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HD106906 Working Papers

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ABSTRACT

This documents keep the main result for *Cloud Atlas* HD106906b (Bailey et al. 2013) observations.

1. INTRODUCTION

HD106906b is a mid-L type planetary mass companion (Bailey et al. 2013).

2. OBSERVATIONS

We observed HD106906b on DDMMYY for two consecutive HST orbits as part of the variability amplitude assessment survey and on DDMMYY2 for seven consecutive HST orbits as part of the Deep Look survey.

3. DATA REDUCTIONS

3.1. *Two Roll Differential Imaging*

3.2. *Ramp Correction*

Describe how ramp correction is done

3.3. *Astrometry*

4. RESULTS

4.1. *Image*

4.2. *Light Curve*

4.3. *Astrometry*

We are particularly interested in the background star that is only $0''.87$ away from HD106906b, because it is unreported in previous studies and could contaminate the photometric and spectroscopic observations of HD106906b. We calculated the differences in right ascension (ΔRA) and declination (ΔDEC) and the separations between HD106906b and the background star from year 2003 (one year before the first direct imaging record of HD106906b) to year 2023. In this calculation, the background star is assumed to be stationary and HD106906b is co-moving with its host star at ($\mu_\alpha \cos\delta = -39.01$mas/yr, $\mu_\delta =$

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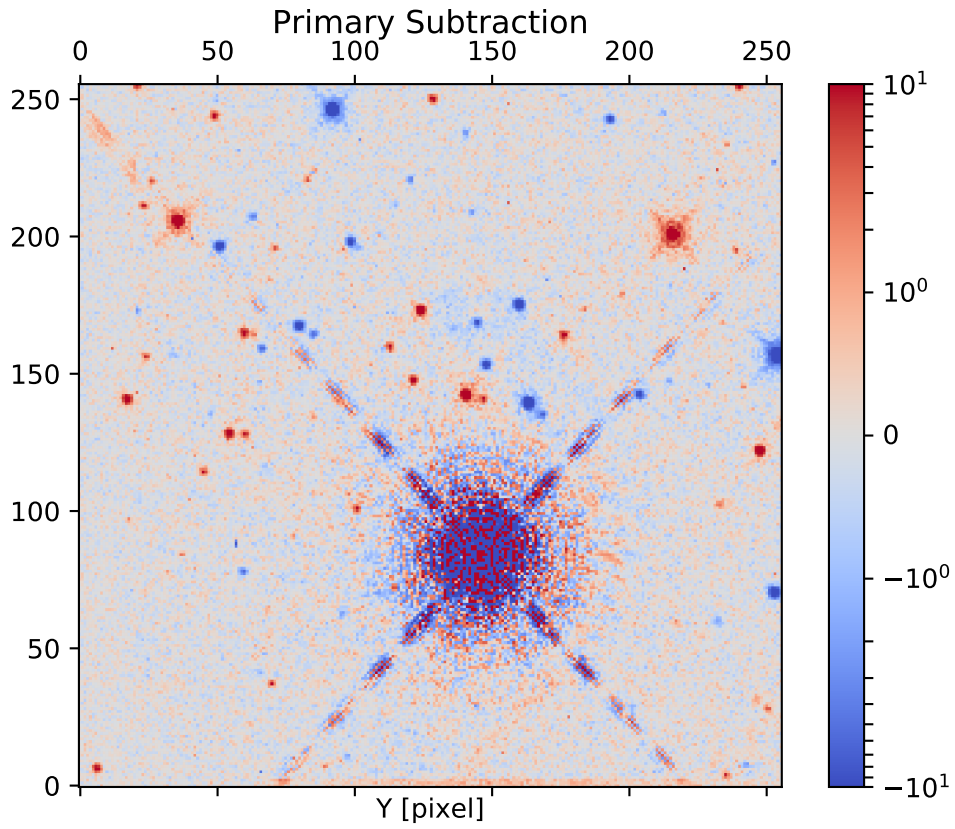

Figure 1. An Example of two roll differential imaging results

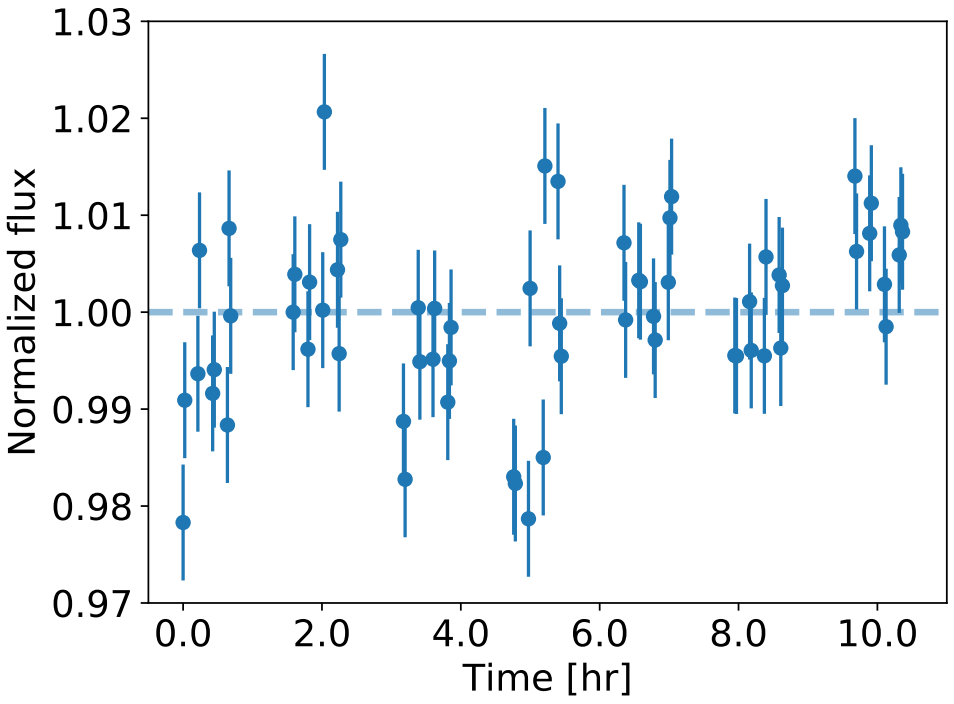

Figure 2. The light curve for HD106906b in F127M, F139M, and F153M

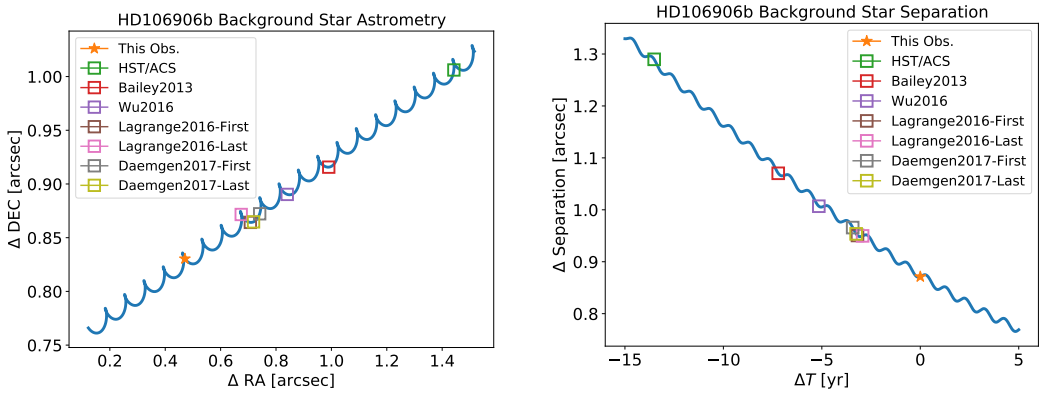

Figure 3. Relative astrometry between HD106906b and a closeby background star. Left: The difference in right ascension and declination. Right: The separation as a function of time. Past observations of HD106906b are marked with squares with their references in the legend.

−12.87mas/yr) (Gaia Collaboration et al. 2016, 2018). The results are shown in Figure **??**. In the same figures, we also marked the previous observations (Bailey et al. 2013; Wu et al. 2016; Lagrange et al. 2016; Daemgen et al. 2017) to evaluate if the background star was detectable or could contaminate the measurements in those observations.

Figure 3 demonstrates that HD106906b, due to its proper motion, has been approaching the background star over the years. The separation between these two object has shrinked from 1″.29 (2004, first imaging record) to 0″.87 (this study). In the study of (Bailey et al. 2013; Wu et al. 2016; Daemgen et al. 2017), the background star had separation of 0.95-1.05 to HD106906b. Given their separations in these studies, it is unclear if the background star contaminated those measurements. Considering the brightness contrast of the two object, in the worst case, the contamination of the background star to HD106906b's broadband photometry is on the order of 7.5% level.

4.4. *Spectral Energy Distribution*

Our observation provide the first 1.4μm water absorption band photometry for HD106906b. We include our photometry with the archived data from (Bailey et al. 2013; Kalas et al. 2015; Wu et al. 2016) to constrain the spectral egnergy distribution fitting for HD106906b.

4.5. *The disk around HD106906*

5. DISCUSSION

1. the variability
   TODO think about light curve analysis. what can be done. What extra information may lie in the data. Think about the constrain on inclination, or taken the possible correlation between modulation and variability amplitude and then use it to constrain the inclination

2. the limit on the inclination (see Vos et al. 2018)

3. SED for HD106906, further determine its spectral type
   This should be easy, collect all point
4. possible astrometry constrains (what about the distortion correction for WFC3)
   the measurement should be easy
5. limit on additional companions
   should be easy
6. assessment of modulation amplitude, are companions same as low surface gravity free floating object?

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