Detection of Radial Velocity Exoplanets With the WFIRST-AFTA Coronagraph



Introduction

Direct imaging methods of exoplanets using WFIRST-AFTA coronagraph will be studied. Target exoplanets are those discovered using the radial velocity method, and the most suitable times to image these exoplanet will be determined. Contrast limitations of the instruments will also be considered to ultimately gather the best set of target exoplanets and corresponding times.

Bandpass	400 nm – 1000 nm
Inner Working Angle	100 mas – 200 mas at 400 nm
Outer Working Angle	1 arcsec – 2.5 arcsec
Detection Limit	Best contrast = $1e-9$

Table 1. Key WFIRST-AFTA coronagraph features ("WFIRST-AFTA Final Report", 2013)



Aastha Acharya, Dmitry Savransky The Sibley School of Mechanical and Aerospace Engineering, Cornell University, Ithaca, NY

Results



Distance to host star (pc

Fig 3. Each point represents 22 of the viewable RV exoplanets using IWA of 200 mas; the color and the corresponding colorbar shows the visibility percentage

Overall Visibility Profiles



Visible 5000 Points 1200 **JO** 1000 Numbe 200 -0.6 -0.4 -0.2 0 0.2 0.4 0.6 0.8 Fraction of Orbital Period

Fig 4a. Visibility distribution for Fig 4b. Visibility distribution for t=0 at minimum radial velocity t=0 at maximum radial velocity



Fig 5a. Six-year time range and RV profile of 47 Uma d



Fig 5b. Six-year time range and RV profile of HD 219077 b

lagnitude

Fig 6a. Limiting contrast curve (green) plotted with ups And d contrast curve (red) versus radius in AU



Contrast Limitations Sample Profiles



Fig 6b. Limiting contrast curve (green) plotted with HD 219077 b contrast curve (red) versus radius in AU

Conclusions

1. Only 22 out of 513 RV exoplanets studied are visible using the WFIRST-AFTA coronagraph with IWA of 200 mas.

2. Based on visibility profiles, the best times to detect the exoplanets are during their minimum and maximum radial velocities.

3. Asymmetry in the overall visibility profiles is a result of the orbital parameters of the exoplanets, namely *I*, ω , and *e*.

4. Given sample time range and contrast limitations, the best exoplanets and the corresponding best times to directly image can be easily determined.

Selected References

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