

February 3rd Know Thy Star

# Shining Light on Granulation: Using Solar Eclipses to Advance Radial Velocity Models

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**Granules**: individual magnetoconvective cells comprised of hot upwelling plasma

**Intergranular Lanes**: rings of cooler, denser downwelling plasma surrounding granules



#### **Granulation Signatures:**

- 1. Broadening of lines
- 2. Asymmetry of lines
- 3. Convective blueshift of lines



#### **GRASS II:** Simulations of Potential Granulation Noise Mitigation Methods

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### **GRASS** Procedure:

- Input: measured line bisectors and widths from 22 LARS lines
- Simulation of spatially-resolved stellar disk
- 3. Spatial integration of the model stellar disk



	October 14th, 2023	April 8th, 2024
% Coverage	76%	69%
Start Local Time (Airmass)	8:11AM (2.86)	11:03AM (1.38)
End Local Time (Airmass)	10:05AM (1.33)	12:34PM (1.10)

## **NEID** Observations

- Highly stabilized spectrometer
- High resolution (R~100,000)
- Optical (380 930 nm)
- Baseline RV measurement precision of 27.5 centimeters per second



## The Role of A Solar Eclipse

1. Sun-as-a-star Observations



## The Role of A Solar Eclipse

- 2. The Rossiter Mclaughlin (RM) Effect:
  - RM curve shape influenced by convective blueshift (CB)
  - CB crucial when modeling Solar RVs during an eclipse



#### 5 2 3 4 6

#### (sub)grid solar surface

Grid

Orientation compute line of sights from

**Eclipse** determine eclipsed cells

observer to solar cells

determine differential rotation, differential extinction, and limb

darkening

Astrophysics

GRASS

simulate granulation driven spectra

compute radial velocity

RV





# Magnetic origin of the discrepancy between stellar limb-darkening models and observations

Nadiia M. Kostogryz <sup>ICI</sup>, <u>Alexander I. Shapiro</u>, <u>Veronika Witzke</u>, <u>Robert H. Cameron</u>, <u>Laurent Gizon</u>, <u>Natalie A. Krivova</u>, <u>Hans-G. Ludwig</u>, <u>Pierre F. L. Maxted</u>, <u>Sara Seager</u>, <u>Sami K. Solanki</u> & <u>Jeff Valenti</u> <u>Nature Astronomy</u> **8**, 929–937 (2024) | <u>Cite this article</u>