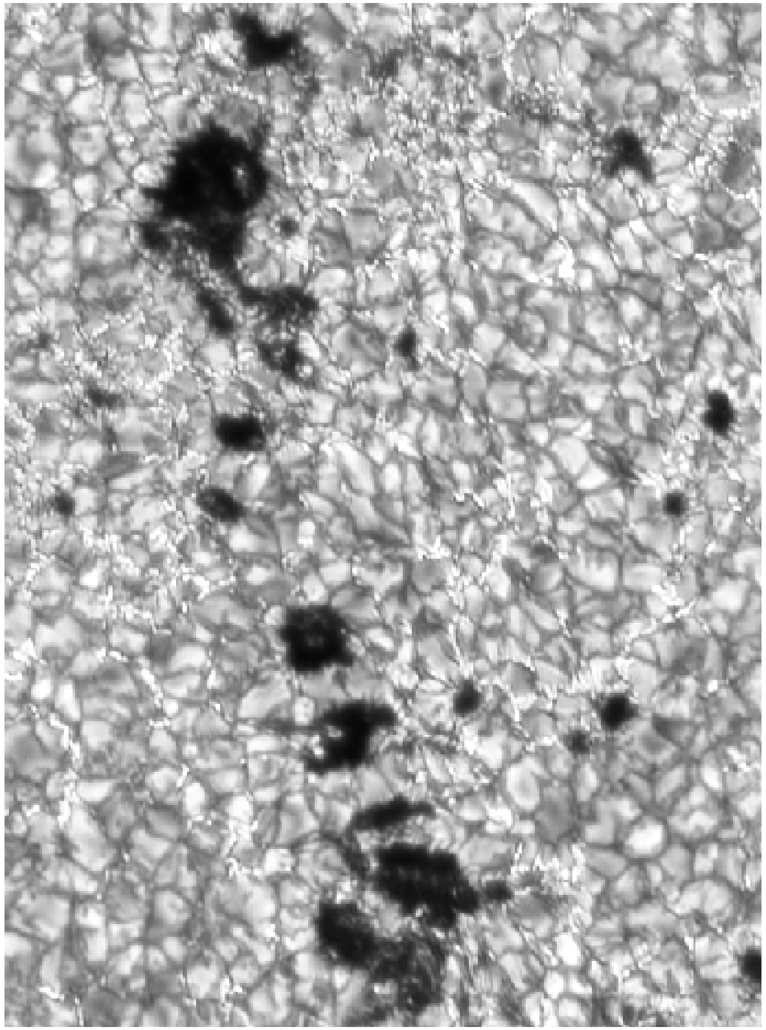
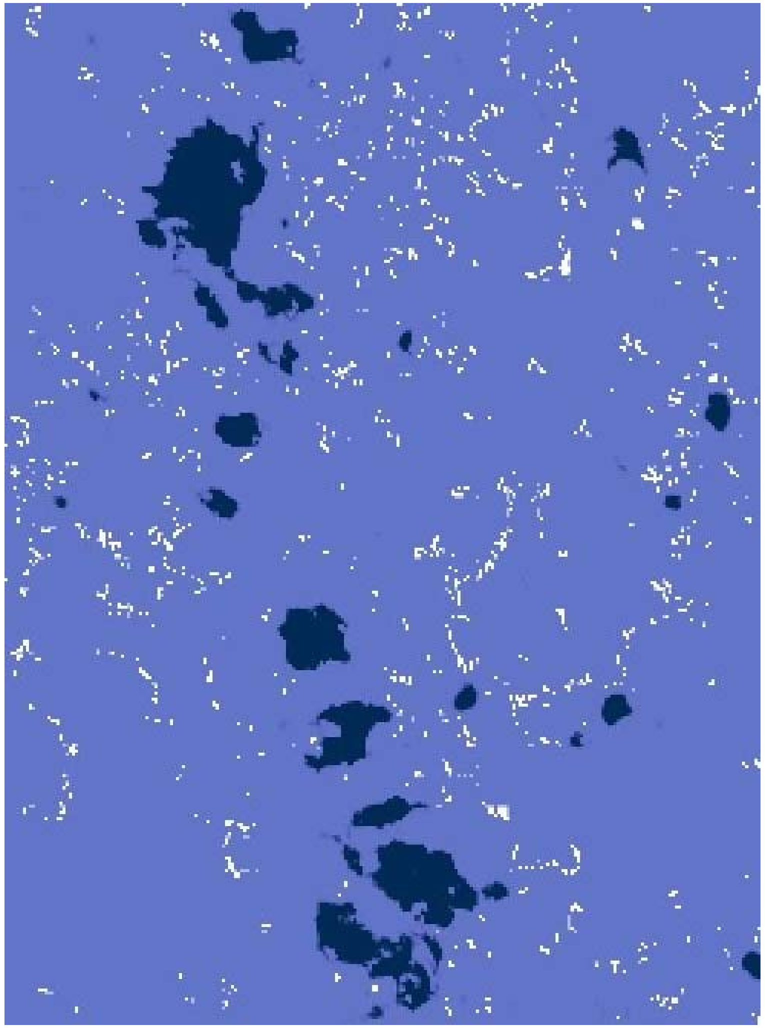
The size of small-scale solar magnetic regions

K.G.Puschmann + E.Wiehr; Inst.Astrophys.Univ.Goettingen (former Univ.Observ.)

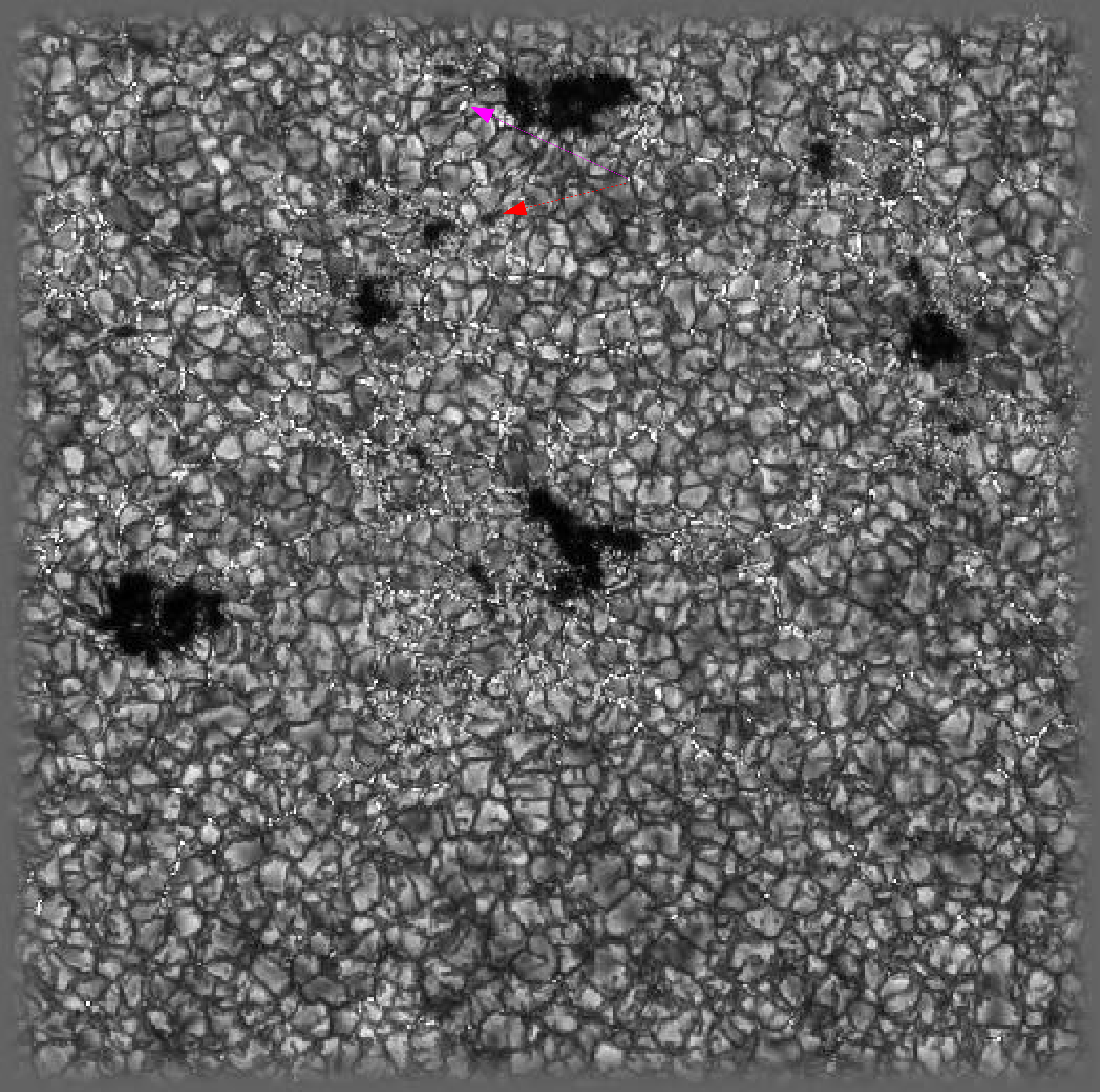


Reconstructed G-band image
(obs.: P.Suetterlin, 45cm-DOT)



Pattern recognition (B.Bovelet)

No smooth transition between bright and dark features.



different sizes of:

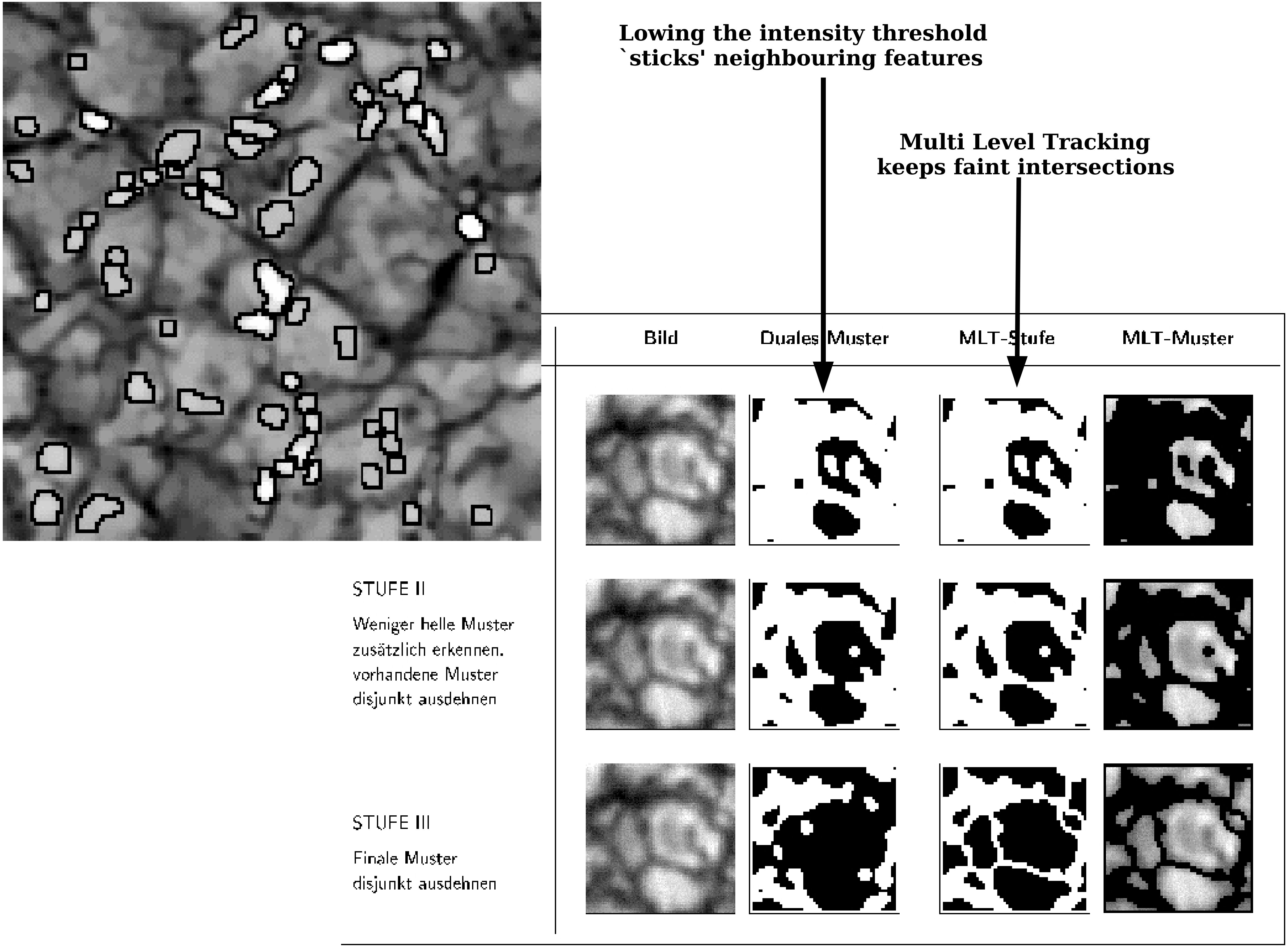
smallest dark

+ largest bright

10''

active region
with 5 spots
and 1800 BP

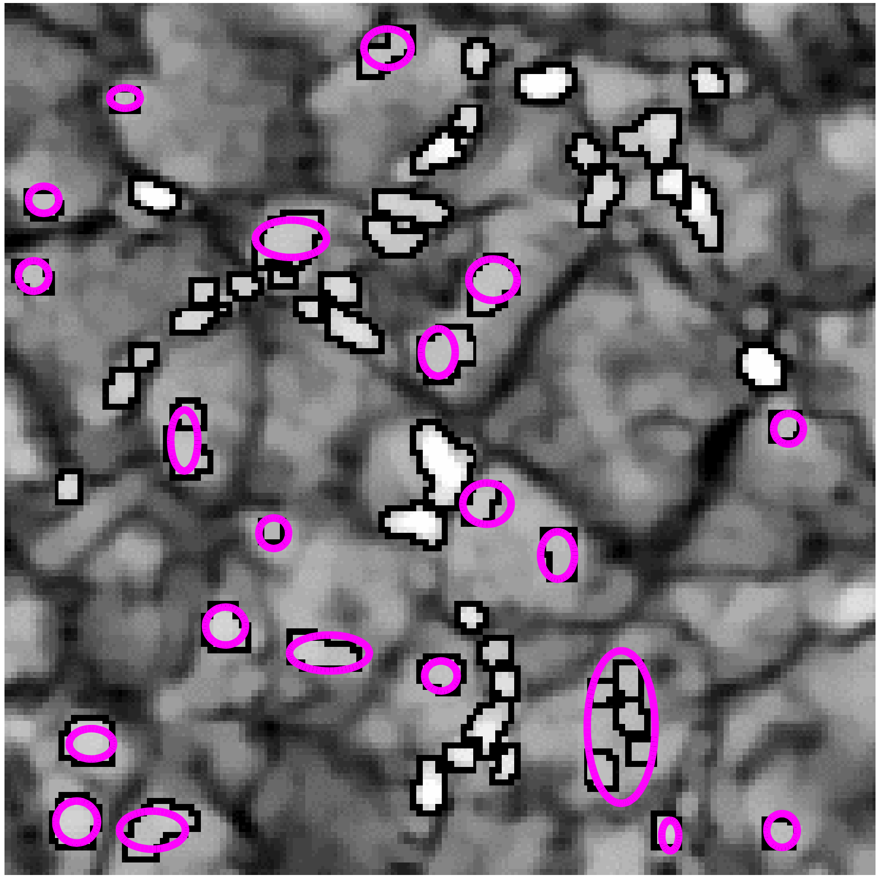
1m SST, July 2003;
Hirzberger+Wiehr,


Lowing the intensity threshold
`sticks' neighbouring features
Multi Level Tracking
keeps faint intersections
Bild
Duales Muster
MLT-Stufe
MLT-Muster
STUFE II
Weniger helle Muster
zusätzlich erkennen.
vorhandene Muster
disjunkt ausdehnen
STUFE III
Finale Muster
disjunkt ausdehnen

The roundish G-band bright points

G-band bright points recognized by autom. pattern recognition

(Bovelet+Wiehr, SP 201, 13, 2001)

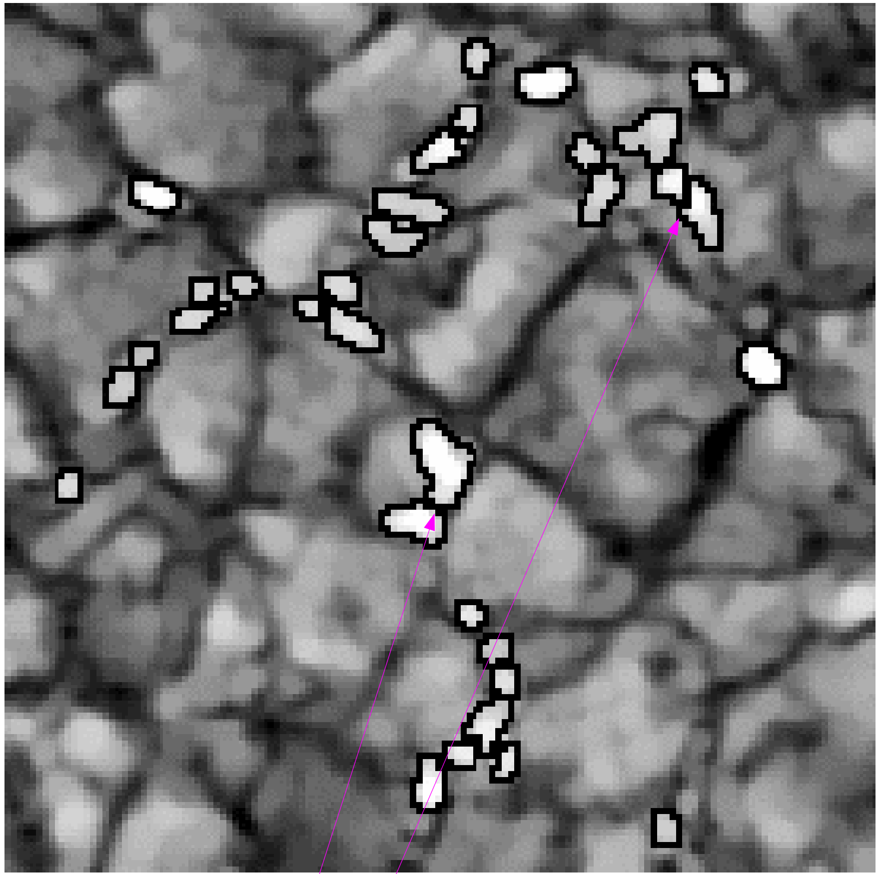


two families of G-band bright points:
1. upward moving 'sub-granules',
2. downward moving flux concentr.

(Langhans, Schmidt, Tritschler, A+A 394, 1069, 2003)

separating both by additional contrast discrimination .....

(Bovelet+Wiehr, A+A 412, 249, 2003)

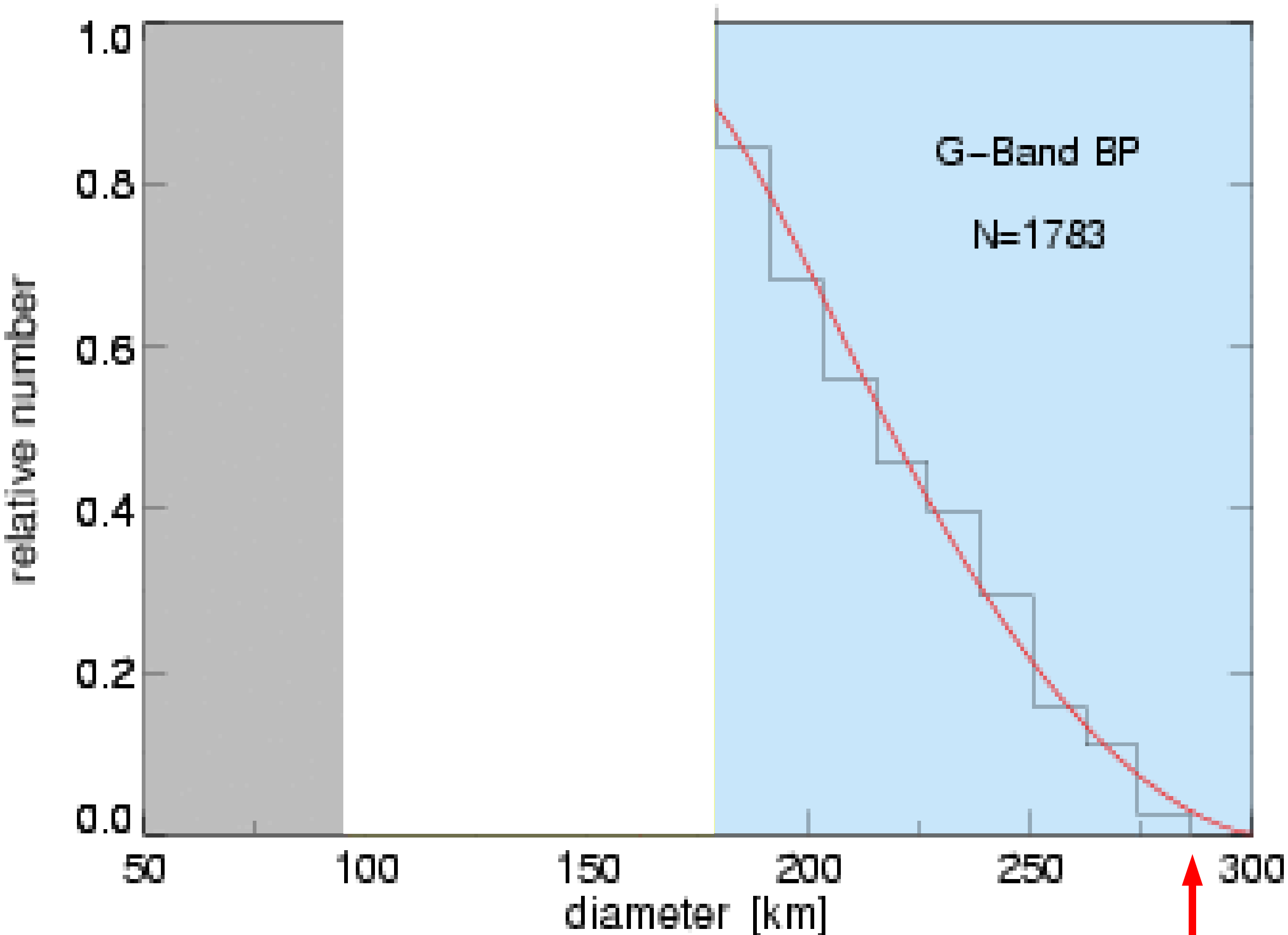


.... eliminates granular features

..only few (5%) remain....

Intergranular (magnetic) G-band bright points in the reconstr. SST images

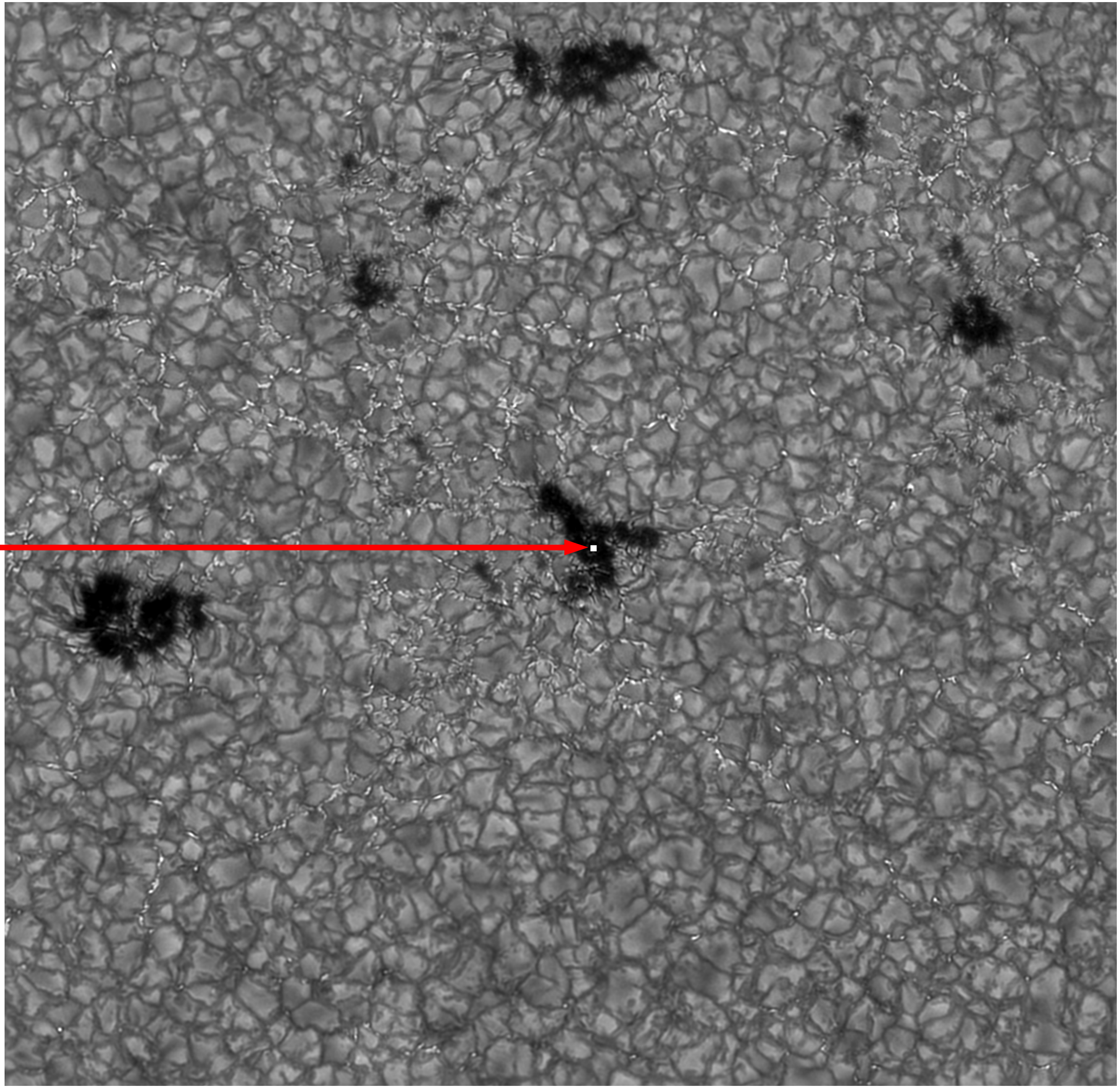
DOT (45 cm)



diameter of equivalent ROUND area:

maximum near 270 km

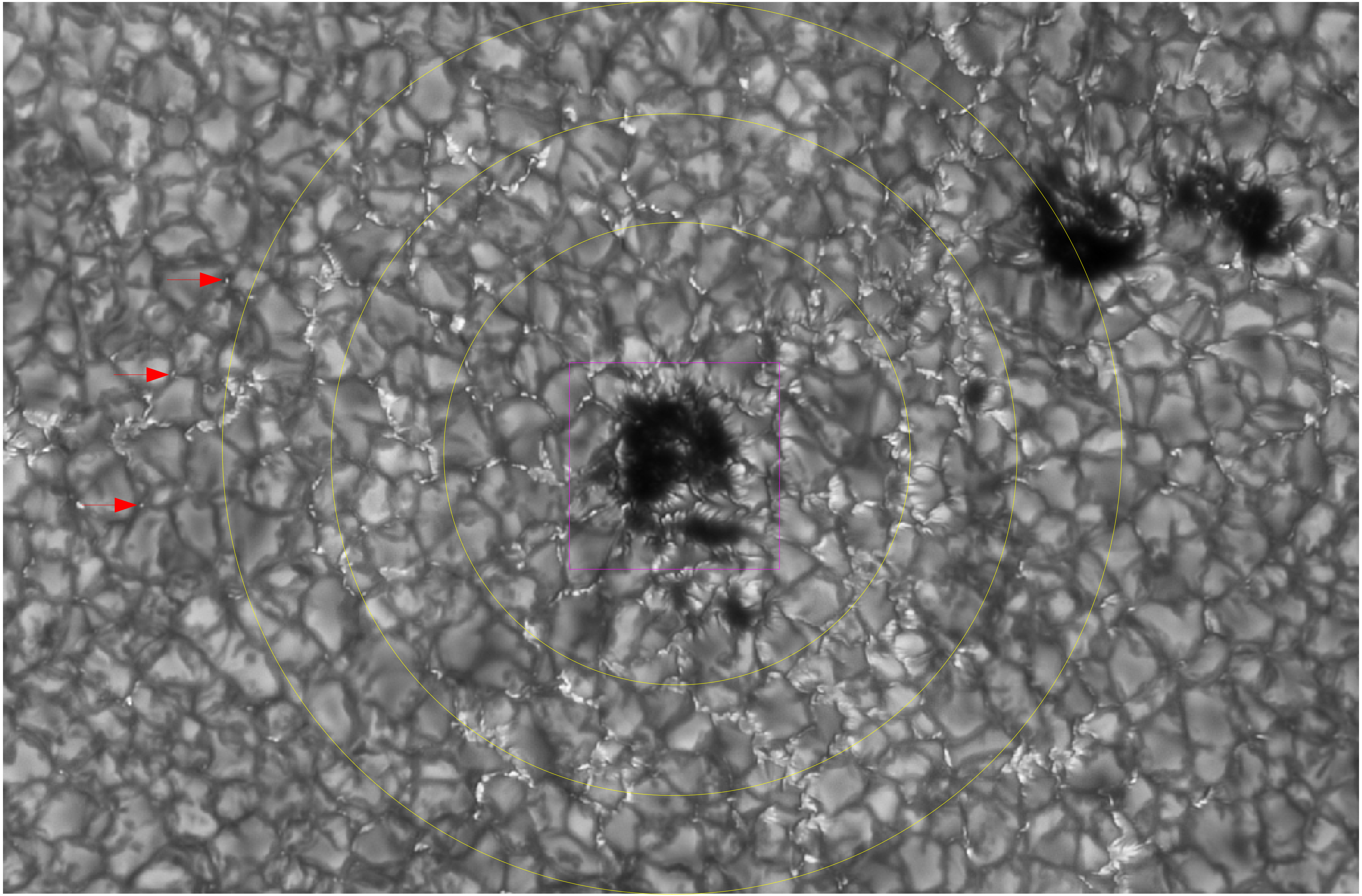
white square:
300*300km

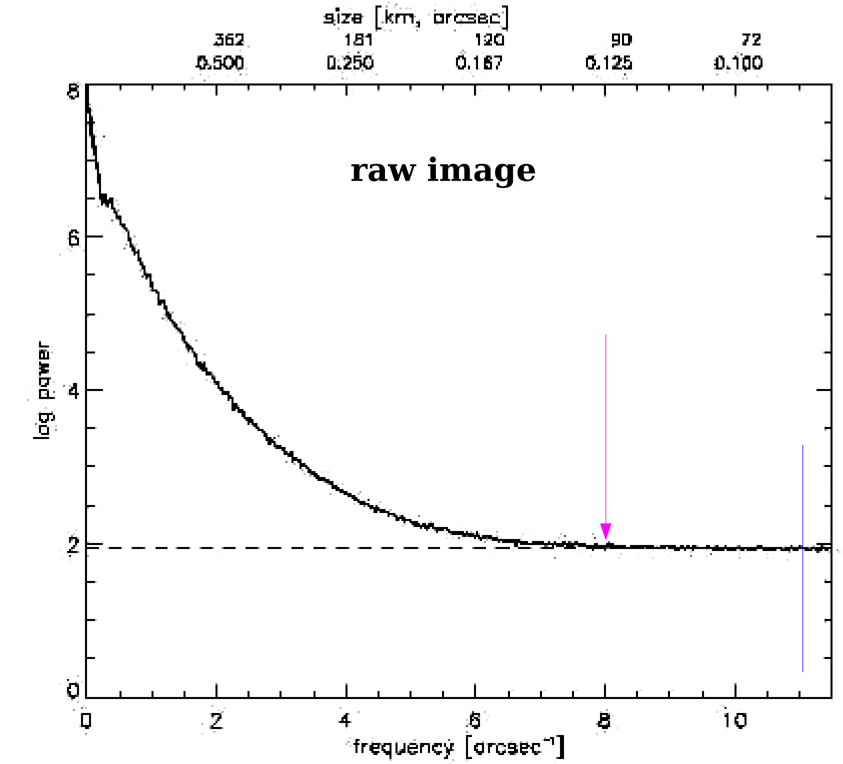


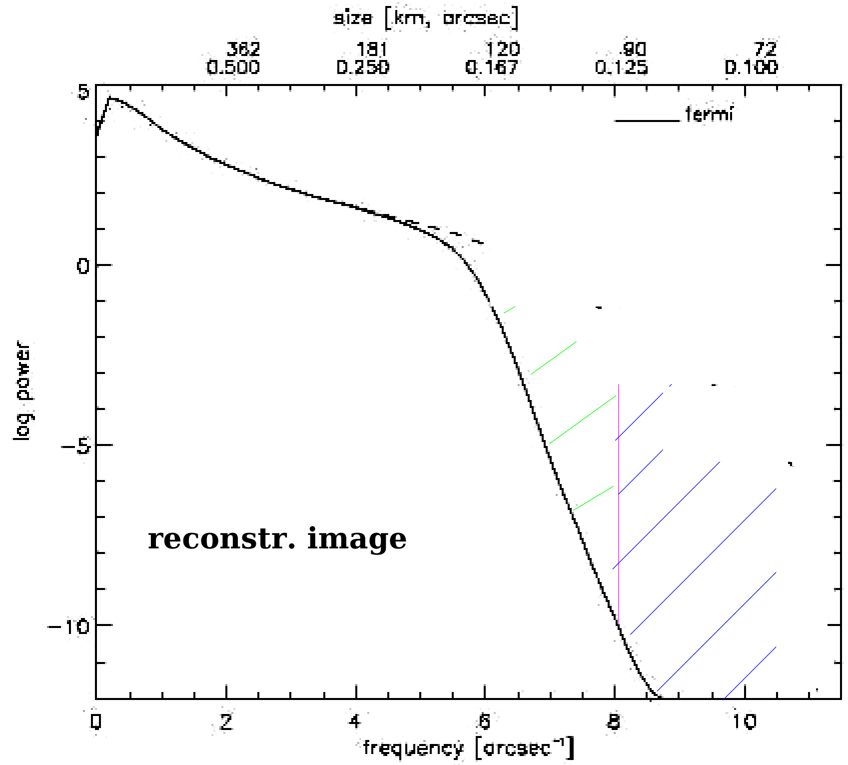
no larger BP ->
diameter gap to
smallest spots

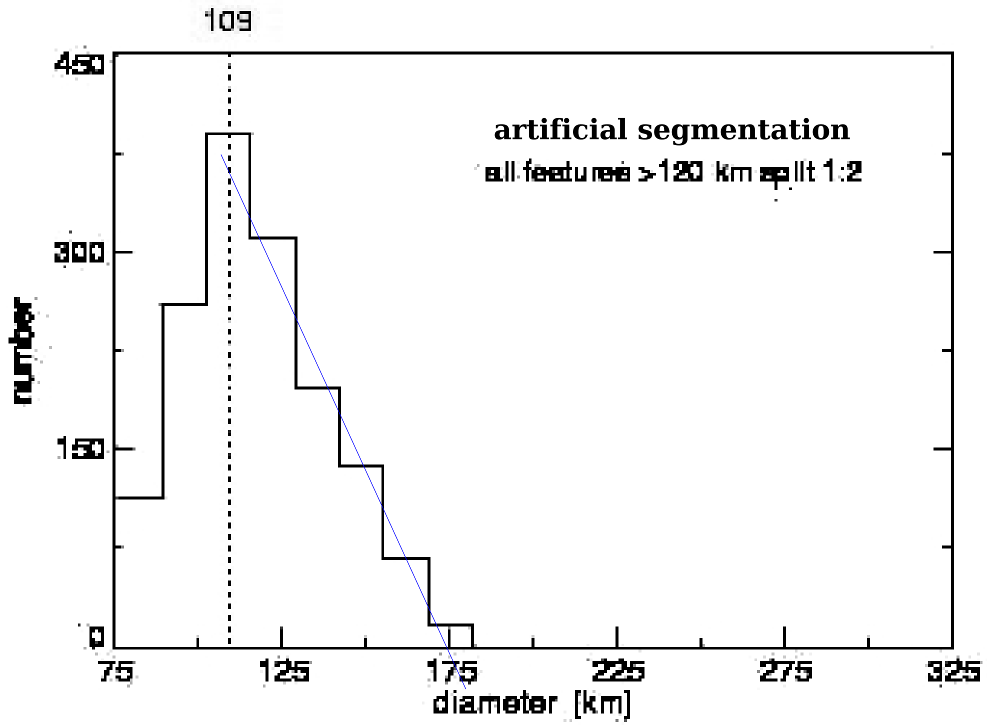
La Palma Observatory

Reconstr. G-band image from SST with AO (35'' x 55'')

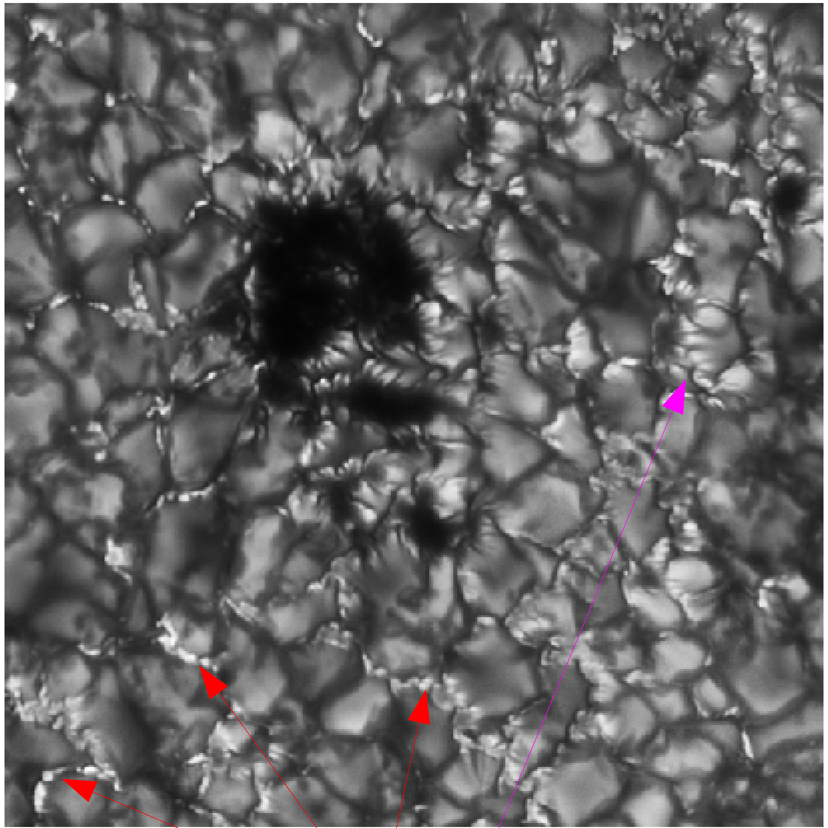



size [km, arcsec]
362 0.500
181 0.250
120 0.167
90 0.125
72 0.100
raw image
log power
frequency [arcsec⁻¹]

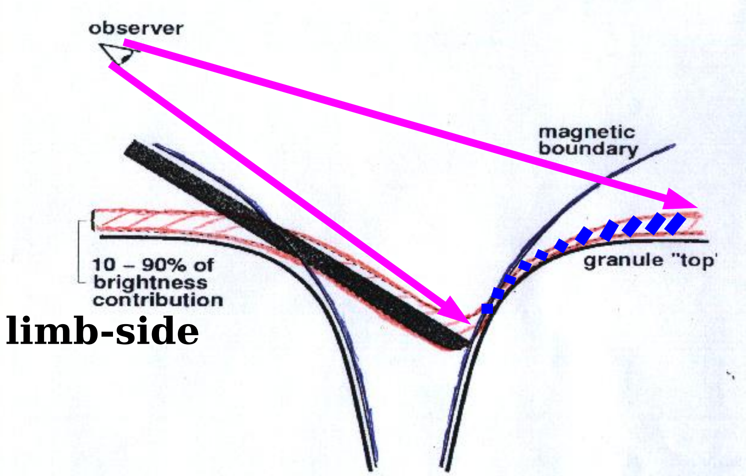

size [km, arcsec]
362 0.500
181 0.250
120 0.167
90 0.125
72 0.100
fermi
reconstr. image
log power
frequency [arcsec⁻¹]


109
artificial segmentation
all features >120 km split 1:2
number
diameter [km]

21deg



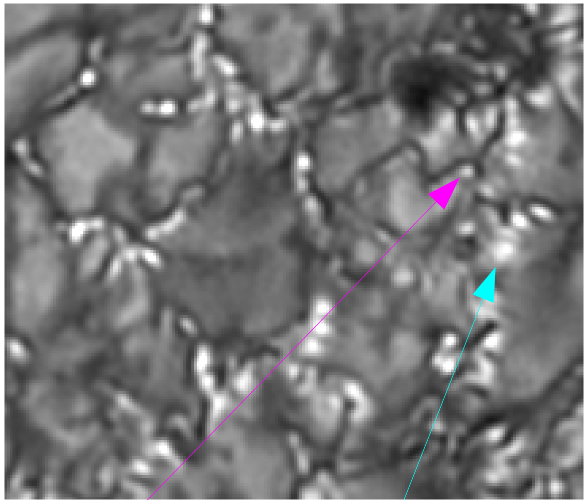
SOLAR FACULAE Keller, Schüssler, Vögler, Zakharov; ApJ 607 L61



limb-side

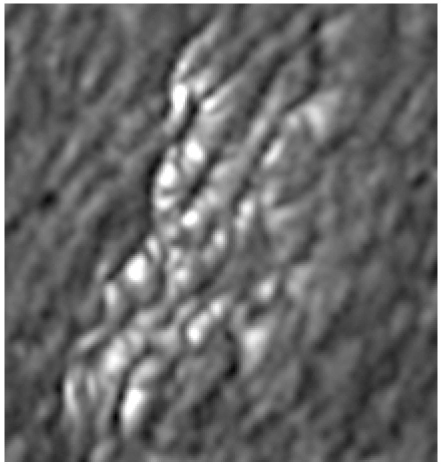
FIG. 4.—Schematic sketch of a magnetic flux concentration (*region within the thin lines*) and adjacent granules (*thick lines*), illustrating the origin of the facular brightening and the dark lane. The dashed lines enclose the region where the dominant part (80%) of the continuum radiation is formed. The brightness enhancement of the facula originates mainly from a thin layer near the limbward interface between the magnetic flux concentration and the hot nonmagnetic granule. The intensity of the dark lane is formed in the relatively cool regions above the centerward granule and inside the flux concentration. The lines of sight for the facular brightening and for the dark, narrow lane are indicated with correspondingly shaded gray areas.

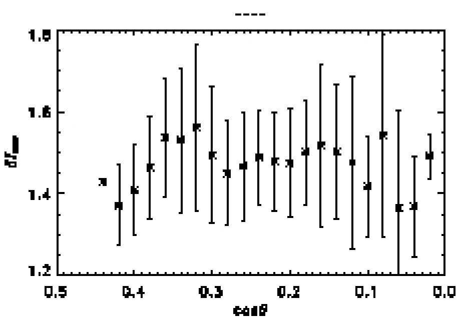
Some elongated features are NOT \`chains of perles' but \`projected' tubes



38 deg

69 deg





Hirzberger+Wiehr, A+A438,1059,2005

round and \`projected' BP at same heliocentr.angle => inclination!!

INTER-GRANULAR G-BAND BRIGHT POINTS

decreasing upper limit due to 'un-conglomeration' by 1m SST

max. diameter of i-gr.BP : < 225 km; [maybe <175 km]

with `most frequent flux' (Berger et at.): 785 Gs/cm^2

=> max. flux of bright magn. regions:
3.1* 10^17 Mx [2*10^17 Mx]

smallest (dark) pores: e.g., 1000 km ; 2000 Gs

=> min. flux of dark magn. Regions: 10^19 Mx

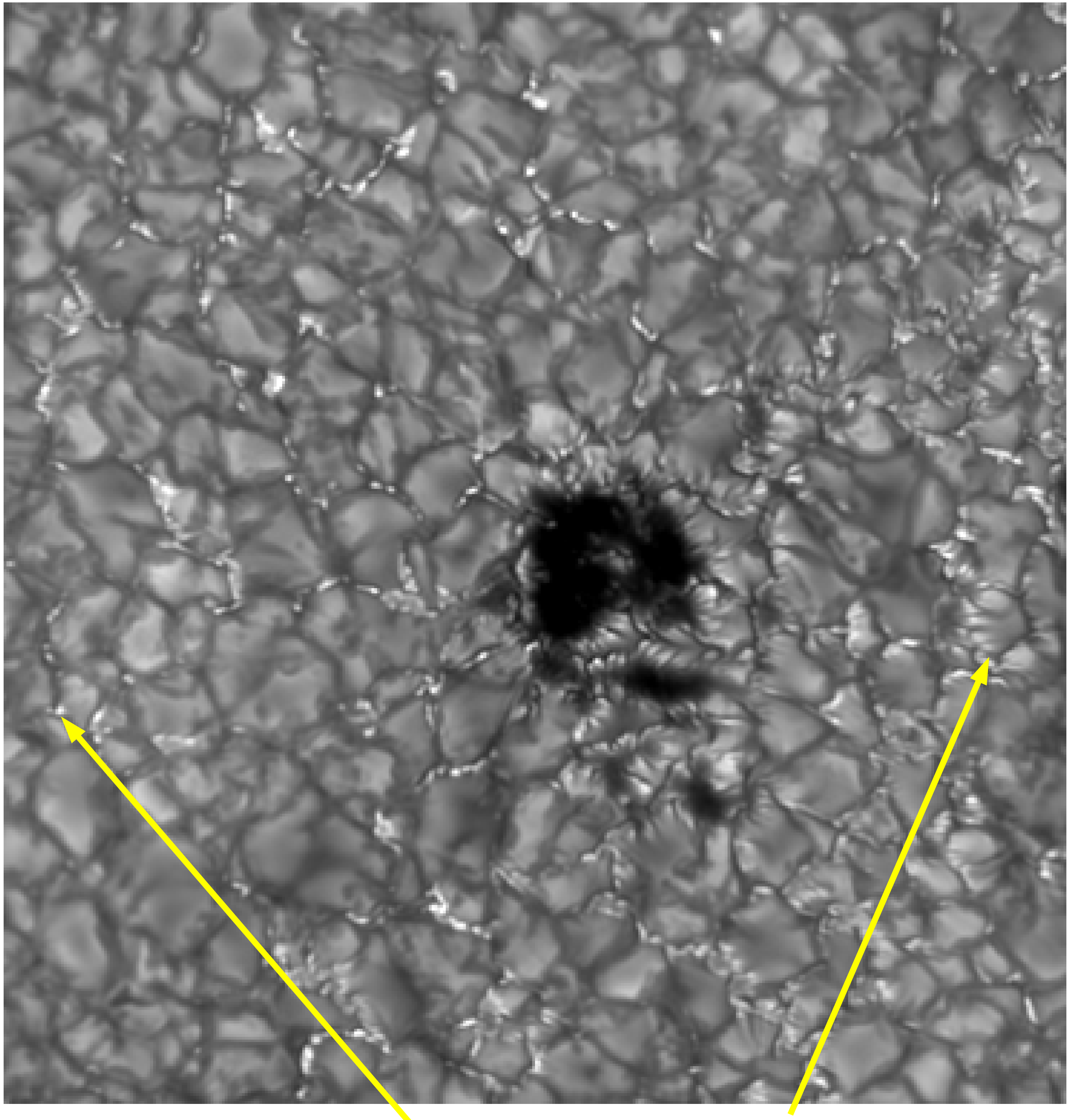
(also the theoret.limit for kink-instab.;Meyer,Schmidt,Weiss, MNRAS)

flux `gap' of factor 30 [50]

(BP diameter equal in G and continuum)

[G-intens.excess = 2.5 * contin.intens.excess]

variety of field inclinations



Co-existence of roundish and `limb projected' BP

... 'already' at 21^o

 Keller, Schüssler, Vögler, Zakharov; ApJ 607, L61

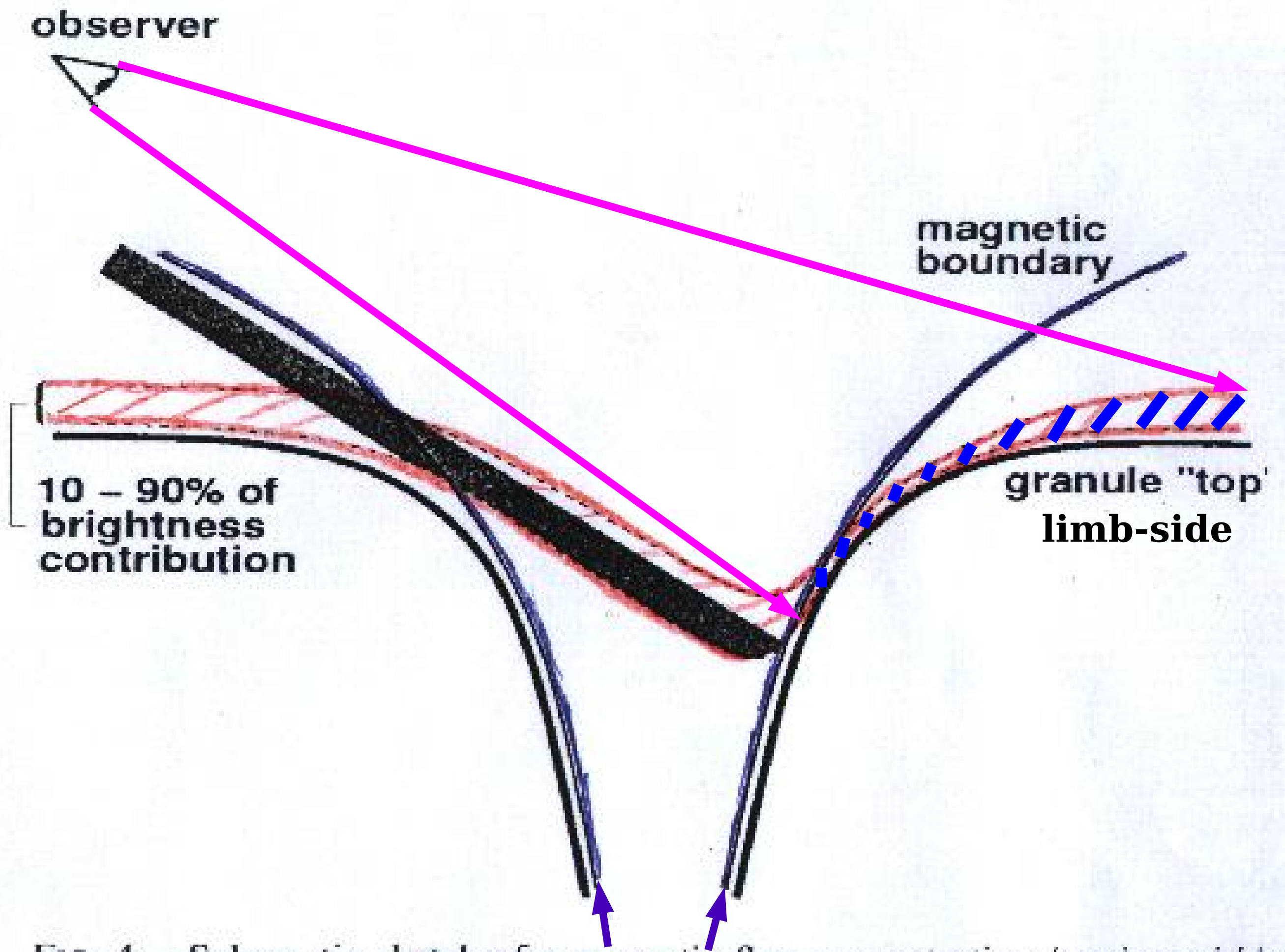
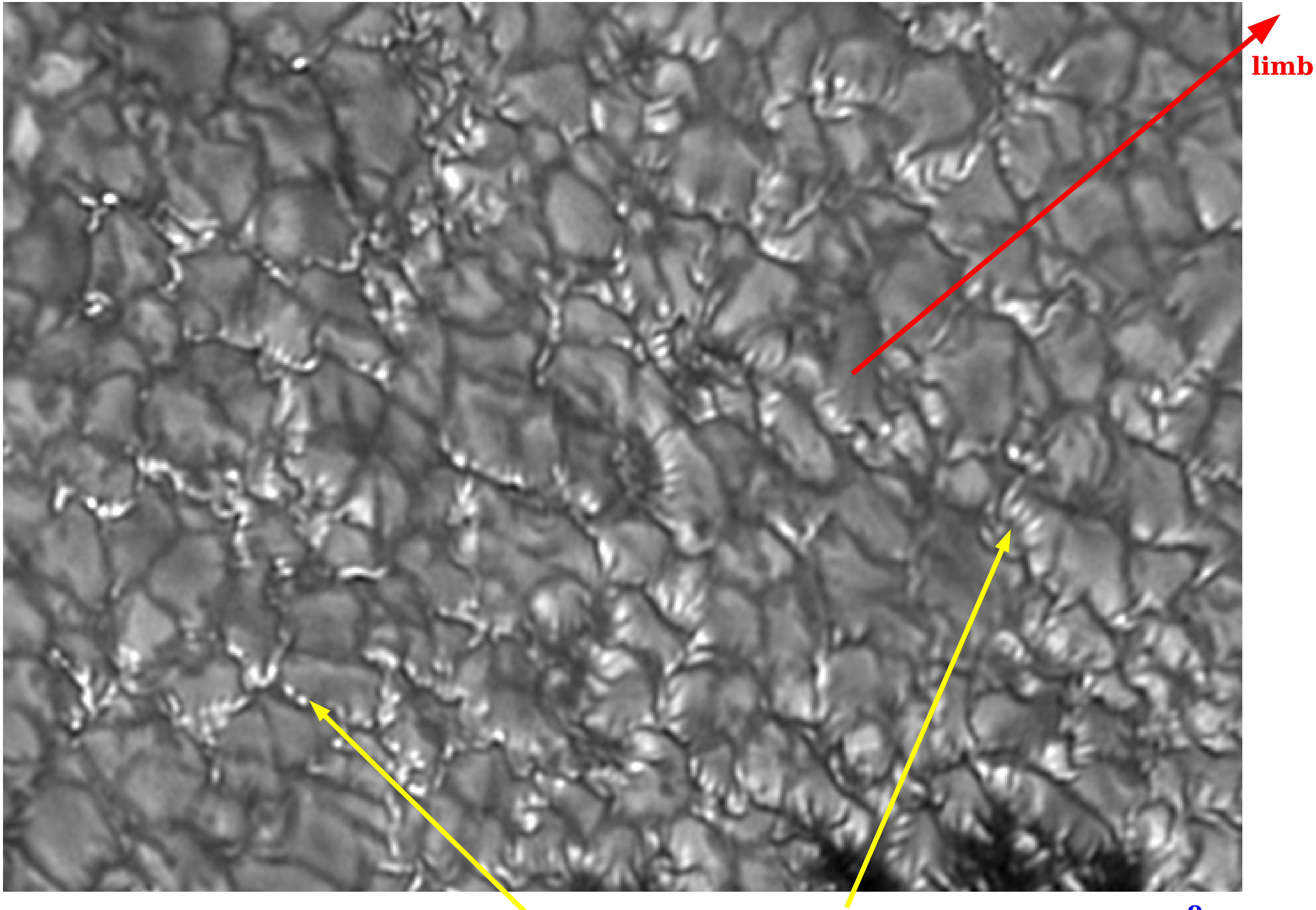


FIG. 4.—Schematic sketch of a magnetic flux concentration (*region within the thin lines*) and adjacent granules (*thick lines*), illustrating the origin of the facular brightening and the dark lane. The dashed lines enclose the region where the dominant part (80%) of the continuum radiation is formed. The brightness enhancement of the facula originates mainly from a thin layer near the limbward interface between the magnetic flux concentration and the hot nonmagnetic granule. The intensity of the dark lane is formed in the relatively cool regions above the centerward granule and inside the flux concentration. The lines of sight for the facular brightening and for the dark, narrow lane are indicated with correspondingly shaded gray areas.



Co-existence of roundish and `projected' BP even at 38^o

hence: inclinations up to 38 ^{o}