Comparison of different populations of granular features in the solar photosphere

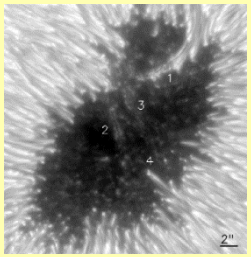
M. Falco[1], G. Puglisi[2], S. L. Guglielmino[3], P. Romano[1], I. Ermolli[4], F. Zuccarello[3]

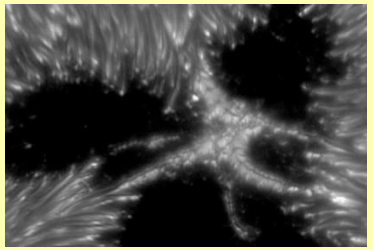
[1]INAF OACt – Osservatorio Astrofisico di Catania – Via S. Sofia 78, Catania, I-95123, Italy
[2]Dipartimento di Matematica e Informatica, Università di Cagliari, Via Ospedale 72, Cagliari, Italy
[3]Università degli Studi di Catania – Dipartimento di Fisica e Astronomia, Sez. Astrofisica – Via S. Sofia 78, Catania, I-95123, Italy
[4]INAF OAR – Osservatorio Astronomico di Roma – Via Frascati 33, Monte Porzio Catone (RM), I-00040, Italy

Light Bridges

Light Bridges (LBs): bright and elongated structure delineating the borders between dark umbral fragments.

- Observed during:
  - the complex assembly process of a sunspot
  - the decay phase of a sunspot
- Origin:
  - field-free intrusions of plasma in the umbral magnetic field
  - signatures of magneto-convection
- Morphological classification:
  - Faint light bridge: located inside umbral core
  - Strong light bridge: separating umbral core

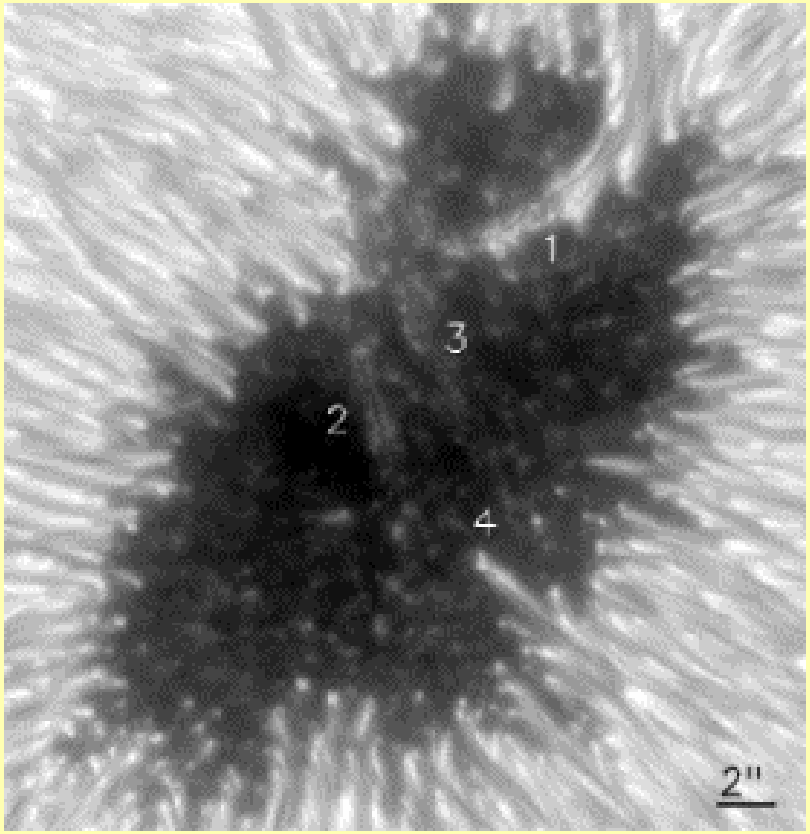




Umbral dots

Umbral dots (UDs): small and isolated bright features often observed in the umbra

UDs are convective phenomena and observation are important in order to know whether or not the properties depend on umbral magnetic field strenght



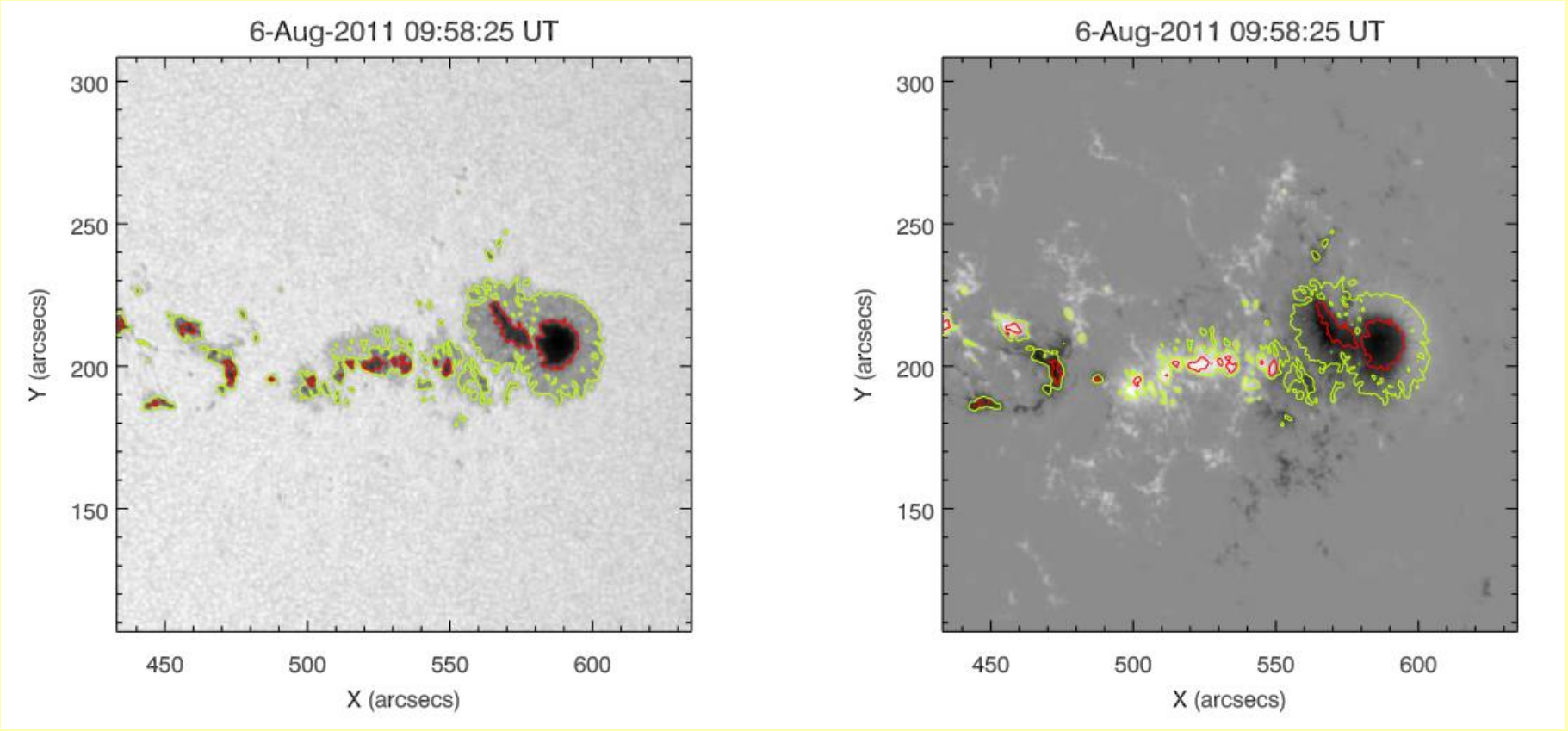
Sobotka, M. & Puschmann, K. G. 2009, A&A

We need high temporal, spatial and spectral resolution data

Observational Campaign data-set

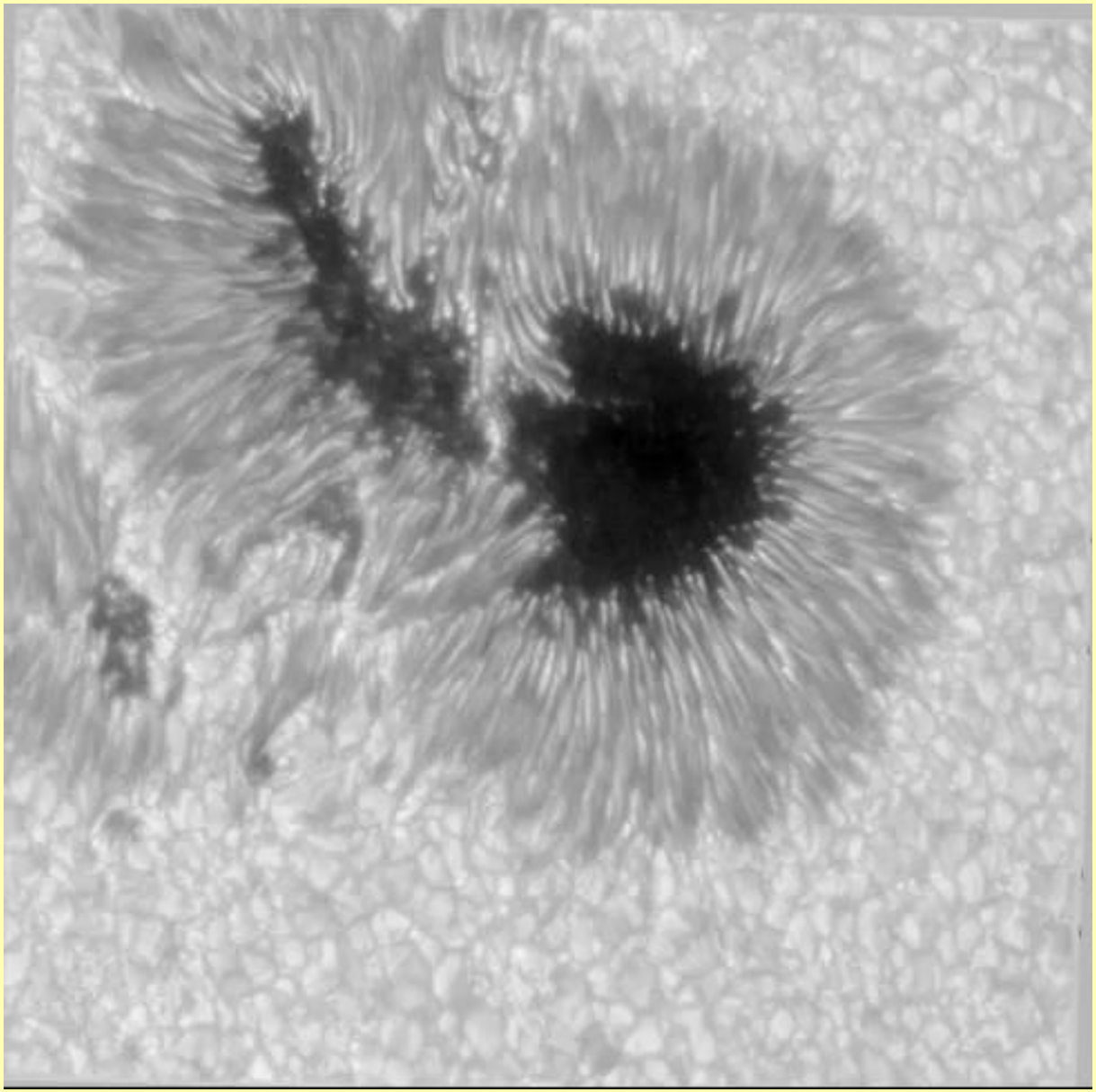
Instrument	Wavelength	Spectral points	Pixel size (arcsec)	Time Resolution (sec)	Observation days
SST	Fe I 5576 Å	20	0.0592	28	6 - 19 Aug 2011
	Fe I pair 6302 Å	15	0.0589	28	6 - 19 Aug 2011
	Ca II H core	1	0.0338	9	6 - 19 Aug 2011
DOT	G band	-	0.071	30	7 - 19 Aug 2011
	Hα	7	0.109	30	
Hinode	G band	1	0.108		6 Aug 2011
	Ca II H	1	0.108		
	Fe I pair 6302 Å (SP)	140	0.32	5 maps in 3 h	
SDO	HMI continuum	-	0.5	720	2 - 7 Aug 2011

NOAA 11263

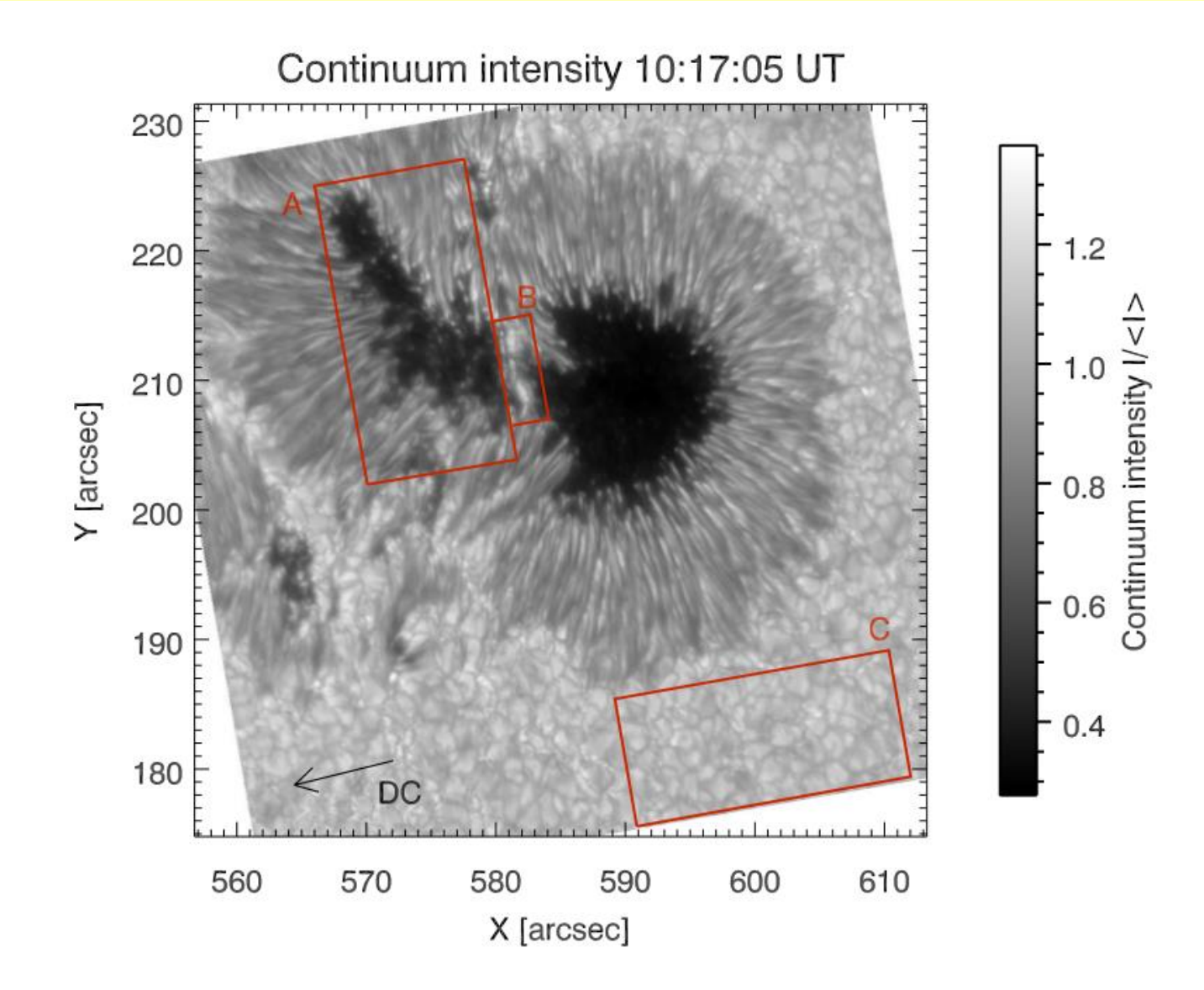


HMI/SDO: Continuum intensity map and LOS magnetogram obtained in the Fe I 617.3 nm line

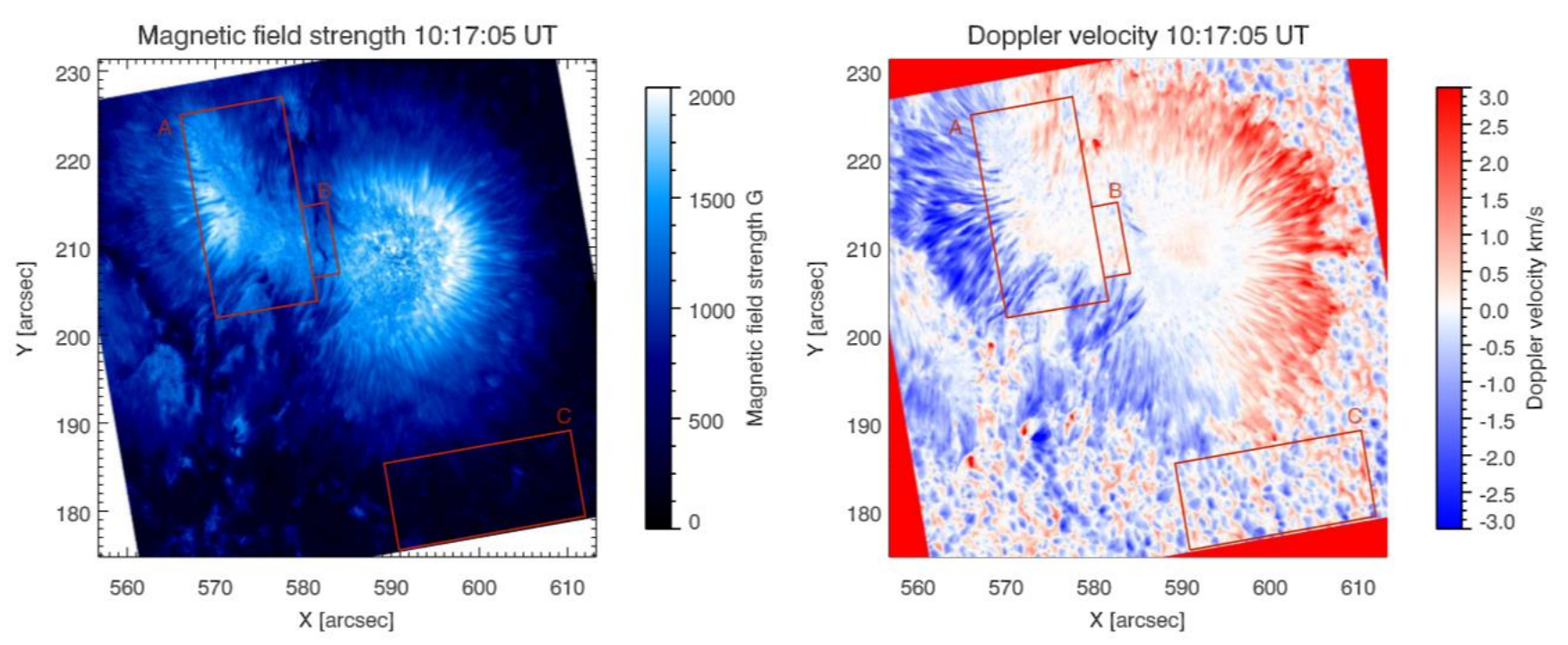
CRISP Continuum - Fe I 5576 Line



NOAA 11263: SST data

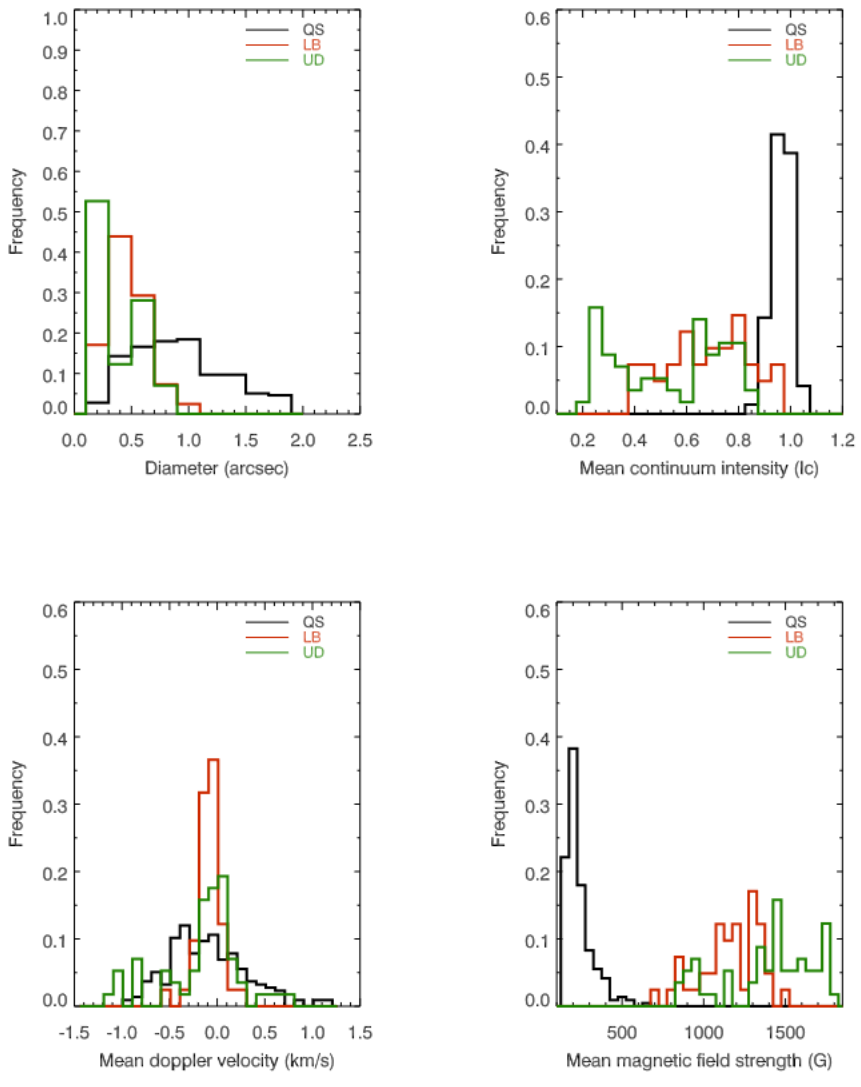


Magnetic field and Doppler velocity maps



- Magnetic field strength map obtained by applying the VFISV inversion code.
- Doppler velocity maps obtained by applying a Gaussian fit to the Fe I line profile at 630.15 nm.

Data analysis



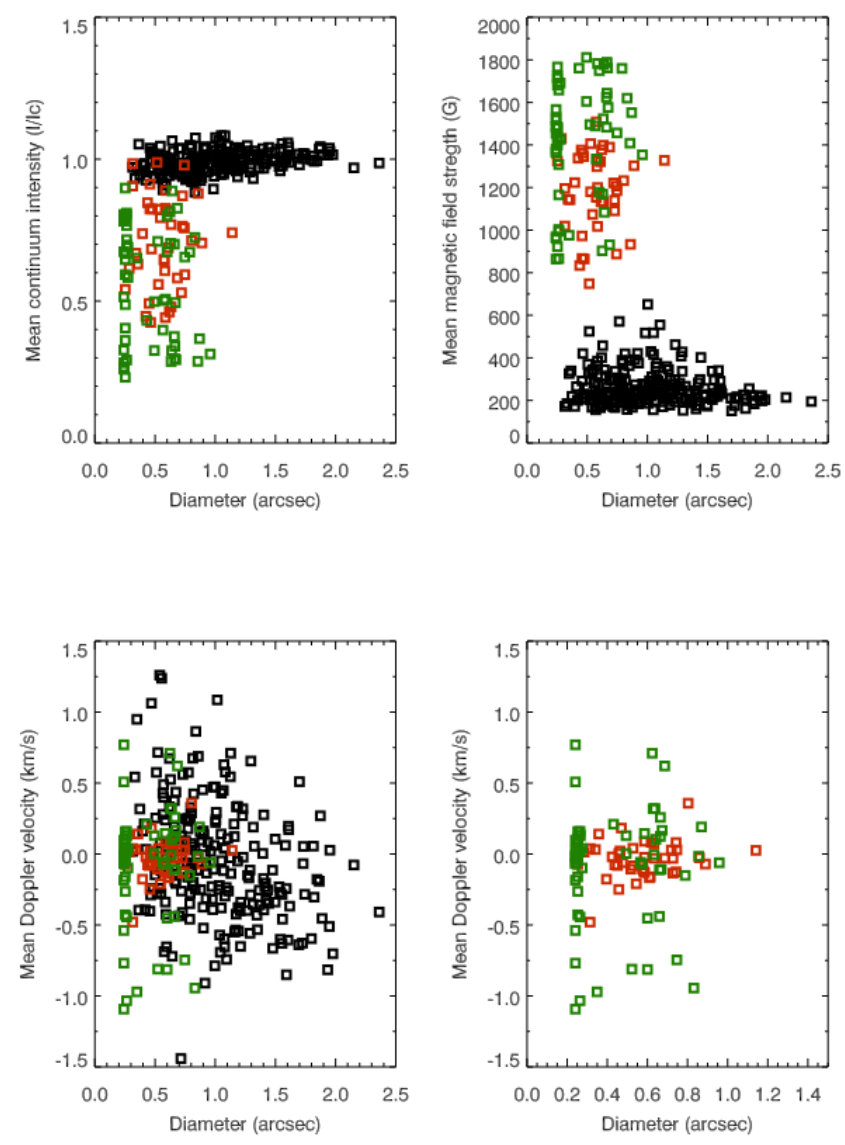
- LB granules (LBGs) are on average smaller than QS granules (QSGs) and slightly larger than UDs.
  LBGs range: 0.25 – 1.14 arcsec

- Continuum intensity [I/I_c]:
  - LB: 0.42 – 0.98
  - UDs: 0.23 – 0.89
  - QS: 0.88 – 1.08

- LOS velocity [Km/s]:
  - LB: [-0.48, +0.35]
  - UDs: [-1.09, +0.76]
  - QS: [-1.44, +1.26]

- Magnetic field strength [G]:
  - LB: 750 - 1500
  - UDs: 860 - 1800
  - QS: peak at 150

Granular properties vs diameter size



- QSGs have high intensity level indipendently from their diameter size. UDs and LBGs, with a diameter confrontable with the small QSGs, show a wide range of intensity.
- Mean magnetic field strength values of LBGs and UDs are higher than QSGs.
- Mean Doppler velocity values cover a larger range for UDs and QSGs than for the LBGs.

Results

Comparison between the physical properties of granules forming the LB and those belonging to the QS and UDs:

Faint Light Bridge ⟶ similar properties between LBGs and UDs

Granular Light Bridge ⟶ granulation features more similar with quiet-Sun granulation (Lagg et al., 2014)

From literature Lagg et al. (2014):

- common origin of GLBs and the QSGs that are anchored in deep layers;
- common origin between UDs and FLBs

⬇

starting from a totally different study, we obtained a result which supports the one carried out by Lagg et al. (2014)