



Radial Velocity Precursor Work

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The background of the slide is a dark space scene. On the left, a large, dark, spherical planet is partially visible. In the center, a satellite or space station is shown in orbit, with various instruments and solar panels. The background is filled with stars and some faint, streaky light trails.

Four main categories

1. Orbital ephemeris refinement of known radial velocity (RV) planets for CGI

2. RV observations for CGI blind search targets

3. Efficient RV observing strategy for orbital ephemeris refinements

4. Methodology that optimizes exploration of the direct imaging (DI) discovery space

1. Orbital ephemeris refinement of known RV planets for CGI

- 14 known RV planetary systems selected as potential CGI targets
- Continuous observation on northern targets in collaboration with the California Planet Search team using Keck/HIRES and APF
- Significant improvement in orbital uncertainty

1. Orbital ephemeris refinement of known RV planets for CGI

Target	Old period (days)	New period (days)	Uncertainty Improvement (%)
HD 219134 h	2146 +/- 64	2198 +/- 17	73
HD 154345 b	3342 +/- 93	3253 +/- 20	78
14 Her b	1773.4 +/- 2.5	1768.84 +/- 0.93	63
47 UMa b	1078 +/- 2	1079.01 +/- 0.83	59
47 UMa c	2391 +/- 100	2329 +/- 22	78
47 UMa d	14002 +/- 5095	12663 +/- 1300	74
HD 190360 b	2915 +/- 29	2885.7 +/- 4.7	84
HD 217107 c	5178 +/- 74	5114 +/- 11	85
HD 134987 c	5000 +/- 400	5849 +/- 130	68
HD 192310 c	525.8 +/- 9.2	457.2 +/- 2.2	76

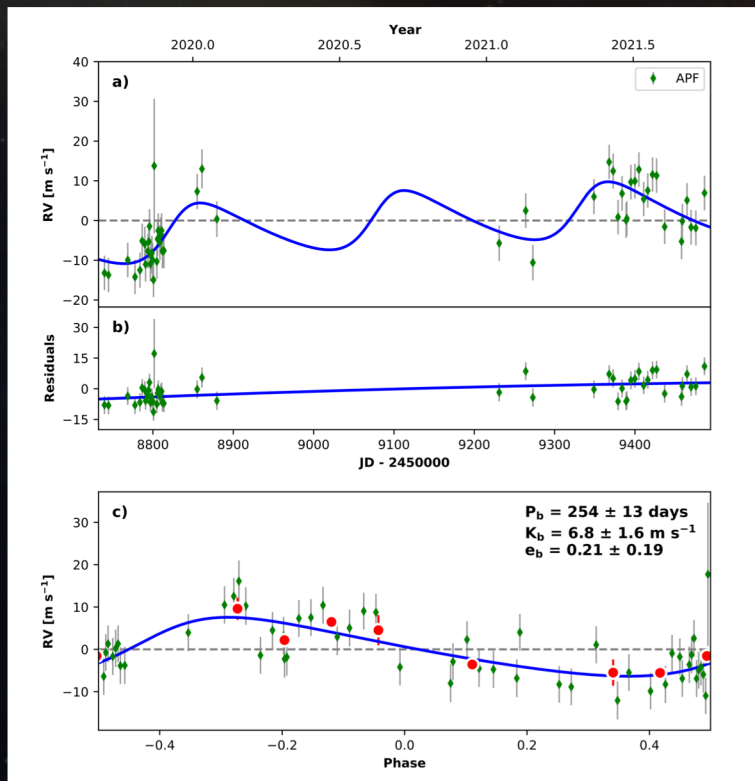
2. RV observations for CGI blind search targets

- Systems that have no known planetary presence yet
- Calculation based on likelihood of CGI discovering Neptune-sized planet or smaller (see Imaging Data Base presentation next)

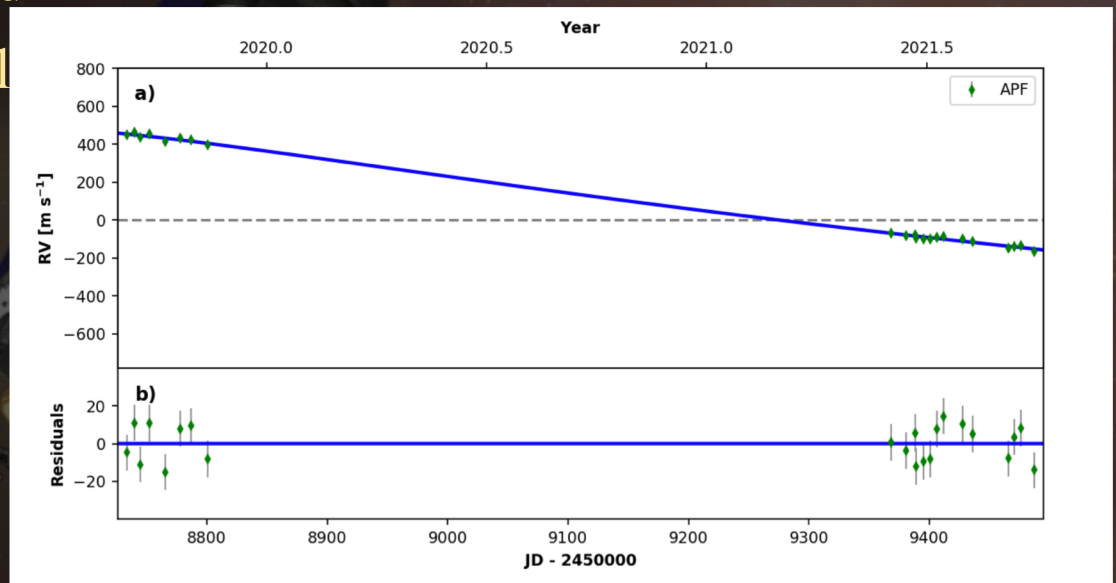
RV precursor search goal:

- Determine if there is a planetary signature for 14 systems from the complete list
- Estimate stellar jitter level for extreme precision RV
- Establish an RV baseline for future observations

2. RV observations for CGI blind search targets.



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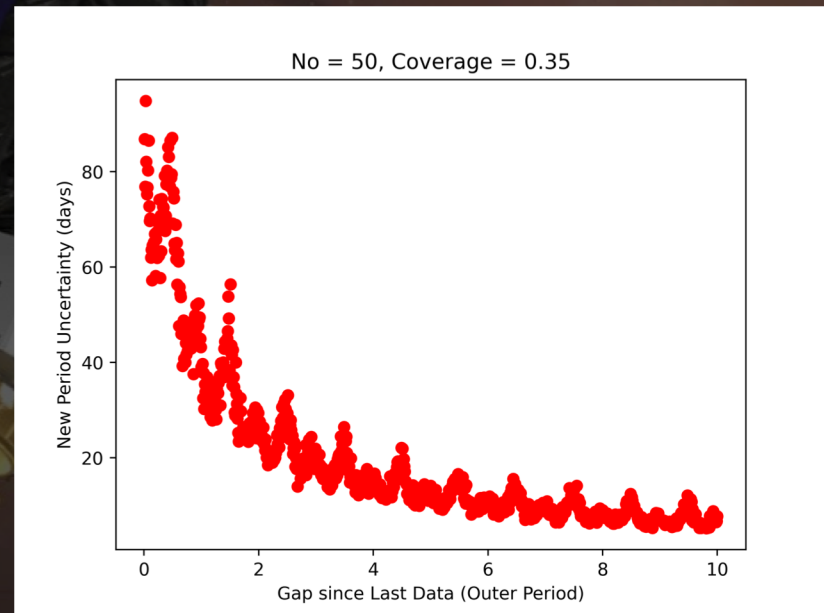
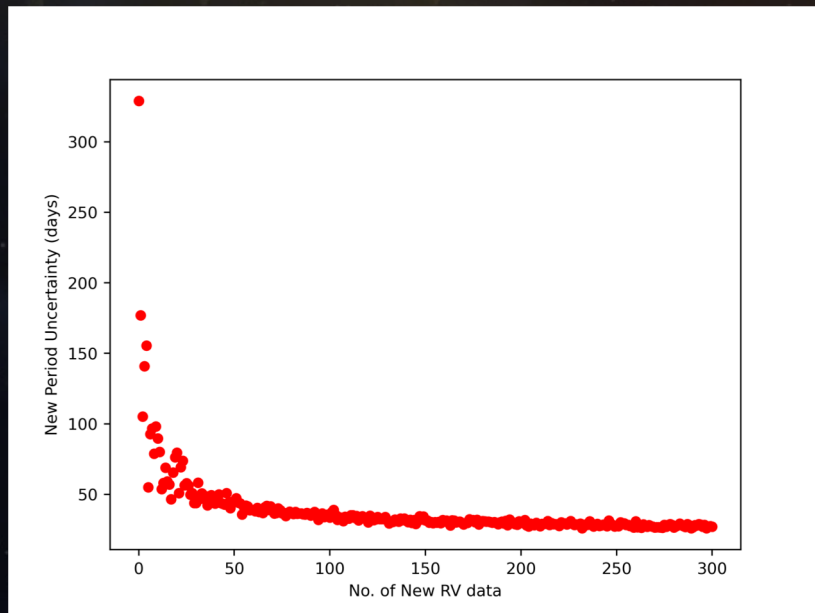


3. Efficient RV observing strategy for orbital ephemeris refinements

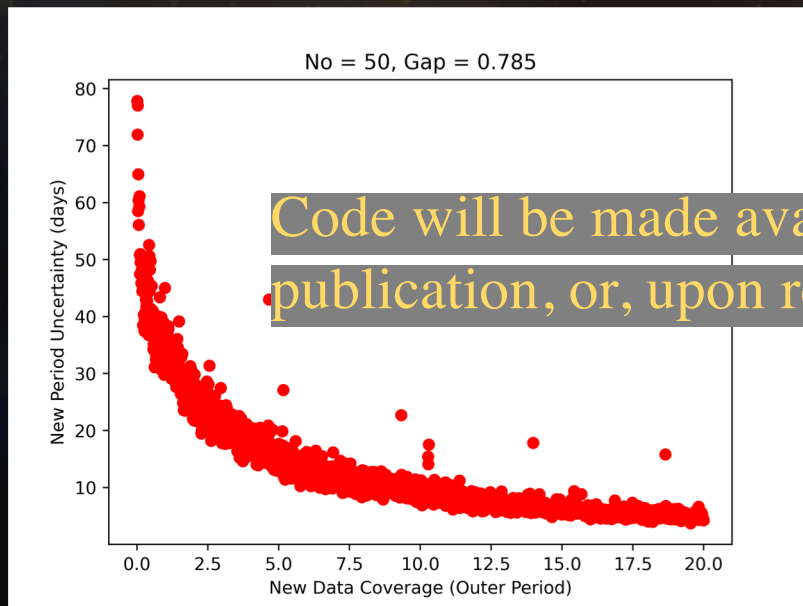
How to plan an efficient RV observing strategy to refine orbital ephemerides?

- Generate realistic synthetic RV data
- Test against four scenarios:
 - Number of future observations
 - Starting time of future observations
 - Phase coverage of future observations
 - RV precision of future observations

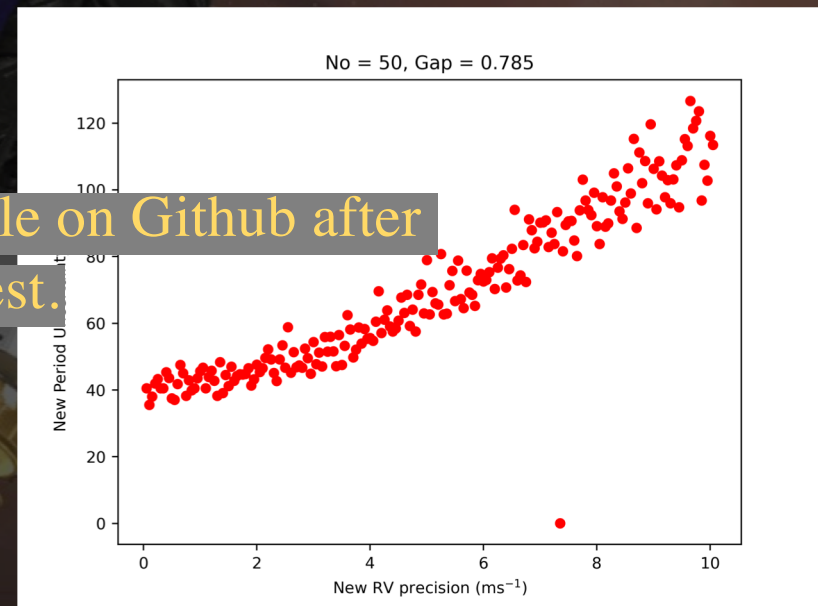
3. Efficient RV observing strategy for orbital ephemeris refinements



3. Efficient RV observing strategy for orbital ephemeris refinements



Code will be made available on Github after publication, or, upon request.

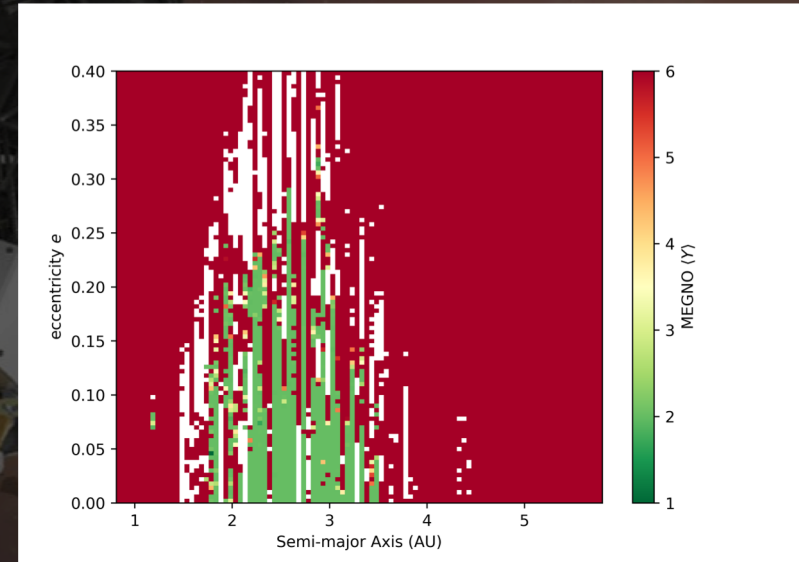
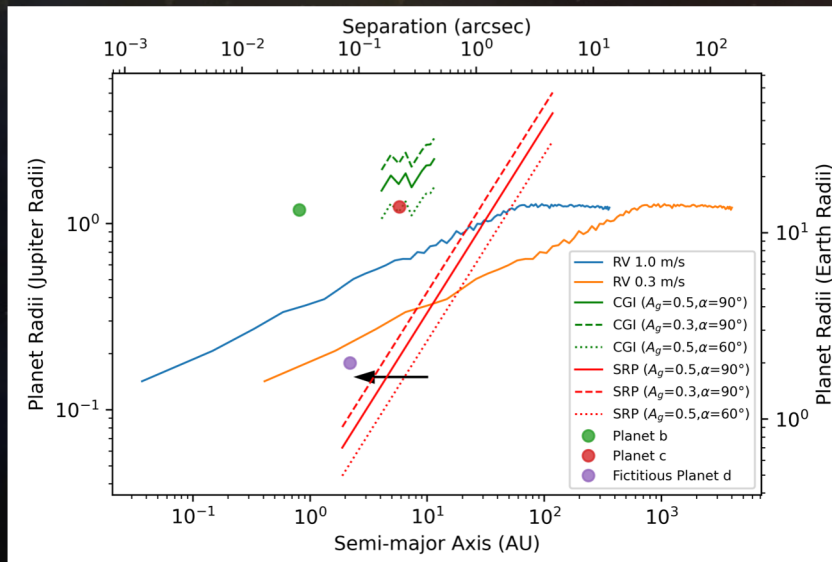


4. Methodology that optimizes exploration of the DI discovery space

Can future DI missions discover new planets within known multi-planetary systems, and if so, where and what kind of planets?

- RV & DI detection sensitivities
- Insert a fictitious planet
- Dynamical simulations
- Detectability/realistic imaging simulations

4. Methodology that optimizes exploration of the DI discovery space



Details see Li et al. 2021, *AJ*, 162, 9 (doi:10.3847/1538-3881/abf831)

Takeaways

- Ongoing RV observations have greatly refined orbits of CGI known RV candidates
- A separate RV program may inform planet presence for CGI blind search candidates
- An efficient RV observing strategy for orbital ephemeris refinement is under development
- Guideline developed to optimize the exploration of DI discovery space