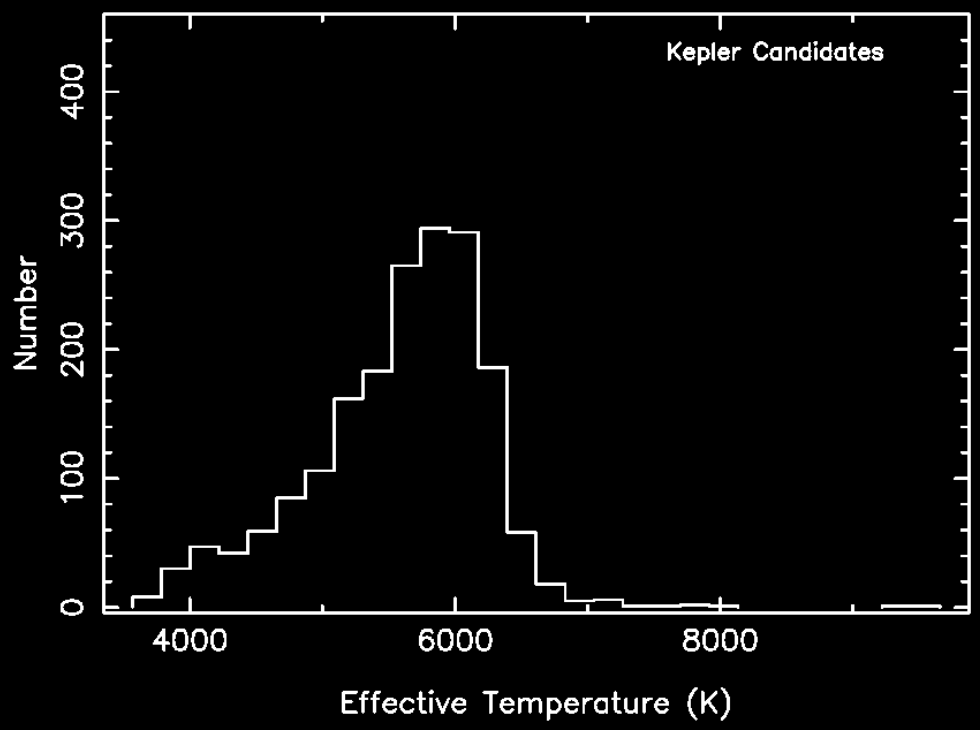
TARGET SELECTION!

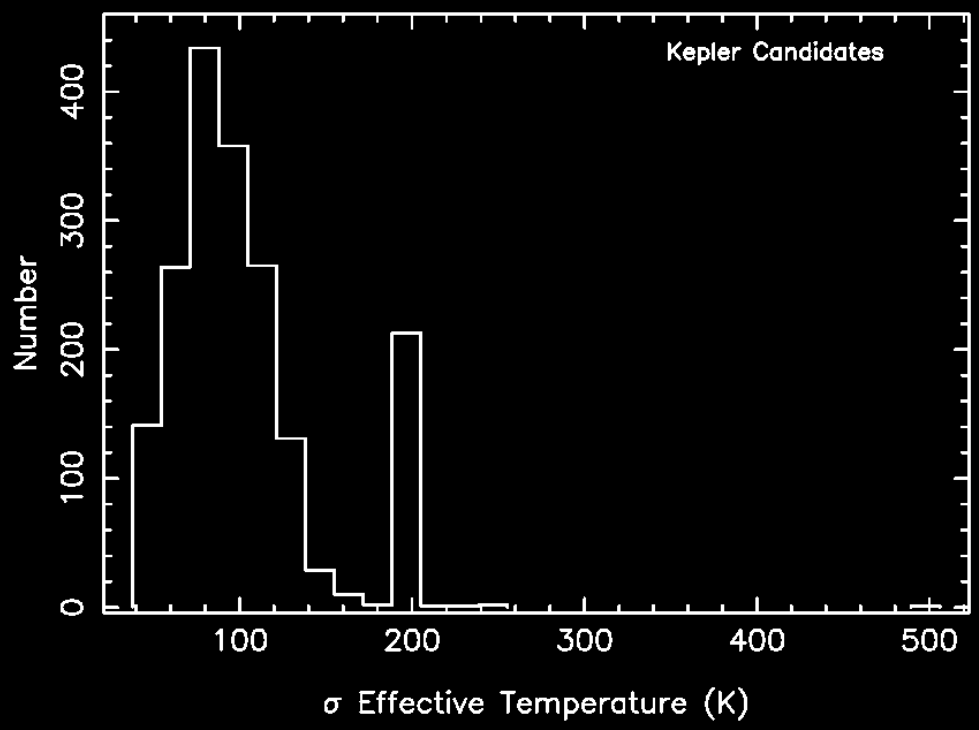

Stellar Parameters
Kopparapu et al. 2013, 2014
Habitable Zone Boundaries

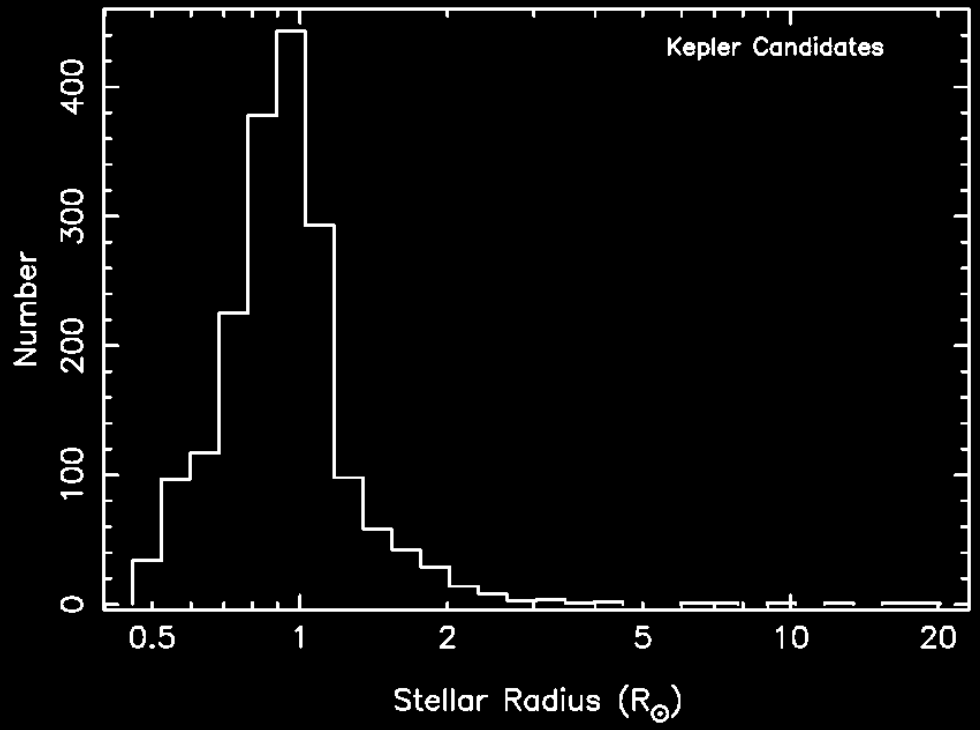
Stellar Parameters +/- X

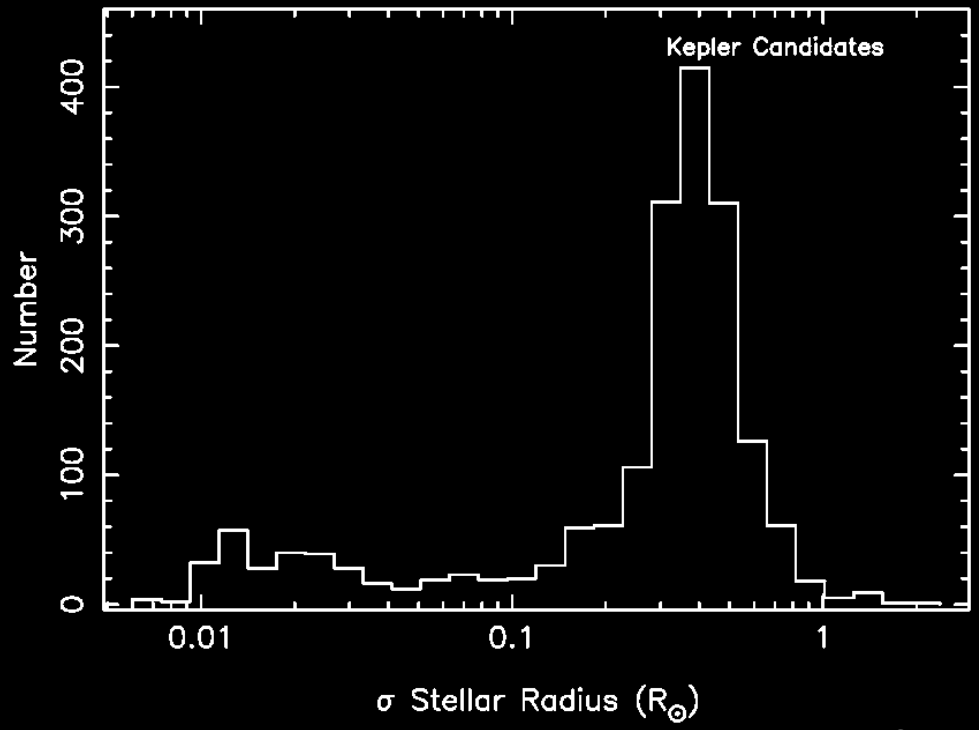
Kopparapu et al. 2013, 2014

Habitable Zone Boundaries +/- Y



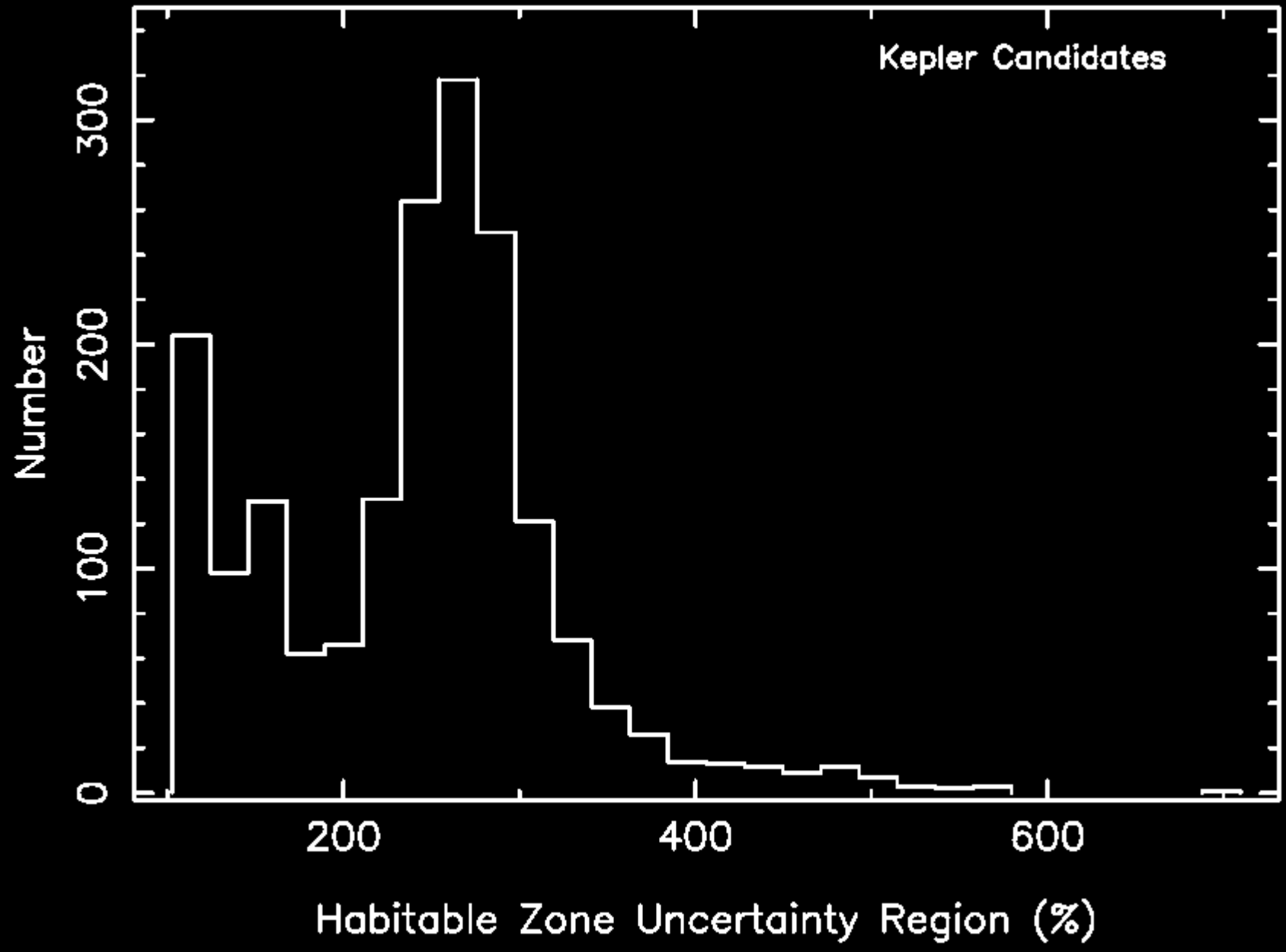






Kane. 2014, ApJ, 782, 111

Where are the Habitable Zone Boundaries?



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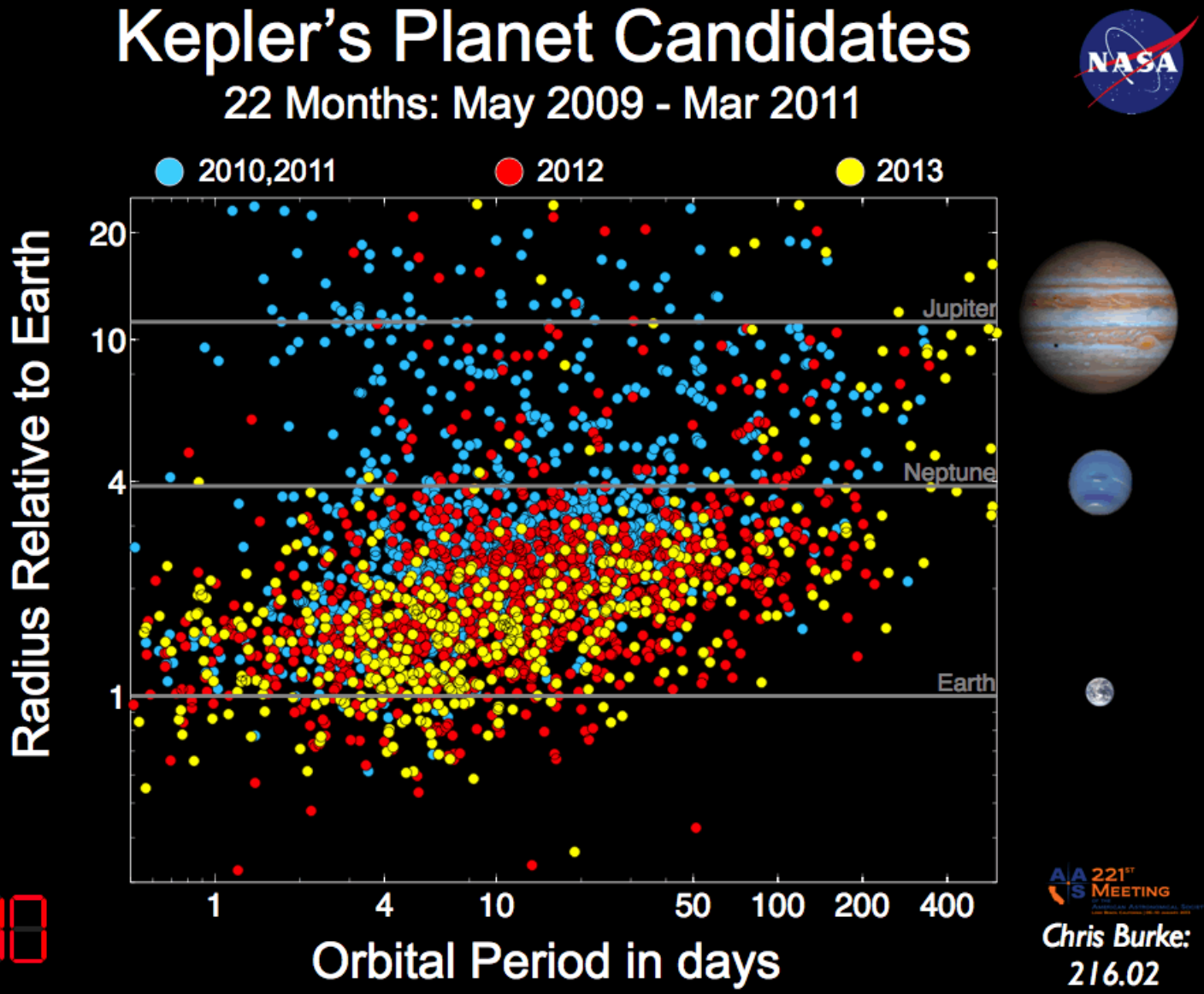
η(Earth) from Kepler

- Define $\eta_{\oplus}$ as fraction of stars with at least one terrestrial planet within the Habitable Zone



2040

AAS 221st Meeting

Chris Burke: 216.02

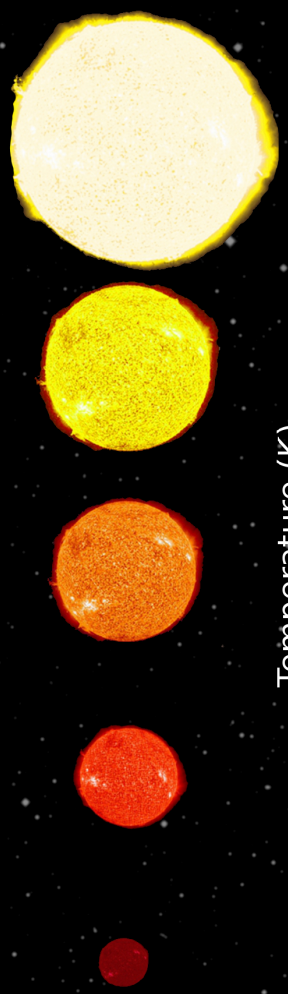
η(Earth) from Kepler

- Define $\eta_{\oplus}$ as fraction of stars with at least one terrestrial planet within the Habitable Zone

η(Venus) from Kepler

- Define η(Venus) as fraction of stars with at least one terrestrial planet within the Venus Zone

- For M stars: η(Venus) = 0.32 +0.05/-0.07
  For GK stars: η(Venus) = 0.45 +0.06/-0.09



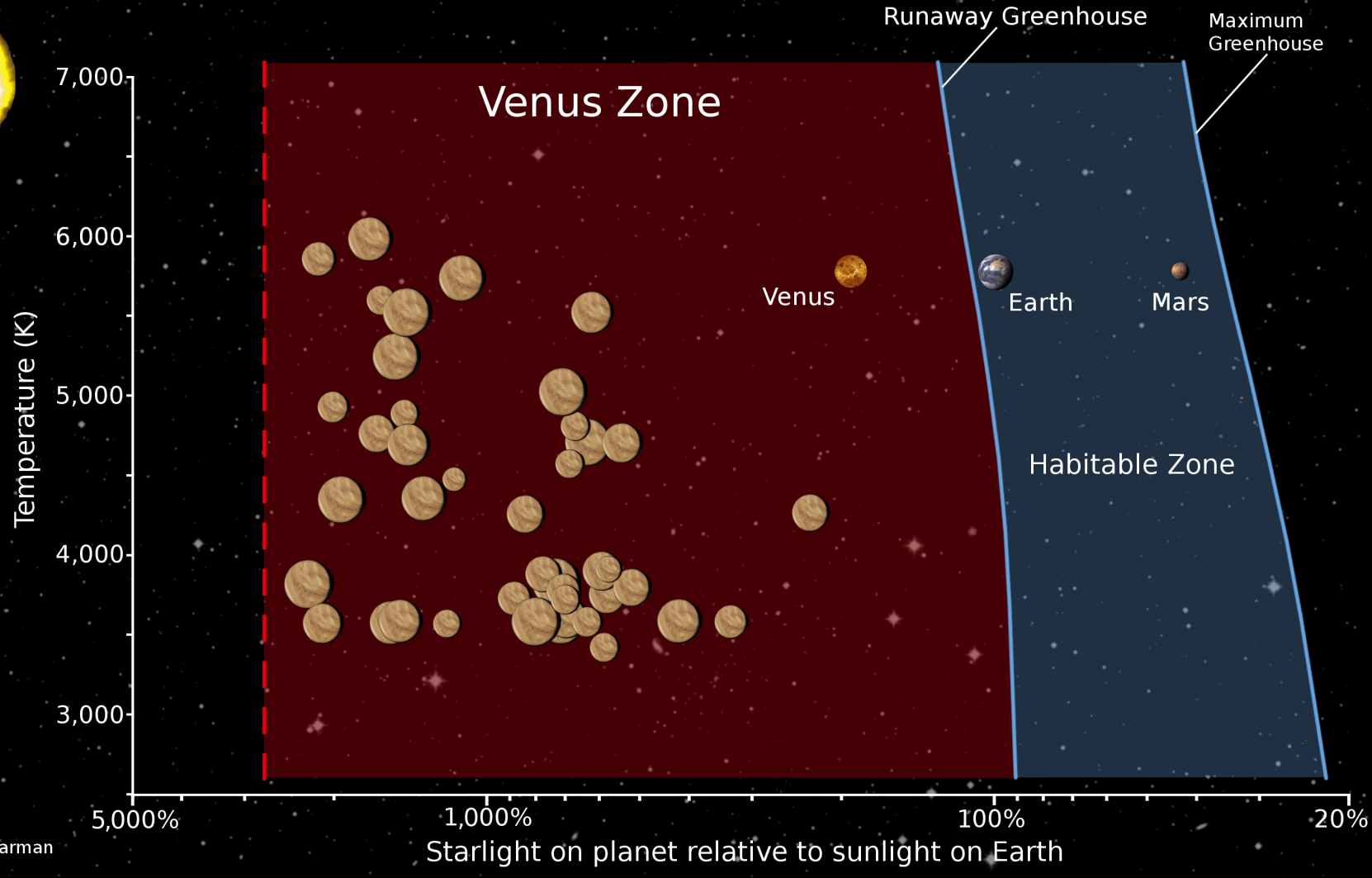
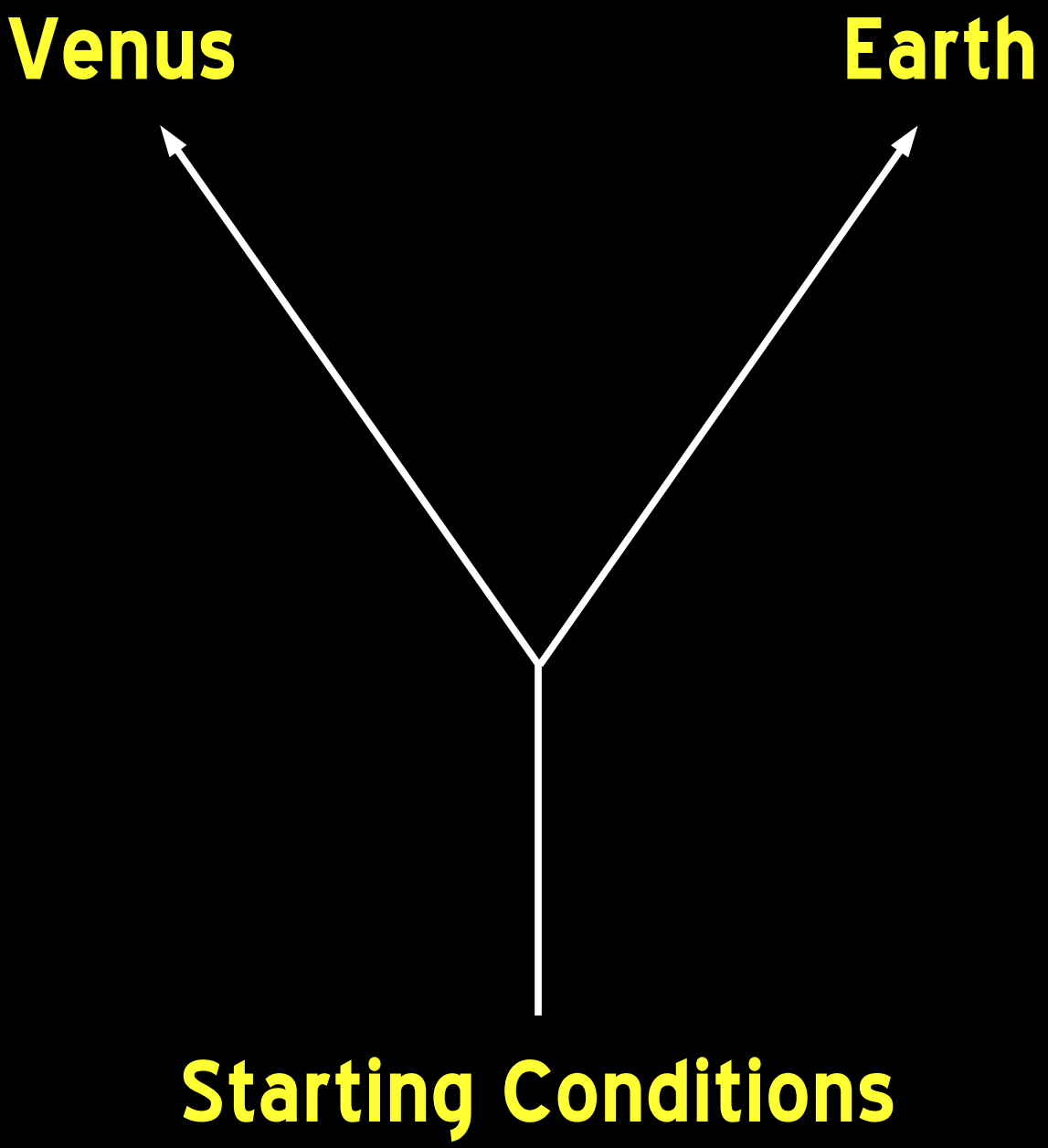
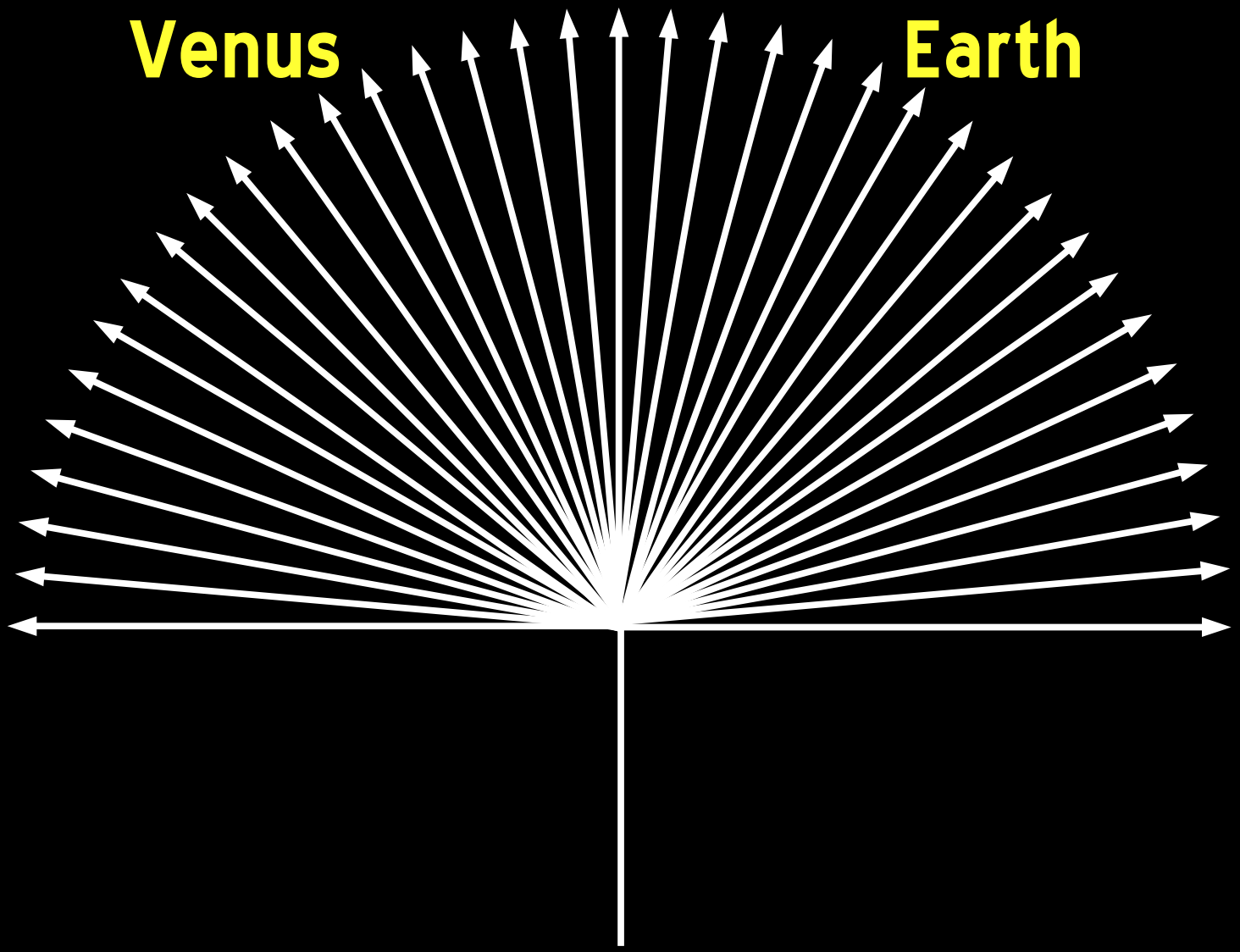


Image Credit: Chester Harman
Planets: NASA/JPL

Kane, Kopparapu, Domagal-Goldman. 2014, ApJ, 794, L5


Venus
Earth
Starting Conditions


Venus
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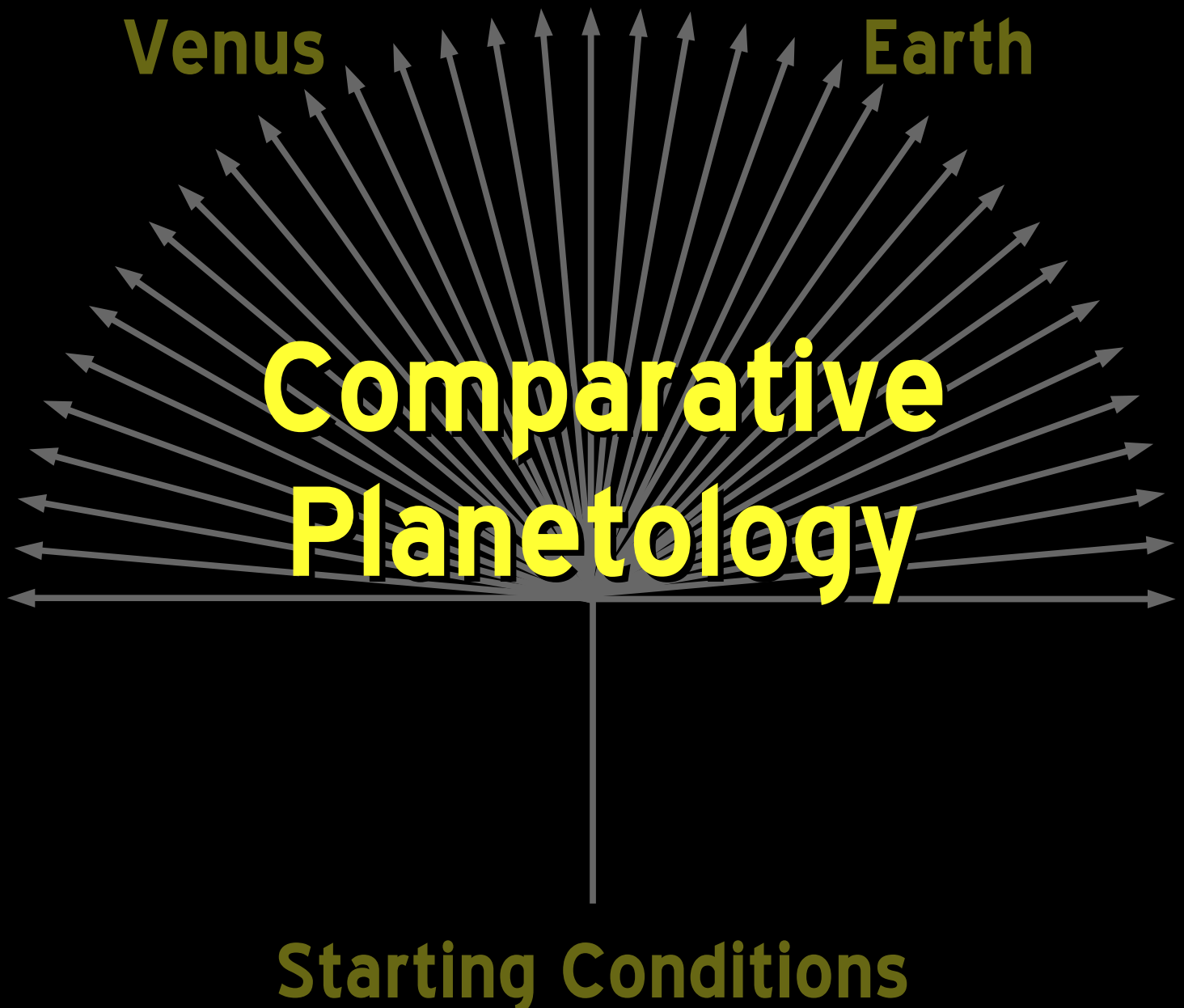
Venus
Earth
Comparative Planetology
Starting Conditions

Conclusions

1. > 90% of everything said at this meeting about habitability is probably wrong

2. The probability that a Habitable Zone planet is actually habitable is ≥ 0%

3. Habitable Zone boundaries are uncertain

4. We are discovering the Venus analogs first

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Posters by Colin Chandler (CELESTA) & Dawn Gelino (HZG)