The Magnetic Fields of Planet-Hosting Stars

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Image Credit: Karen Teramura/University of Hawaii Institute for Astronomy
Me...

- PhD Student, University of Southern Queensland
- Supervisors Stephen Marsden, Brad Carter, Rim Fares
- Magnetic fields of planet hosting stars
- Tau Boo, Tau Boo, Tau Boo.....

- All figures/pictures by the author unless different image credit shown.
A BCool magnetic snapshot survey of solar-type stars

Planet Hosting Stars Survey

- 19 Stars

- Target list chosen:
  - Planet hosting stars
  - Approximate BCool criteria:
    - $5100K < T_{\text{eff}} < 6300K$
    - $M_\star < 1.5 M_\odot$
  - Visible at TBL ($V < 9$; decl. $> -10^\circ$)

- Paper in Preparation now

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Measured longitudinal magnetic field, $B_\ell$

$$B_\ell = -2.14 \times 10^{11} \frac{\int vV(v)dv}{\lambda_0 g_0 c \int [I_c - I(v)]dv}$$

(Donati et al 1997, Mathys, 1989)

Determined if magnetic detection (FAP < 10^{-5} for definite)
Planet Hosting Stars Survey

- Measured radial velocity
- Stellar activity proxies
  - Ca II H &K (S-Index)
  - Ca II IRT
  - Hα
- Derived:
  - \( \log(R'_{HK}) \)
  - \( \log(P_{\text{rot}}/\tau) \), Chromospheric Age
HR Diagram
$\log(v \sin i)$ vs $T_{\text{eff}}$
$\log(|B_\ell|)$ vs $T_{\text{eff}}$
$\log(|B_l|) \text{ vs } \log(R'_{HK})$
\[ \log(|B_l|) \text{ vs } \log(v \sin i) \]
\( \log(|B|) \) vs Age/Chromospheric Age

![Graph showing \( \log(|B|) \) vs Age/Chromospheric Age.](image)
Summary

- Planet hosts (especially discovered using RV) usually older, therefore less active - sample bias

- Lower detection rate than wider BCool survey

- Same relationships with rotation, age, Rossby number, etc as Marsden et. al. 2014

- No indication of SPI, although most sample stars are not hot Jupiters (and therefore most likely due to tides/magnetic reconnection/whatever). More targets needed - Claire Mouton CFHT

- Mengel, M. W. et. al. (in prep)
(and even more!) τ Boötis

τ Boötis

- F7V
- v sin i ~ 15.9 km/s
- Large planet (Mass 6 times Jupiter) at 0.049 AU
  - Orbital period/Rotational period of 3.31d
- Age ~ 1 Gyr
- Observed regularly since 2007
- My work on observations since 2011
- Some weak indications of SPI (not entirely convincing)
τBoötis

- Spectropolarimetric observations taken at the Télescope Bernard Lyot at the Observatoire Midi-Pyrenees (2013-2015) using NARVAL
- 2011 observation taken using HARPSpol

τ Boötis

- 2-year cycle of polarity reversals but this would be a reversal per 3 Ca II HK cycles (~117d)
Rapid Evolution after Reversal

\[ B_{\text{mod}}(\text{G}) \]

\[ \tau \text{ Boo Magnetic Field Configuration Apr 2013-May 2015} \]

\[ \% \text{ Tor.}, \% \text{ Axis. Pol.}, \% \text{ Pol. } \ell \leq 2 \]
Magnetic Cycles of τ Boötis

- 3 cycles of “magnetic energy” per polarity reversal
- MHD simulations (Augustson et al, 2013) suggest this may be correct, in which case we confirm this behaviour
  - The Sun does not behave this way
  - Potentially a different dynamo process?
    - Age/Rotation speed/Spectral Type?
    - Planetary influence?

- Telescope time for 2016 to confirm 3:1 periodicity
- Potential biases based on time of observation?
- Mengel, M. W. et. al. (submitted MNRAS)
Thank you

- Questions

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