

# Physics 681: Solar Physics and Instrumentation – Lecture 16

*Carsten Denker*

*NJIT* Physics Department  
Center for Solar–Terrestrial Research



## Granulation

- ❑ Cellular pattern covering the entire Sun
- ❑ Granules (bright isolated elements) and intergranular lanes (dark background)
- ❑ Bright granules: upward-moving (blue-shift), hot parcels of gas
- ❑ Intergranular lanes: downward-moving (red-shift), cooler material
- ❑ Intensity contrast (Planck spectrum)

$$\delta I / I = 4\delta T / T \quad \text{and} \quad C = 2 \frac{I_{\max} - I_{\min}}{I_{\max} + I_{\min}}$$

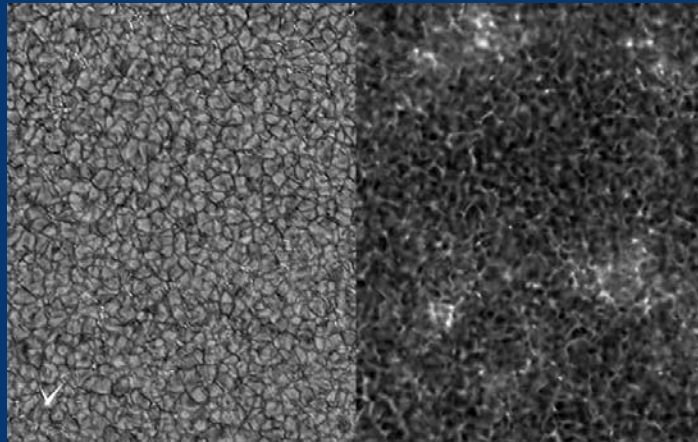
- ❑ Contrast in excess of 10%
- ❑ Seeing attenuated high-frequency part of the power spectrum  $\Leftrightarrow$  diminishing the contrast of small-scale features
- ❑ Solar eclipse are used to measure the telescope MTF
- ❑ Image restoration
- ❑ Power spectrum analysis



October 27, 2005

Center for Solar-Terrestrial Research

# Granulation – G-Band & Ca II K

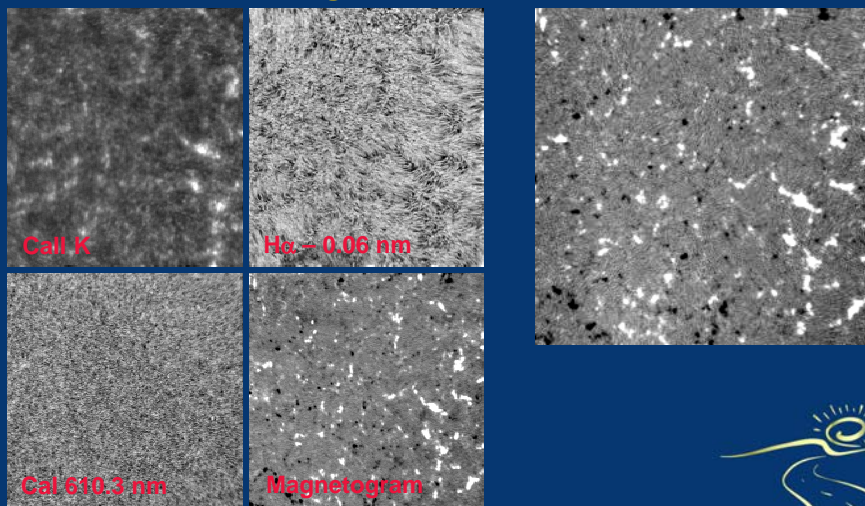


October 27, 2005

Center for Solar-Terrestrial Research



# Dynamics of Quiet Sun Magnetic Fields

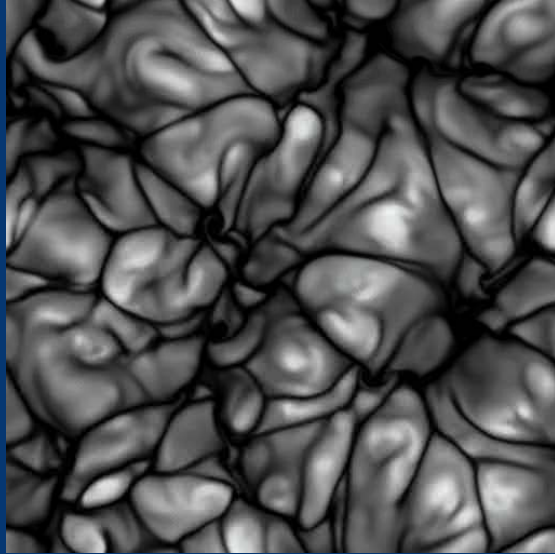


October 27, 2005

Center for Solar-Terrestrial Research



# Model of Convection



3D animation of convection. The animation shows temperature fluctuations in a layer of unstable, turbulent gas.  
*(Courtesy of Andrea Malagoli, University of Chicago)*



October 27, 2005

Center for Solar-Terrestrial Research

# Size and Lifetime

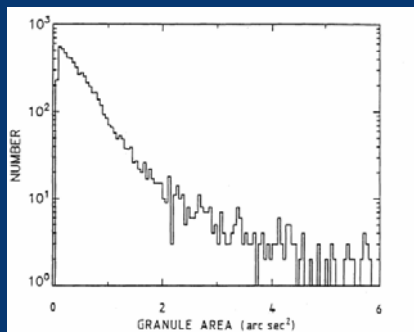


Fig. 3. Histogram of granule areas derived from the string analysis (total of 6298 strings).

Brandt et al. (1991)

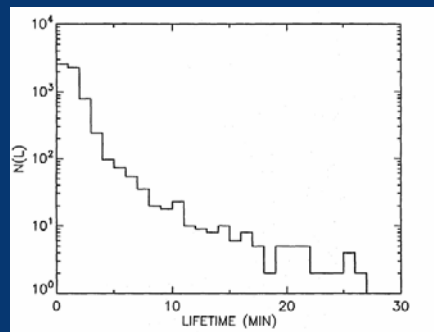


Fig. 5. Distribution of granule lifetimes (6298 string samples) as determined from the string analysis.



October 27, 2005

Center for Solar-Terrestrial Research

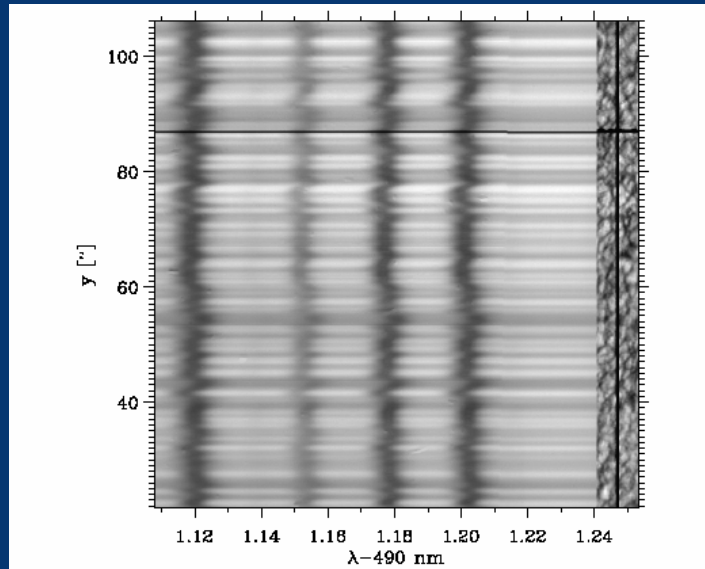


Fig. 1. Part of our best spectrogram 9954.Sp66, in the wavelength region  $\lambda$ : 491.11–491.24 nm with the corresponding slit-jaw white light picture attached at the right border. The dark line parallel to the x-axis, at 87 arcsec on the y-axis, is due to a calibration hair across the spectrograph slit. The dark line parallel to the y-axis corresponds to the spectrograph slit.

Nesis et al. (2001)



October 27, 2005

Center for Solar-Terrestrial Research

## Power Spectrum

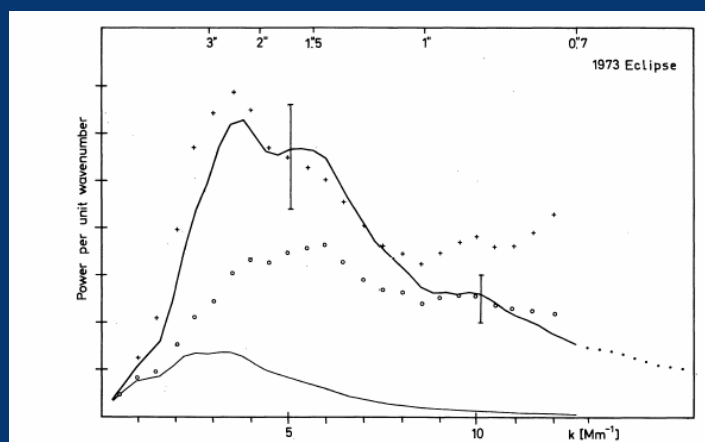


Fig. 5. "Observed" and corrected powerspectrum. Symbols are the same as in Fig. 4. The error bars give the 80% confidence limit

Deubner & Mattig (1975)



October 27, 2005

Center for Solar-Terrestrial Research

# Velocity Distribution Functions

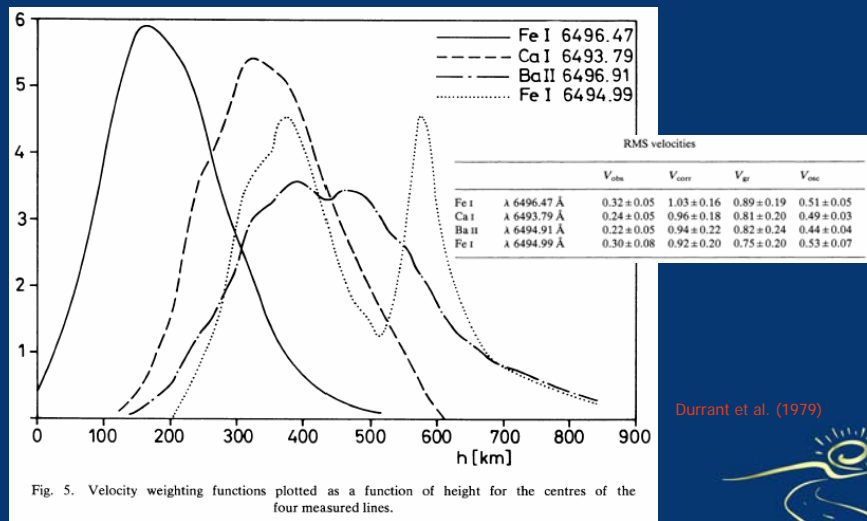


Fig. 5. Velocity weighting functions plotted as a function of height for the centres of the four measured lines.

Durrant et al. (1979)



October 27, 2005

Center for Solar-Terrestrial Research