New view on exoplanet transits: describing the granulation pattern with three-dimensional hydrodynamical simulations of stellar convection

Andrea Chiavassa (Observatoire de la Cote d’Azur, Nice)

1. 3D hydrodynamical simulations of stellar photosphere

2. Center-to-limb computation of monochromatic emerging intensity

3. Synthetic stellar granulation images varying with time for all the HR diagram
New view on exoplanet transits: describing the granulation pattern with three-dimensional hydrodynamical simulations of stellar convection
Andrea Chiavassa (Observatoire de la Cote d’Azur, Nice)

1. The granulation of solar/dwarf type star affects the transit depth with an intrinsic noise

2. The resulting planetary radius incertitude is wavelength dependent and measurable with 3D hydrodynamical simulations of stellar convection
Precise activity measurements from high-resolution spectra

We use least-squares deconvolution and Gaussian processes to obtain the disc-averaged magnetic field strength as proxy for activity-driven radial velocity variations.
Magnetic Fields and Circumstellar Environment around Planet-Hosting Stars

J.D. Alvarado-Gómez¹ • G. Hussain¹ • O. Cohen² • J. Drake² • J. Grunhut¹ • C. Garraffo²

¹European Southern Observatory, Garching, Germany
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Planet-Hosting Systems

<table>
<thead>
<tr>
<th>Name</th>
<th>Spectral Type</th>
<th>T$_{\text{EFF}}$ [K]</th>
<th>R$<em>*$/R$</em>\odot$</th>
<th>M$<em>*$/M$</em>\odot$</th>
<th>P$_{\text{ROT}}$/[d]</th>
<th>Activity</th>
<th>M$<em>*\sin(i)$ [M$</em>{\text{JUP}}$]</th>
<th>a [AU]</th>
</tr>
</thead>
<tbody>
<tr>
<td>HD 1237</td>
<td>G8V</td>
<td>5572</td>
<td>0.86</td>
<td>1.00</td>
<td>7.00</td>
<td>− 4.38</td>
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<tr>
<td>HD 22049</td>
<td>K2V</td>
<td>5146</td>
<td>0.74</td>
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<td>11.68</td>
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<td>HD 147513</td>
<td>G5V</td>
<td>5930</td>
<td>0.98</td>
<td>1.07</td>
<td>10.00</td>
<td>− 4.64</td>
<td>28.92</td>
<td>1.21</td>
</tr>
</tbody>
</table>

Large-Scale Magnetic Field (ZDI maps)

Contact
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3D MHD Numerical Simulations

HD 1237  HD 22049  HD 147513

Circumstellar Environment

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The Replicable High-resolution Exoplanet and Asteroseismology (RHEA) spectrograph


- Optical Single-mode fibre-fed spectrograph
- Double-pass echelle design
- R~75,000 at 550nm
- Stable to ~1 m/s RV precision measurements
- ~US$20,000 per unit

- Long-baseline radial velocity monitoring of bright stars with small telescopes
- Currently targeting giant stars looking for Jupiter sized planets
- Asteroseismology = better mass estimates
Imperfect (= Low-contrast)

Pre-Coronagraph (LPC) for additional contrast

Low-contrast Pre-Coronagraph (LPC) method submitted

LPC is used in four-stage configuration.

- Needs two operation procedures.

Features:
- LPC provides Synergy Extinction of Dark Hole
- when the contrast of the main coronagraph is limited by some reason.

Pathways 2015
Bern July 12-17

J. Nishikawa (NAOJ), M. Oya
N. Murakami, M. Tamura
T. Kurokawa, Y. Tanaka
Imperfect (= Low-contrast)

Pre-Coronagraph (LPC) for additional contrast

- Experimental setup is under construction.
  - DM1: 12x12 BMC
  - Pre-Coronagraph: Achromatic Vector Vortex Coronagraph *, **
  - DM2: 12x12 BMC
  - Main Coronagraph: Achromatic Vector Vortex Coronagraph *
    * AVVC = Polarizer + QWP + Concentric HWP + QWP + Analyzer (Murakami 2013)
    ** Low-contrast condition is obtained by rotating the Polarizer
Rotation Periods, Activity-Induced RV Signals, and Detection of Habitable Planets

Jonay I. González-Hernández, Alejandro Suárez-Mascareño, Rafael Rebolo & Massimiliano Esposito

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\( P_{\text{ROT}} \) vs \( \log R'_{\text{HK}} \)


\( A_{\text{RV}} \) vs \( \log R'_{\text{HK}} \)

Suárez-Mascareño et al. (2015, in preparation)
Photo of participants in La Silla

Thank you

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Rafael Rebolo-López – Departamento de Astrofísica