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IBIS Observations of Quiet Sun Photosphere - Velocity Structure from Fe I 7090.4 Å

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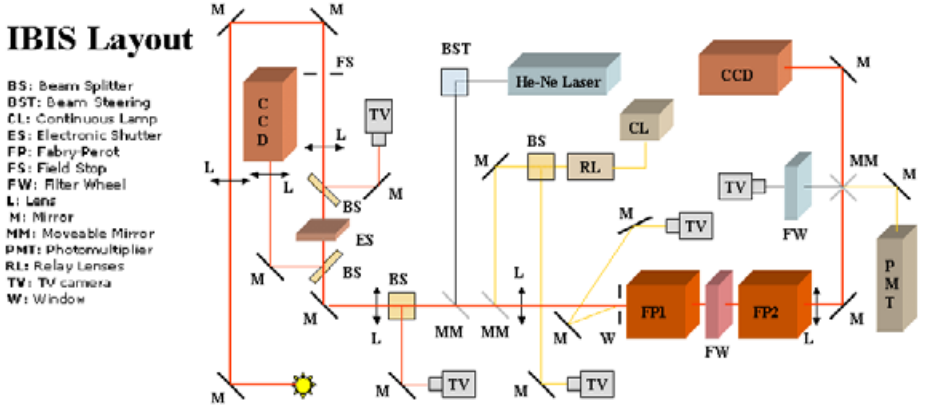
Abstract. In our contribution we introduce the new Interferometric BIdimensional Spectrometer (IBIS) and present the first results on bisector velocities of two dimensional spectral scans in FeI 7090.4 Å comparing granules and intergranular regions.

Motivation The comparision of spatially resolved solar lines with the results of simulations is a major task, that is complicated by several factors: The need to obtain observations of sufficient spectral purity, combined with the high spatial resolution necessary to resolve the small scales present in the computations, short acquisition times to avoid the evolution of the observed solar structures, an extended field of view to properly distinguish surface structures, and spectral stability for long sequences of data to evaluate the effects of oscillations and obtain proper time-averages.

The new IBIS (Interferometric BIdimensional Spectrometer) instrument, installed at the 76 cm Dunn Solar Telescope, Sacramento Peak Observatory, and fed with an adaptive optics corrected beam, is capable of satisfying these constraints in producing data with highest resolution, regarding space, time and wavelengths.

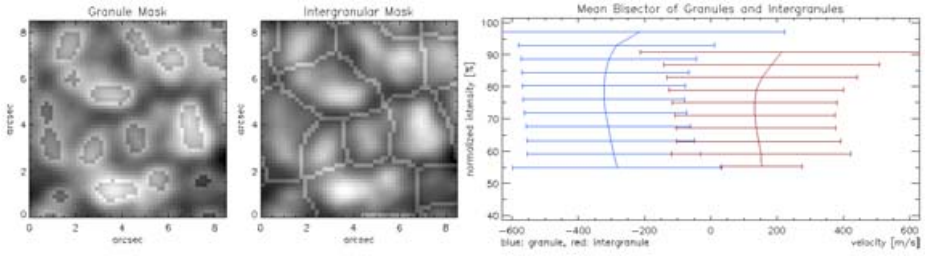


IBIS Characteristics IBIS provides a useful wavelength range of 5800 - 8600 Å, with spectral channels in Na D1 5896 Å, Fe I 6302 Å, Fe I 7090 Å, Fe II 7224 Å and Ca II 8542 Å (2.0 Å channel widths in 5800 - 7500 Å, 3.5 Å in 7500 - 8600 Å). The spectral resolving power $\lambda/\Delta\lambda$ equals 212000 - 274000. The maximum radial wavelength shift is 60 - 90 mÅ, the wavelength drifts less than 10 m/s in 10 h. Parasitic light is 2.4 - 0.5 %. The field of view measures 80" in diameter with an image scale of 0.085" per pixel. The peak transparency is 15 - 20 % and the transmission profile has a FWHM of 20 - 40 mÅ. Exposure times are 10 - 100 ms, while 20 ms are needed for wavelength tuning. The acquisition rate is 4 frames/s with 512×512 pixels, or 2.5 frames/s with 1024×1024 pixels. In October 2004 a polarimeter will be installed at IBIS. See *www.arcetri.astro.it/science/solare/IBIS*.

Data Acquisition The data shown here stem from the first run of IBIS in June 2003. They show quiet sun regions in Fe I 7090.4 Å , a magnetically insensitive line (g=0) with a core formation height of 120 km. They consist of a time series of 60 scans (32 min.) at disc center, of which the best one was chosen. The wavelengths stepwidth is 26 mÅ , covering a range of 0.806 Å . The original image scale of 0.085″ per pixel (1024×1024 px) was binned by a factor of 2 after the acquisition.

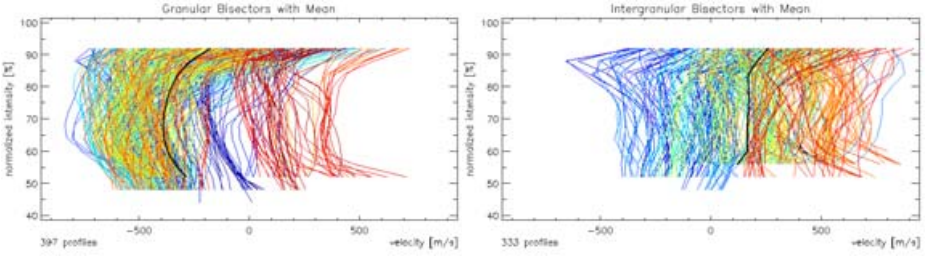
We present our first attempt to derive spatially resolved parameters of photospheric dynamics. The final aim of our work is a comparison with results of 3D hydrodynamical simulations of the solar surface convection, such as those described in Stein & Nordlund (1998) and Asplund et al. (2000).

Granular and Intergranular Bisector Granular and intergranular masks were defined with the skeleton algorithm introduced by Berrilli et al. (1998). It uses a varying threshold in a box of ˜2" to obtain the bright granular pixels. Then the intergranular mask is calculated as the skeleton of the intermediate space, see Florio & Berrilli (1998).



Applying these masks to a 40″×40″ field of view, we first derive an averaged profile for granular and intergranular pixels, then calculate their bisectors. Even if small differences can be seen, the shapes of the granular and intergranular bisector resemble each other, unlike the ones found by Hanslmeier et al. (2000). The errorbars indicate the 1-σ range of profile variation.

Single Bisectors for 8"x8" Area These bisector profiles, each corresponding to a single pixel in the above shown masks, demonstrate the broad variation of profile shapes, both for granules and intergranules. Hence it is possible to find straight or even inverted bisectors in restricted areas, as done by Maltagliati & Righini (2003).



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References

Asplund, M., Nordlund, A., Trampedach, R., Allende Prieto, C., Stein, R. 2000, A&A **359**, 729
Berrilli, F., Florio, A., Ermolli, I. 1998, Solar Phys. **180**, 29
Florio, A., Berrilli, F. 1998, A&A **69**, 655
Hanslmeier, A., et al. 2000, A&A **356**, 308
Maltagliati, L., Righini, A. 2003, Memorie della Societa Astronomica Italiana **74**, 599
Stein, R., Nordlund, A. 1998, Astrophys. Journal **499**, 914