The Pan-Pacific Planet Search: Exploring new frontiers

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Outline

- Pan-Pacific Planet Search
  - A southern hemisphere search for planets orbiting massive evolved stars
  - Latest results and candidates

- Intermediate-mass stars: Where are the short-period planets?
  - A “Monster Run” approach
How does planet formation depend on host-star mass?

Motivations:

- Most planet-search target stars are 0.7-1.3 solar masses.
- These sun-like stars are best for high-precision Doppler velocity work.
- Many spectral lines, slow rotation.

Johnson (2007)
For high-mass stars on the main sequence, we cannot get precision velocities because:
1) High temperatures = fewer spectral lines.
2) Rapid rotation = lines are broadened.

When the star evolves into a subgiant, its photosphere expands and cools, solving both of these problems!
High-mass stars seem to be more likely to have planets.

But the sample size is small.

We need to target more of these massive stars to confirm this trend.

Recent results show that ~20% of stars $M>1.5 \, M_{\text{sun}}$ have a planet.
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AAT observations and funding proposals
Rob Wittenmyer, Chris Tinney

Stellar abundance analysis
Liang Wang, Gang Zhao

Doppler code and McDonald observations
Michael Endl

Keck observations of promising candidates
John Johnson
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Single-epoch RV precision 4-6 m/s

Tau Ceti, the "gold standard" for velocity stability
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7 CMa b: First planet discovery!
$P = 763$ days, 2.6 Jupiter masses
Some long-period candidates needing more data to complete orbits.
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Candidate 2-planet system
P1 = 1091 days, P2 = 52 days
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Short-period candidate:

P = 105 days, 1.6 Jupiter masses

Now being observed at Keck to confirm
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Short-period candidate: P = 47 days

AAT data through 2012 May
2012 June observations consistent with 47 day period

RMS about fit: 5.6 m/s

Phase plot
Where are the short-period planets?

Only 6 with $P<50$ days

Is this a real deficit, or due to observational selection effects?

e.g. O’Toole et al. 2009, Wittenmyer et al. 2010, 2011a, 2011b
A “Monster Run” approach: Choose a small number of stars, observe every one on every night, for 40+ consecutive nights!

This has resulted in AAPS discovery of 5 low-mass planets.

No one has tried this for massive stars! We will be the first: Shandong University 1-metre telescope with new high-resolution spectrograph.

Plan: Choose ~30 bright giant stars, Observe for 40-50 consecutive nights.

Aim: Detect or exclude all planets with a<0.3 AU, M>0.5 Jupiter mass.

61 Vir planets: Vogt et al. (2010)
We are expanding Australian leadership in exoplanetary science with new projects that explore new frontiers in parameter space.

A collaborative survey of evolved stars is delivering results which will provide valuable statistics on planetary systems orbiting high-mass stars.

A further 3 years of data needed to maximise our return on effort.

We plan the first dedicated survey for short-period planets orbiting massive stars.
Discovery history of Johnson’s Northern hemisphere program suggests that discovery rate “explodes” between Years 3-6.