

Hot Jupiter - Cold Jupiter

A complex sibling relation

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Background

The discovery of thousands of planetary systems in the last 30 years have challenged our theories about how they form. After decades trying to explain **how the Solar System came to be the way it is**, the diversity of different systems have made the scientific community struggle. Our research focuses on a particular planetary architecture that involves 2 giant planets in **weird orbits**

look for the other planet 4 posters to the right one planet here

Motivation

Planetary juggling
Hot+cold Jupiter planetary systems are thought to emerge from past turbulent interactions involving 3 planets. One planet gets ejected, another is drawn into a close orbit (**hot Jupiter**), and the third settles into an eccentric, distant orbit (**cold Jupiter**). While these systems are infrequent, their scarcity might be influenced by detection biases.

To answer this question is necessary to detect long period planets (Jupiter-like). These planets are difficult to detect because they require many years of observation to become evident.

So, how frequent really are these kinds of planetary systems?



Methods

Your giant planet in 3 simple steps!

Generate fake planetary radial velocity data for those systems with a hot Jupiter for different cadences, different durations and different instrument accuracies

Inject and recover planets (RVSearch)

See how the detection limit improves as the cadence, duration and accuracy increase

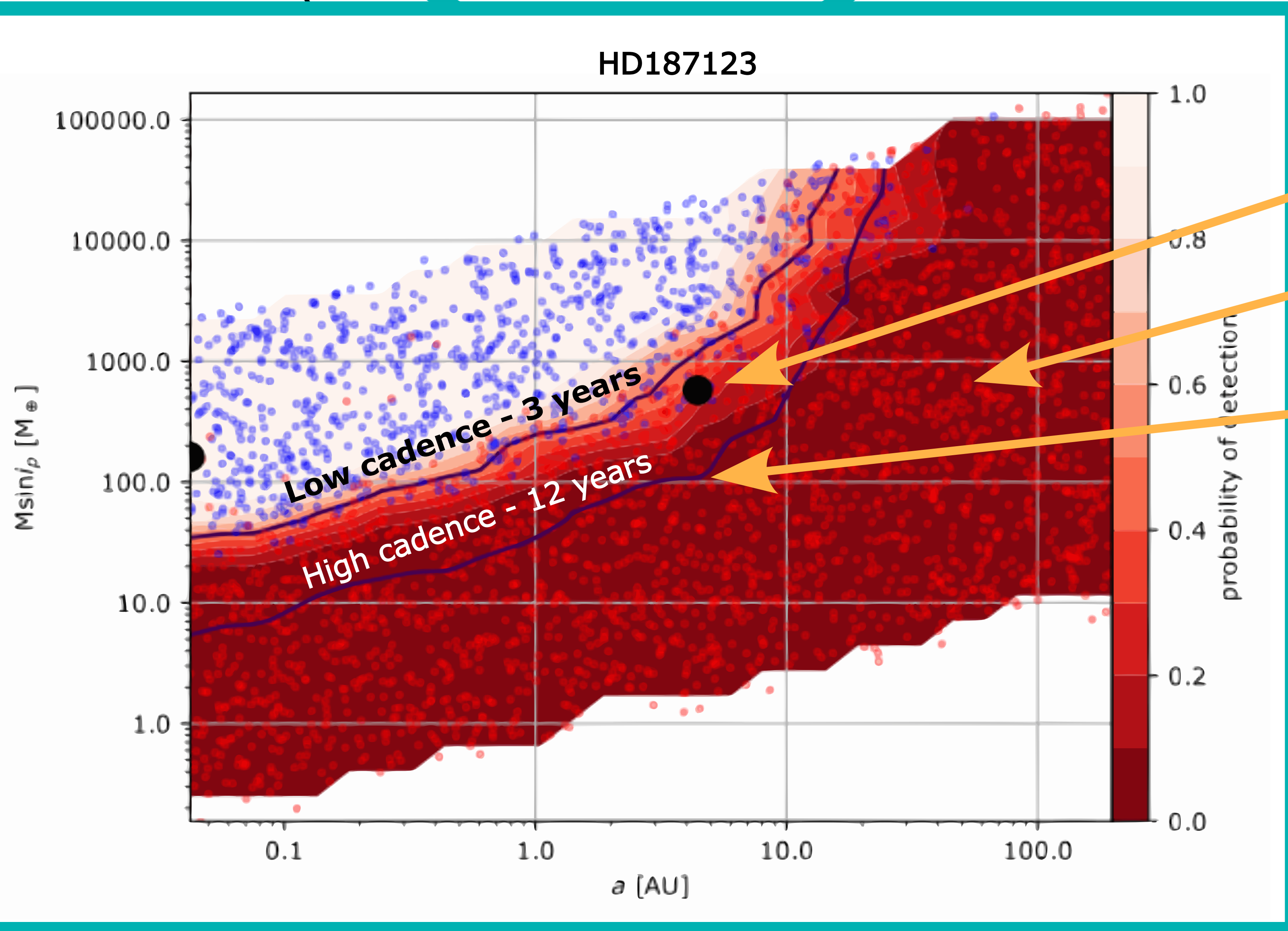
Understanding this plot

Big black dots: the confirmed planets for this system

Small dots: injected planets (synthetic signal). The blue ones were recovered (detected), the red ones were not.

Purple line: boundary between blue and red zone (50% probability of recovery).

If the planet you want to detect (e.g.: $a > 4$ au and $M > 300 M_{\oplus}$ Jupiter-like planet, like the one in this plot) is in the red zone, **you have to do something...**



What to do

What if my planet is in the red zone?
You have to move the purple line as much as you can to the bottom right of the plot

How to do it

Increase the cadence (observe the target more frequently)

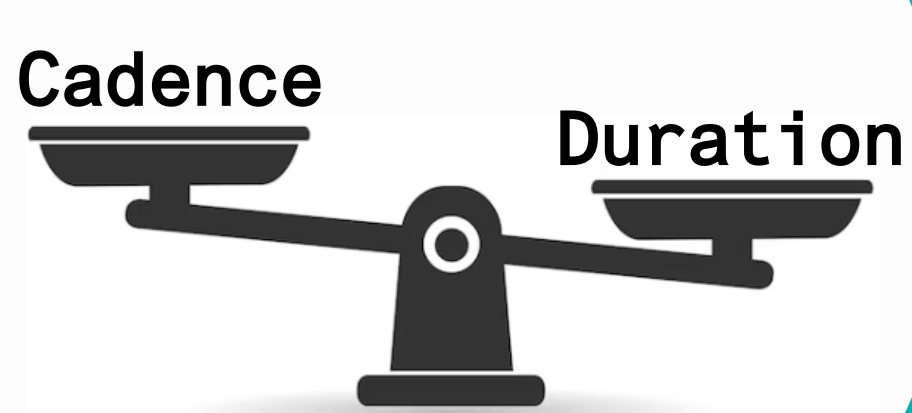
Increase the duration (observe the target for more years)

Use a powerful, more accurate telescope



Results

Although not all our results behave exactly the same, in general terms we can say that duration does more to move the purple line than cadence (to detect Jupiter-like planets)



Conclusion

Time to use big telescopes is hard to obtain. To do the most with small telescopes depends on a clever strategy of use. Our research tries to determine the best way to take advantage of small telescopes in order to find cold Jupiters

Want to know more:

Centre for Astrophysics - UniSQ
<https://astrophysics.usq.edu.au/>