A Granular Light Bridge Observed by Hinode: Evidence for Naked Granules

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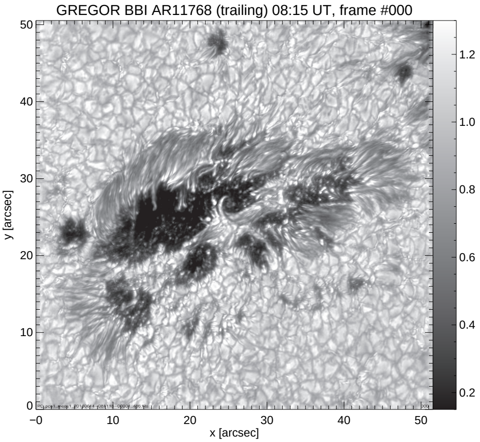
Light Bridges

Shimizu (2011)

- separate umbrae in two magnetically similar polarity regions
- source: convective motions
- weak field plasma penetrates from below photosphere
- cusp/canopy configuration at surface
- types: FLBs, SLBs, GLBs
  $\rightarrow$ different origins?

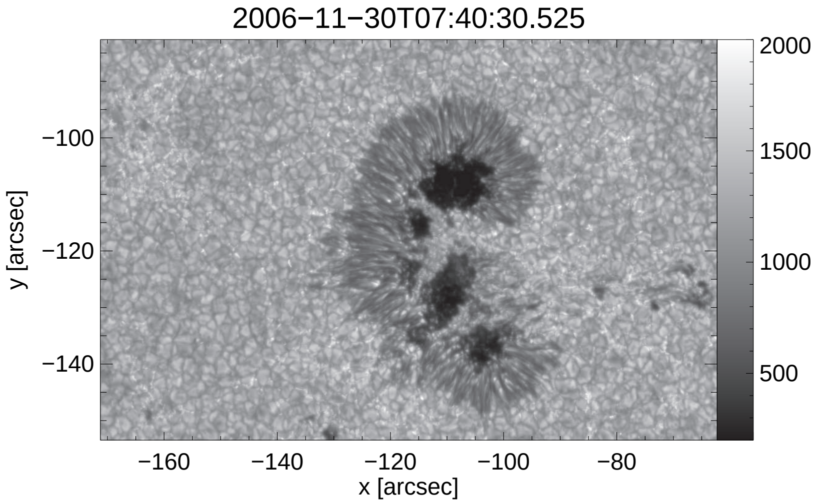
Light Bridge References

Sobotka & Puschmann (2009); Sobotka et al. (1993); Lites et al. (1991); Sobotka et al. (1993); Rimmele (2008); Rezaei et al. (2012); Vazquez (1973); Lites et al. (1991); Sobotka et al. (1994); Leka (1997); Rouppe van der Voort et al. (2010); Louis et al. (2009); Bharti et al. (2013); Shimizu et al. (2009); Rüedi et al. (1995); Joshi (2013)

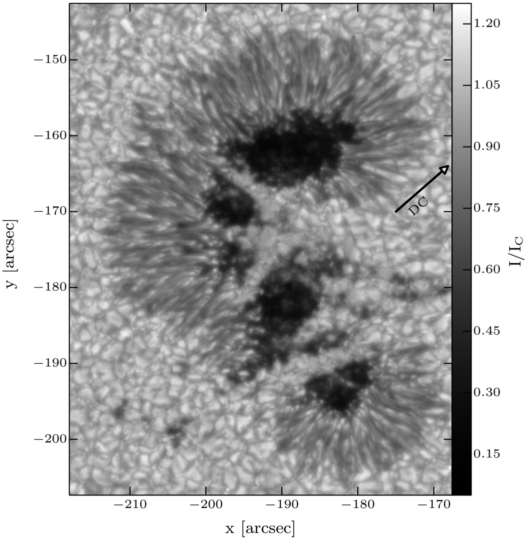


GREGOR BBI 486 nm, 14-Jun-2013

AR10926, G-band, temporal evolution



AR10926,SOT/SP scan



AR10926

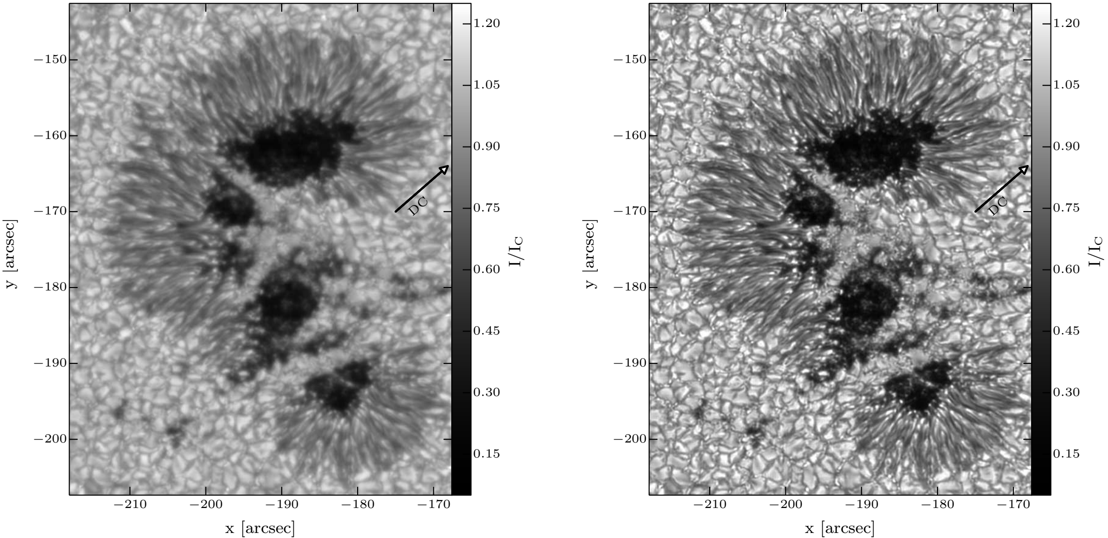
- several granular light bridges: Nov 26 – Dec 4 2006
- $\mu = \cos\Theta = 0.96$
- SP scan (normal mode) on Nov-30 2006, 2300 UT

Inversions van Noort (2012)

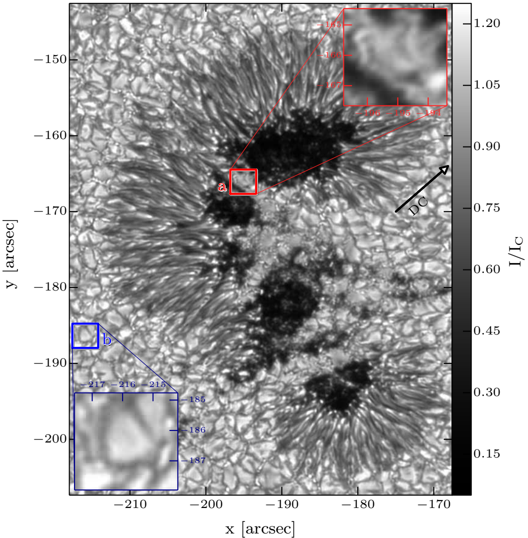
POSTER: S1 - P - 27

- spatial coupling using PSF $\longrightarrow$ acts as deconvolution
- 3 nodes in T, B, γ, ϕ, v_{LOS}, v_{micro}

AR10926, intensity



AR10926, selected regions

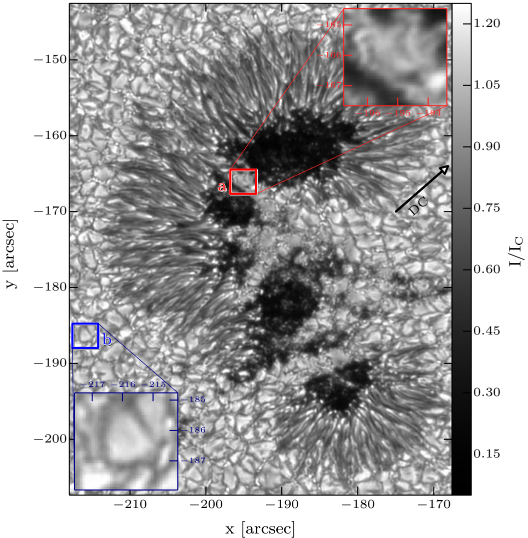


Broad light bridge

- temporal evolution indicates convective motions
- brightness similar to QS

$\longrightarrow$ granule

AR10926, selected regions



Broad light bridge

- temporal evolution indicates convective motions
- brightness similar to QS

→ granule

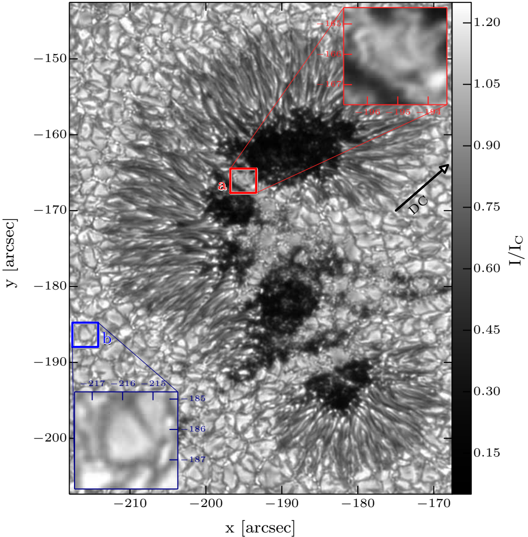
QS Granule

... not really "quiet" (too close to spot).

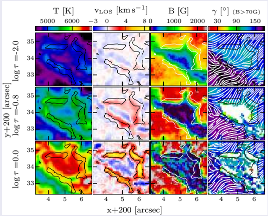
- BUT: properties very similar to QS granule

→ selected for comparison

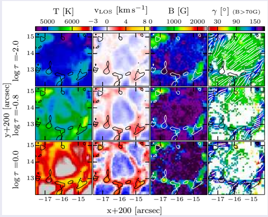
Comparison: LB Granule vs. QS Granule



LB granule



QS granule

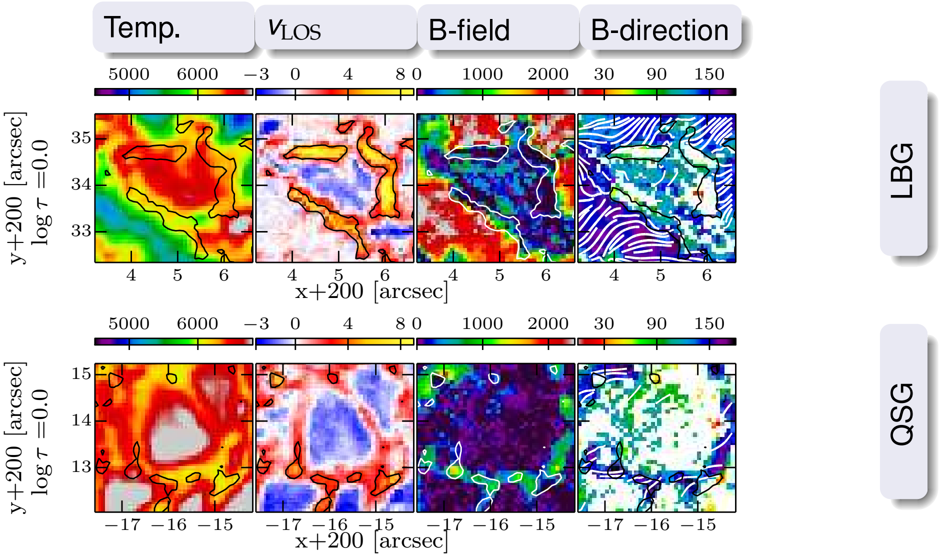


Atmospheric parameters

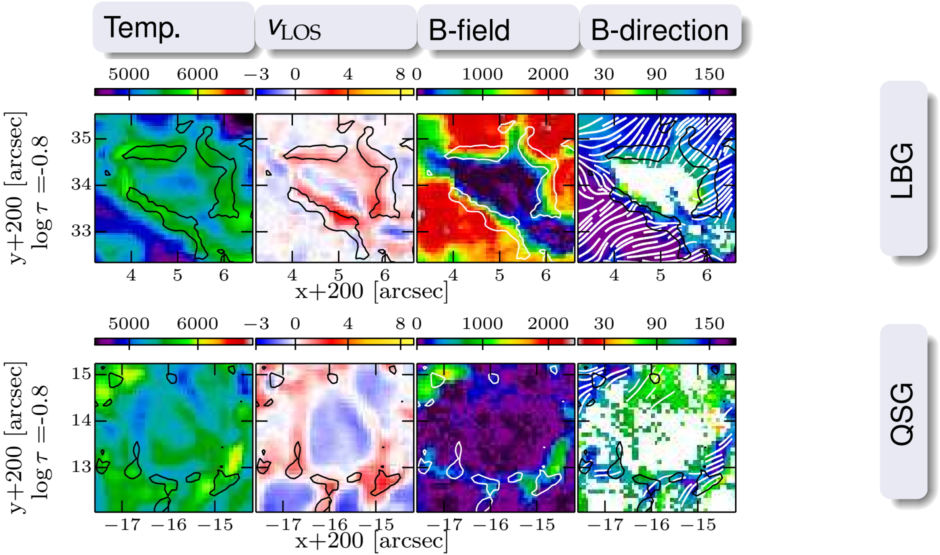
- Temp., LOS-velocity, magn. field strength & direction
- at three height nodes

Comparison LB / QS granule

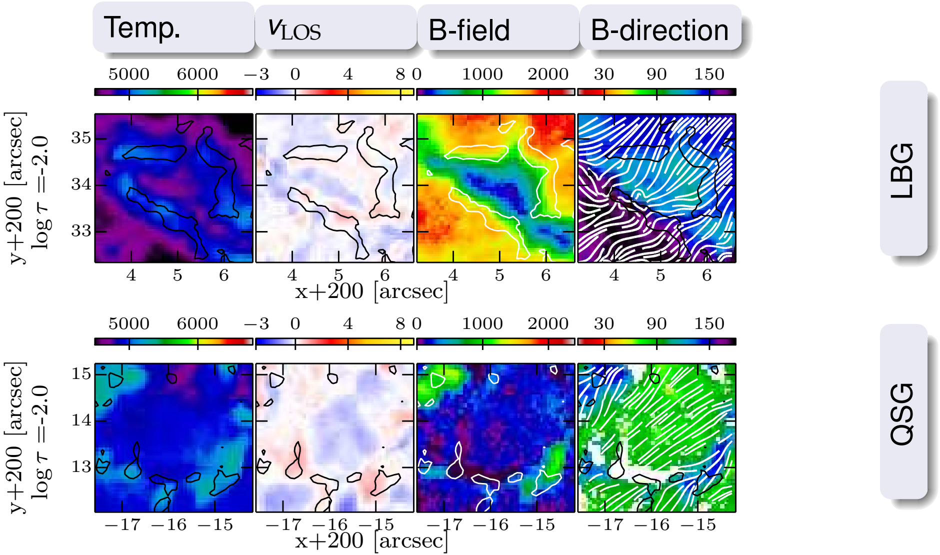
$\log \tau = 0.0$



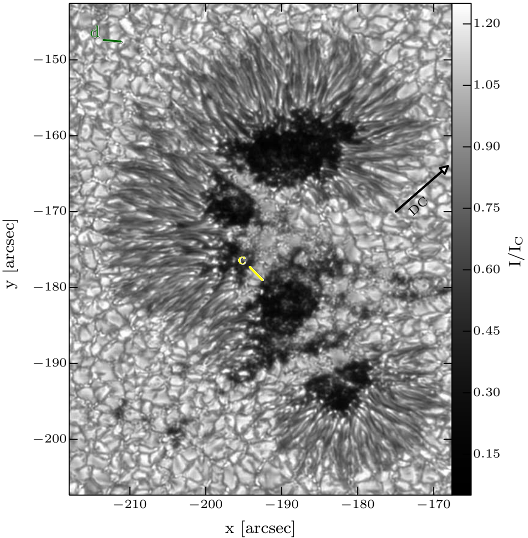
Comparison LB / QS granule $\log\tau = -0.8$



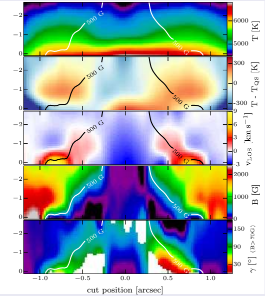
Comparison LB / QS granule $\log\tau = -2.0$



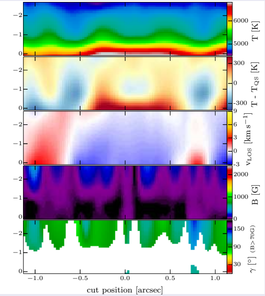
AR10926, selected cuts



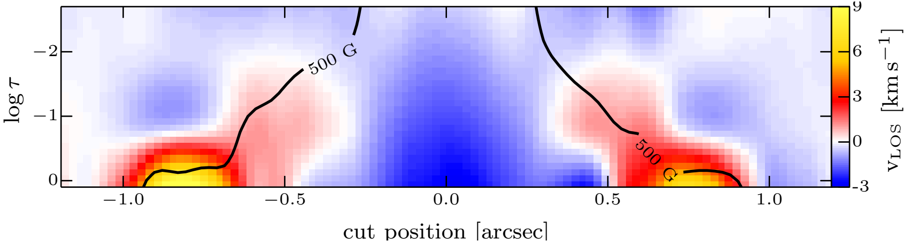
Cut through LB



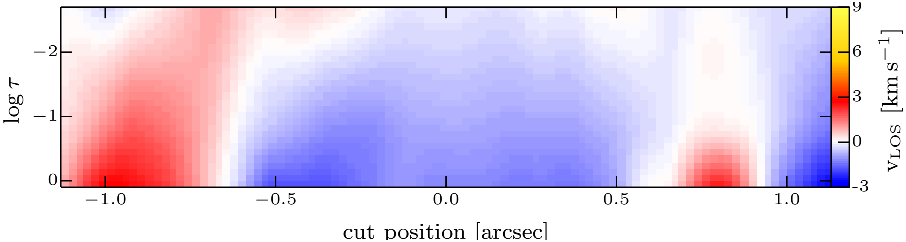
Cut through QSG



Cut through LB / QS granule LOS-velocity

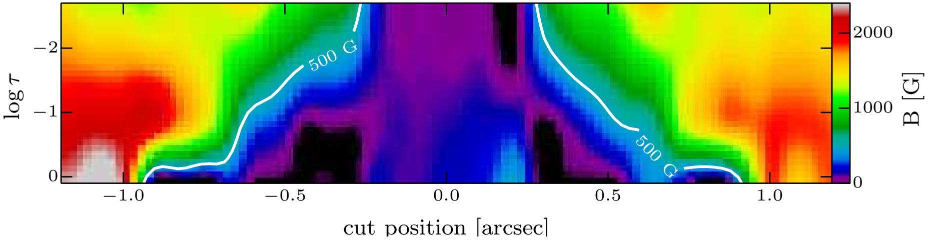


LBG

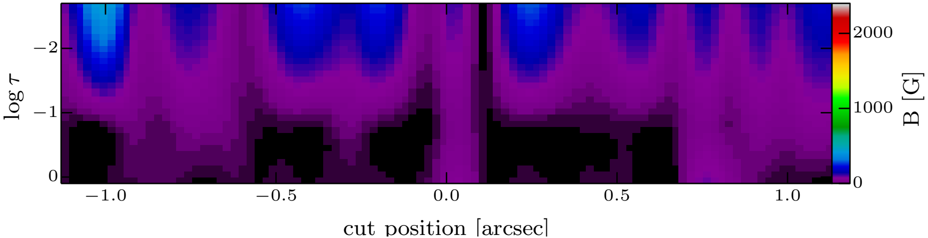


QSG

Cut through LB / QS granule magnetic field

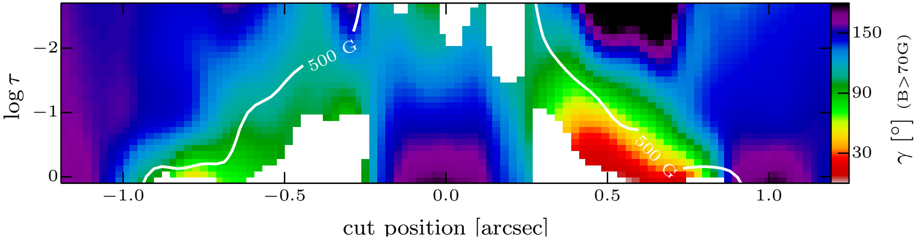


LBG

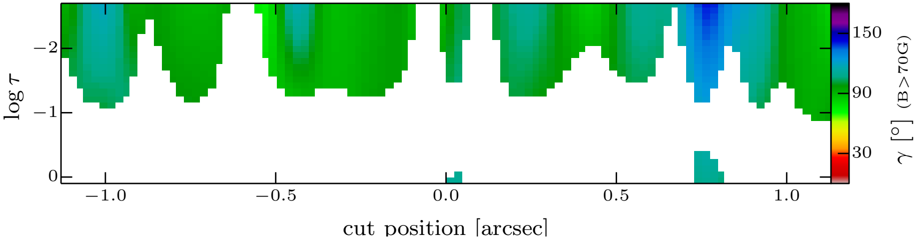


QSG

Cut through LB / QS granule mag. field inclination



LBG



QSG

Comparison: LB Granule vs. QS Granule

Similarities

- central upflows ($\approx$2 km s^{-1}) of hot material
- surrounded by cooler downflows

$\longrightarrow$ typical pattern for convection

- decreasing velocities with height
- field free / weak fields in deep layers
- field concentrations at boundaries

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Differences

LB: faster downflows (10 vs. 4 km s^{-1})

LB: narrowing upflows with height

LB: enhanced temp. at downflows in middle layers, lower in deepest layer $\rightarrow$ small radial gradient at $\tau = 1$

LB: opposite polarity field at location of downflows

LB: cusp-like field in highest layer

QS: canopy field in highest layer

Downflows: reconnection sites?

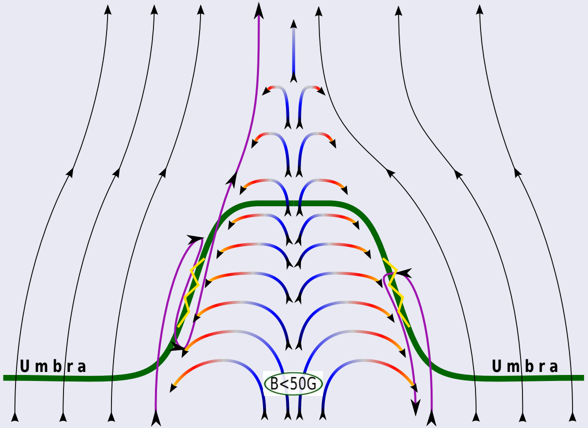
High speed downflows (10 $\mathrm{km\,s^{-1}}$)

Result of Reconnection? (Louis et al. 2009)

+ hints of polarity reversal
+ above downflows: T enhanced

Downflows: reconnection sites?

Configuration



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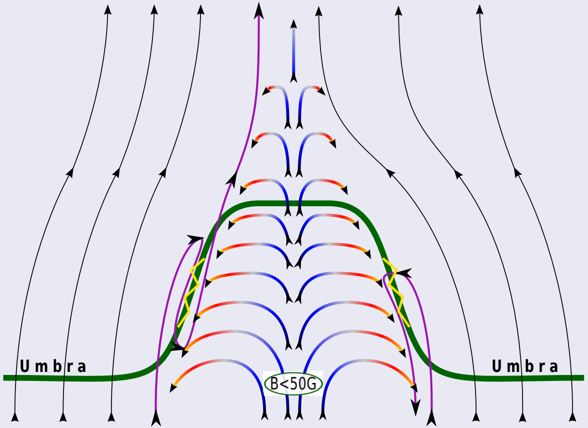


High speed downflows (10 $\mathrm{km\,s^{-1}}$)

Result of Reconnection? (Louis et al. 2009)

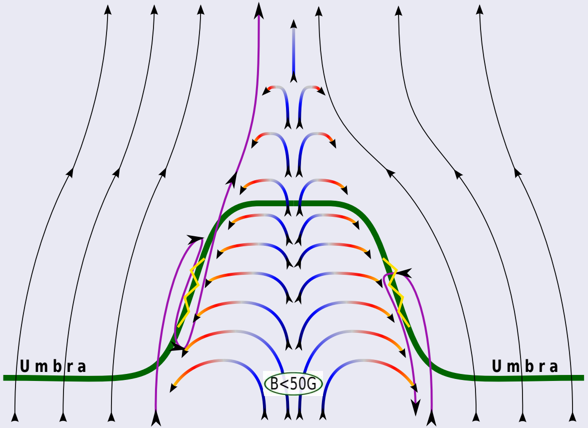
- \+ hints of polarity reversal
- \+ above downflows: T enhanced

- – height: 200–300 km
- – strong downflows by gravity & reduced density
- → drag field lines and create opposite polarity field
- → reconnection / current sheets (with heating) result of downflows

"Naked" granules

Summary & Outlook

Configuration



Exposed granules (Wilson depression)

- LBG and QSG similar in deep layer
  $\longrightarrow$ points to common origin
  $\longrightarrow$ anchored in deep layers
- different from FLBs or umbral dots ("surface" convection)
- probe sub-surface spot structure

Outlook

$\rightarrow$ investigate granular light bridges under different viewing angles

- possible to access granular interior

Furukawa Festival (town next to Takayama,every April)

many similarities

- interior: turbulent motions
- boundary: downflow streamlines
- cusp shape
- “granule” exposed to cold environment
- “naked”: not quite (only linecloths)

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Bilbiography

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