An analysis of chromospheric fine structure with the ALMA radio telescope

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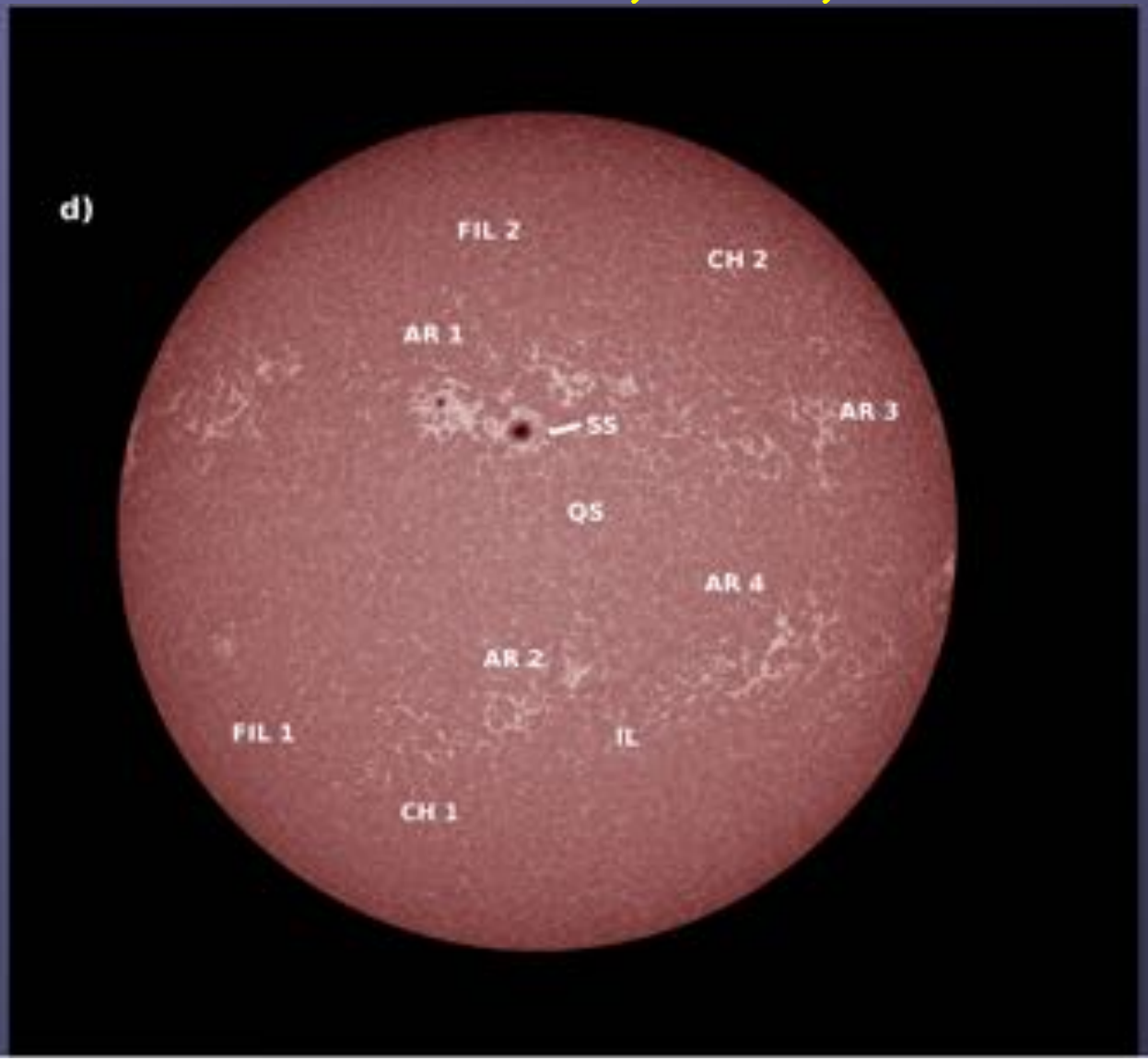
Topic 1: Full-disc solar images, general look

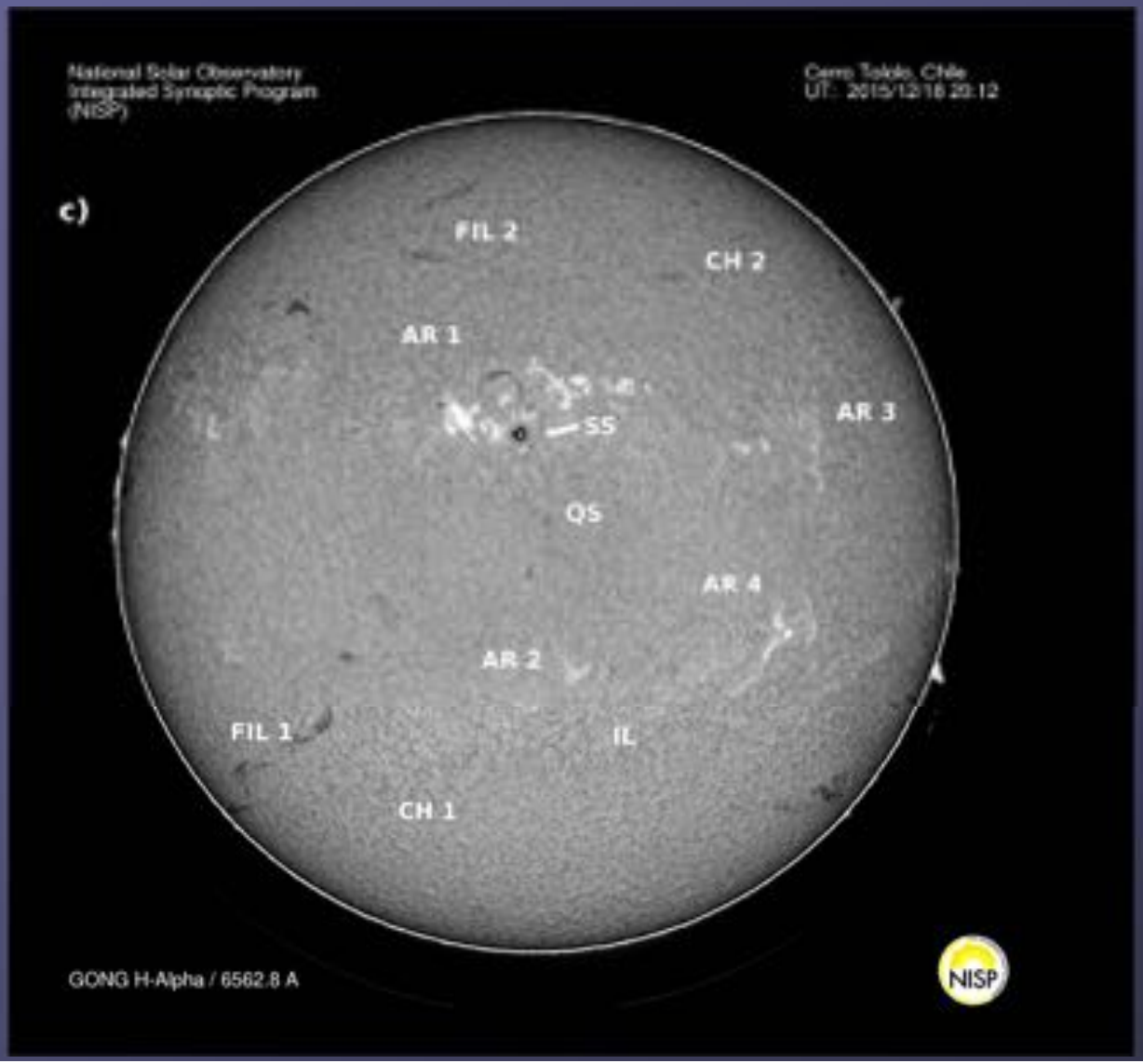
- Identification of solar structure in full disc (single dish, total power) ALMA images
- λ=1.21 mm, 248 GHz, Band 6
- Brajša et al. (2017a)

SDO/AIA, 18 December 2015, λ = 170 nm; AR, SS



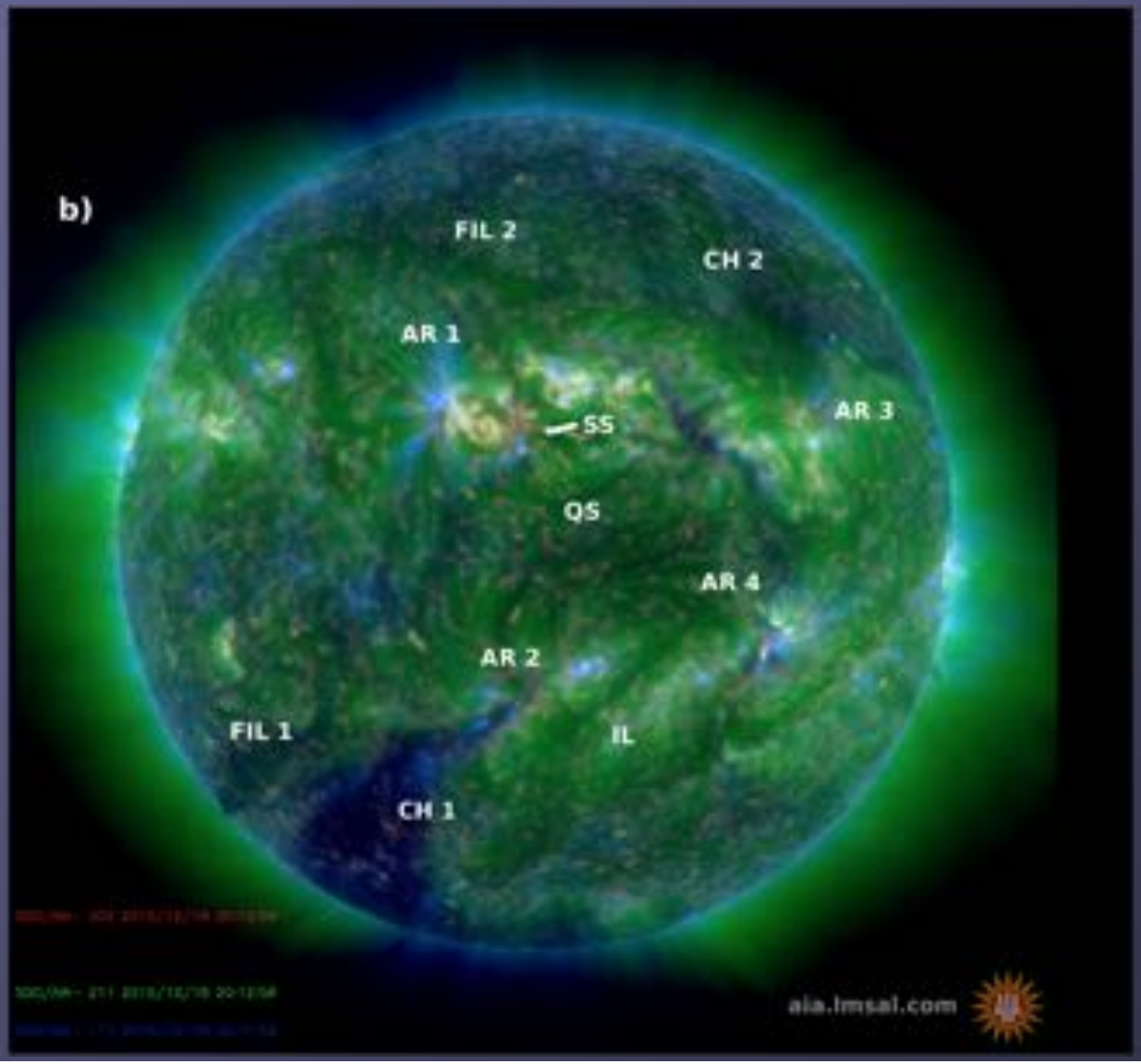
NSO, NISP, Cerro Tololo, 18 December 2015, Hα; AR, SS, FIL

20:12 UT

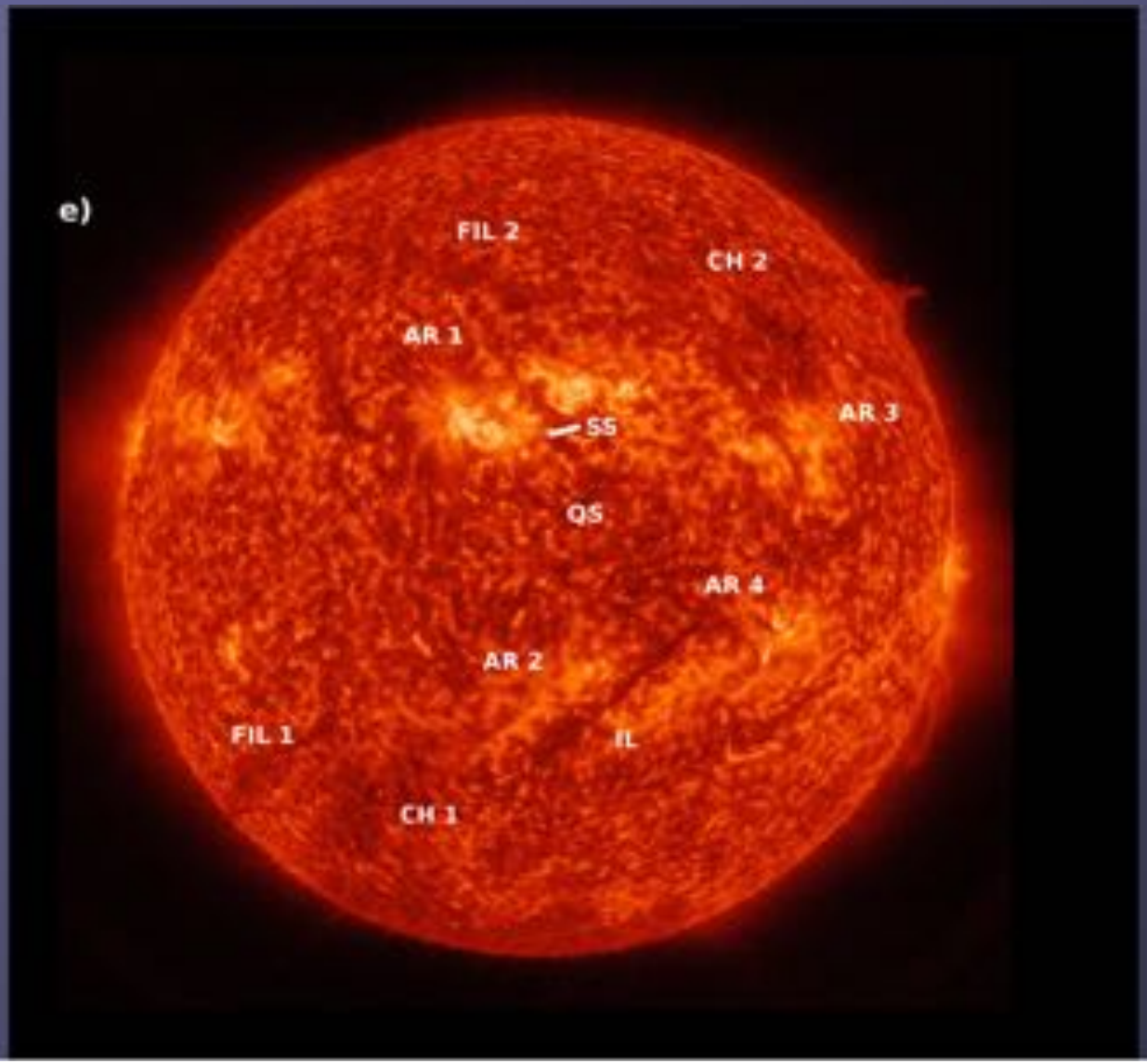


SDO/AIA, 18 Dec. 2015, λ=17.1nm, λ=30.4nm, λ=21.1nm; AR, CH

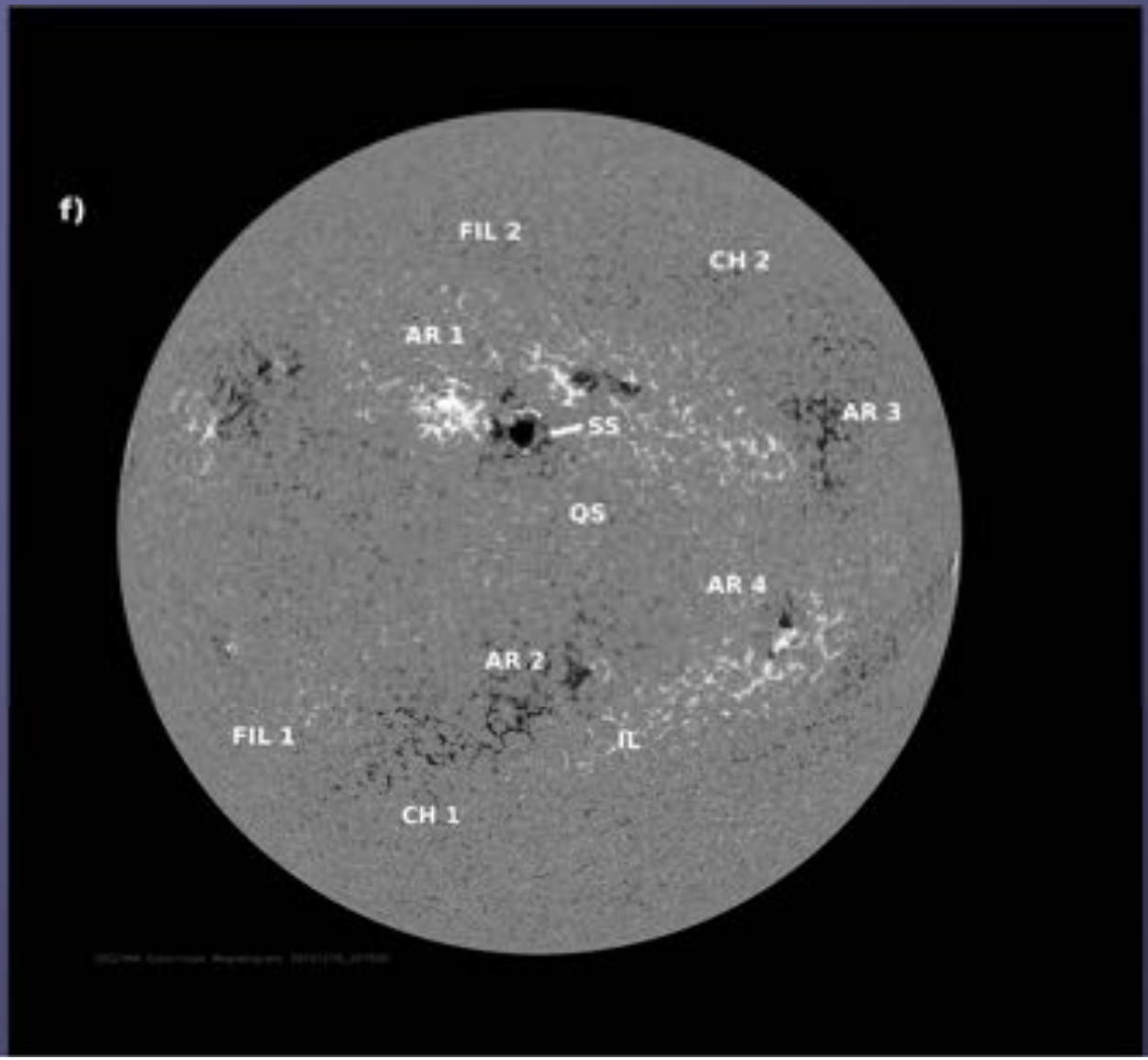
20:12:58 UT



SDO/AIA, 18 December 2015, λ=30.4 nm; AR, FIL, IL



SDO/HMI, 18 December 2015; IL, AR1: B_{max}≈1000 G; SS: B_{max}=1500-2500 G

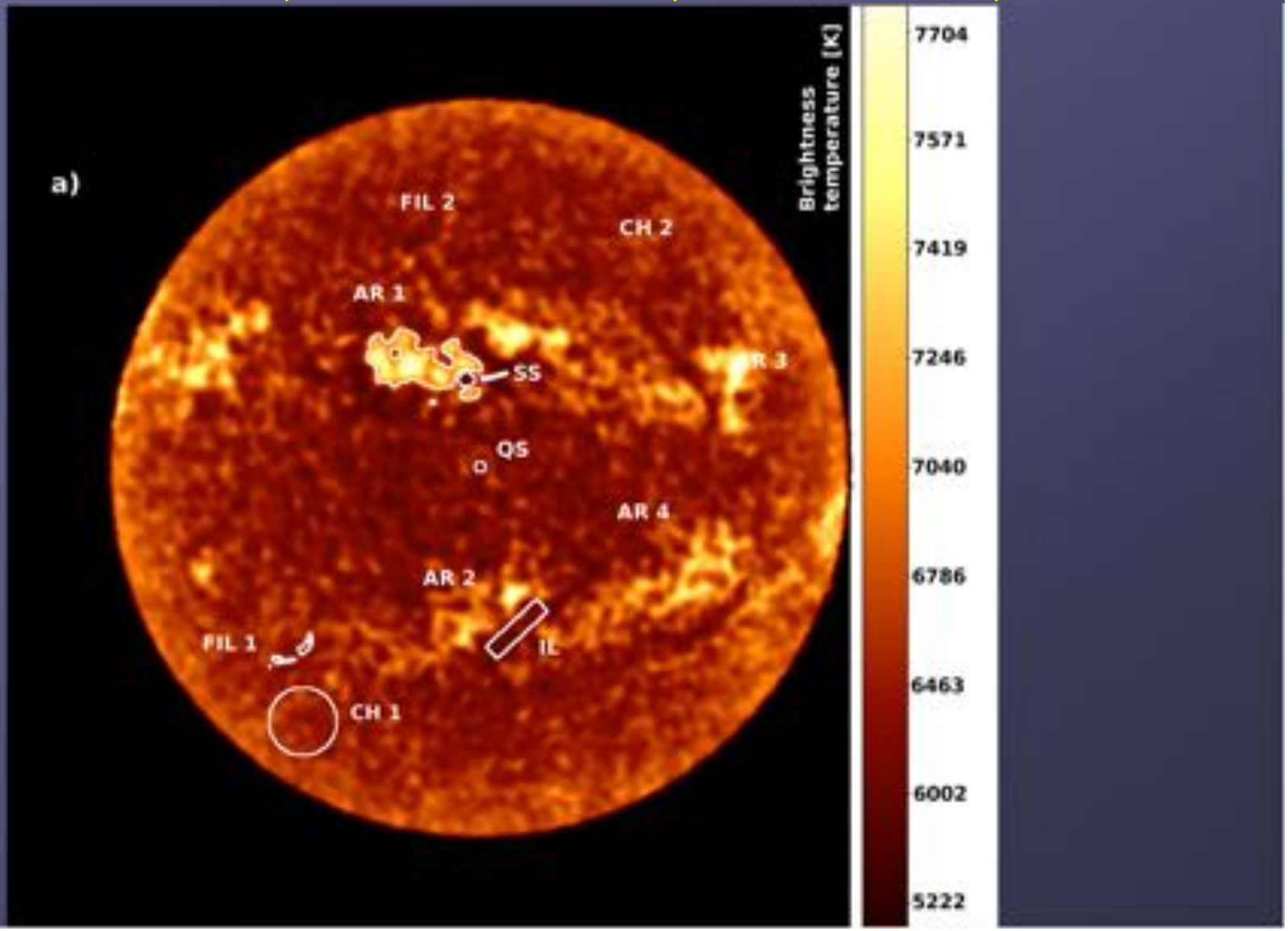


ALMA, 18 December 2015, λ=1.21 mm, 248 GHz, Band 6, RoI

CSV data release

20:12:21 UT

Brajša et al. (2017a)



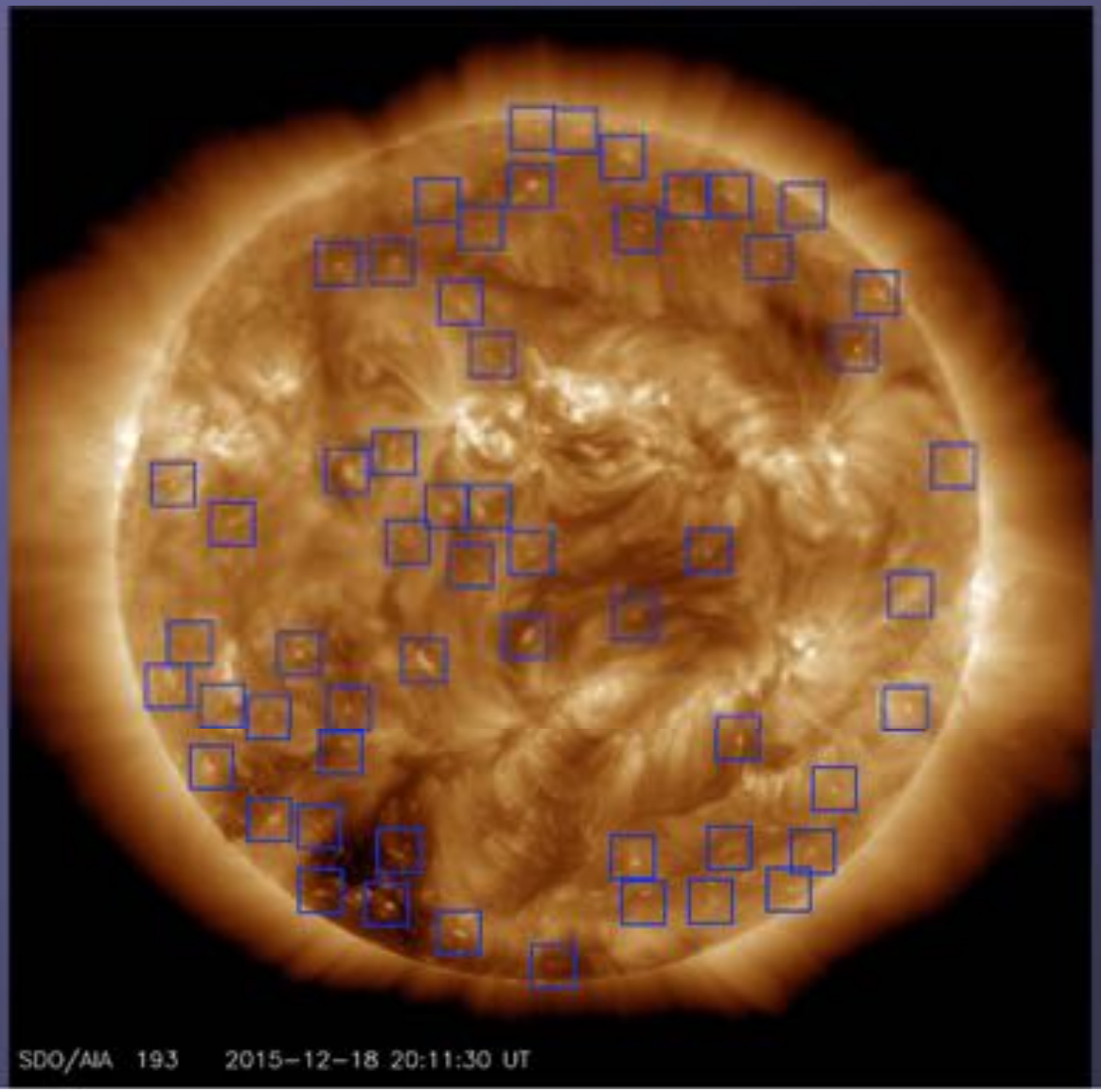
Structure	r (pixels)	T_b(QS) (K)	T_b(structure) (K)	ΔT_b (K)
QS	0	6040	6040	0
SS	77	6165	6080	−85
AR	105	6238	7253	+1015
IL	147	6302	6127	−175
PR (FIL)	229	6461	6347	−114
CH	273	6585	6537	−48

- QS – Quiet Sun
- SS – Sunspot
- AR – Active Region
- IL – Inversion magnetic line
- PR (FIL) – Prominence on the disc
- CH – Coronal Hole
- r – relative distance from the disc center
- $\sigma_{av}(T_b) \approx 150$ K
- limb brightening ≈ 10 %

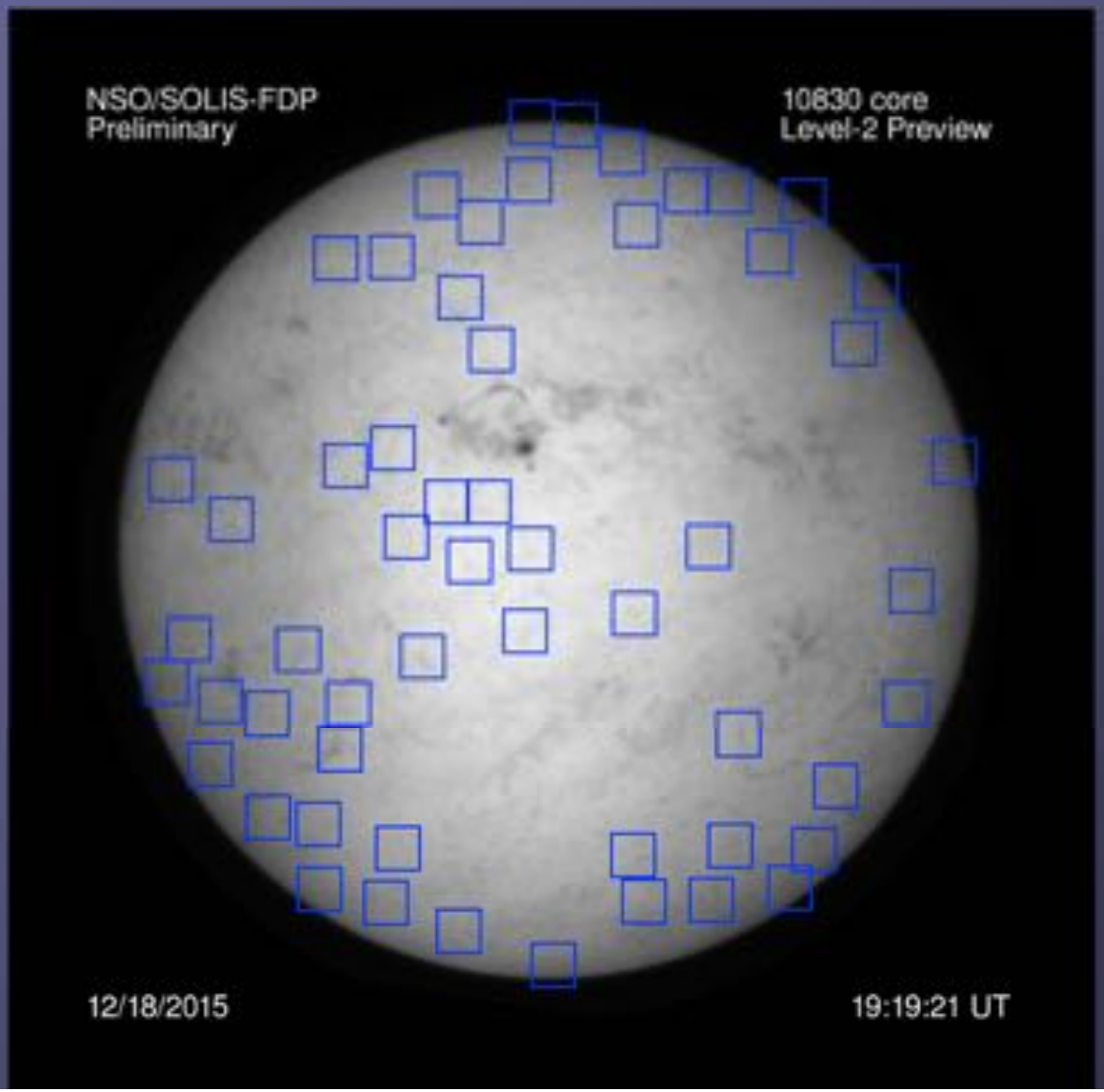
Topic 2: Full-disc solar images: coronal bright points

- Can coronal bright points be seen in full disc ALMA images of the Sun ?
- single dish, total power, 18 December 2015
- λ=1.21 mm, 248 GHz Band 6
- Brajša et al. (2017a)

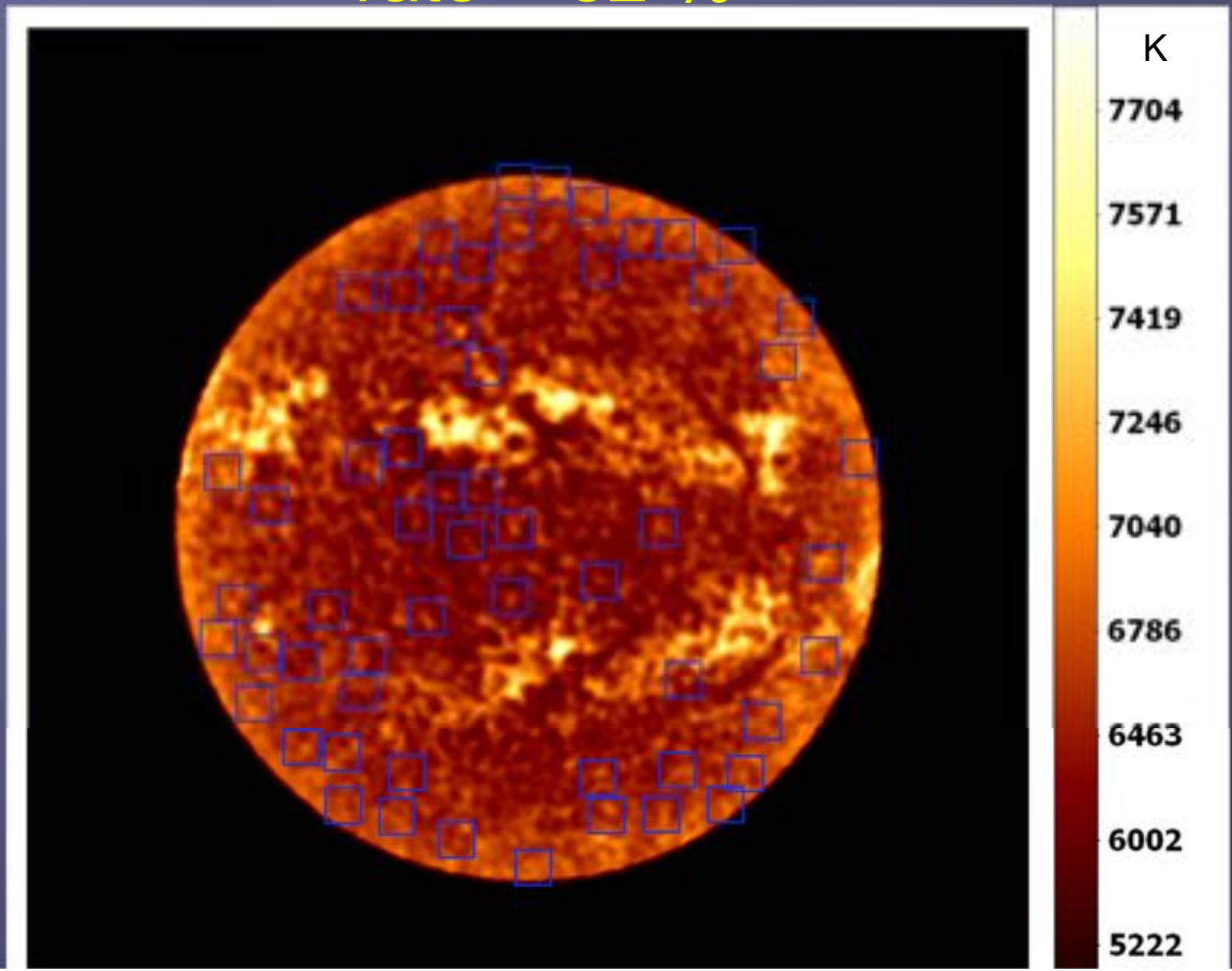
Coronal bright points, SDO/AIA, 19.3 nm, 56 structures



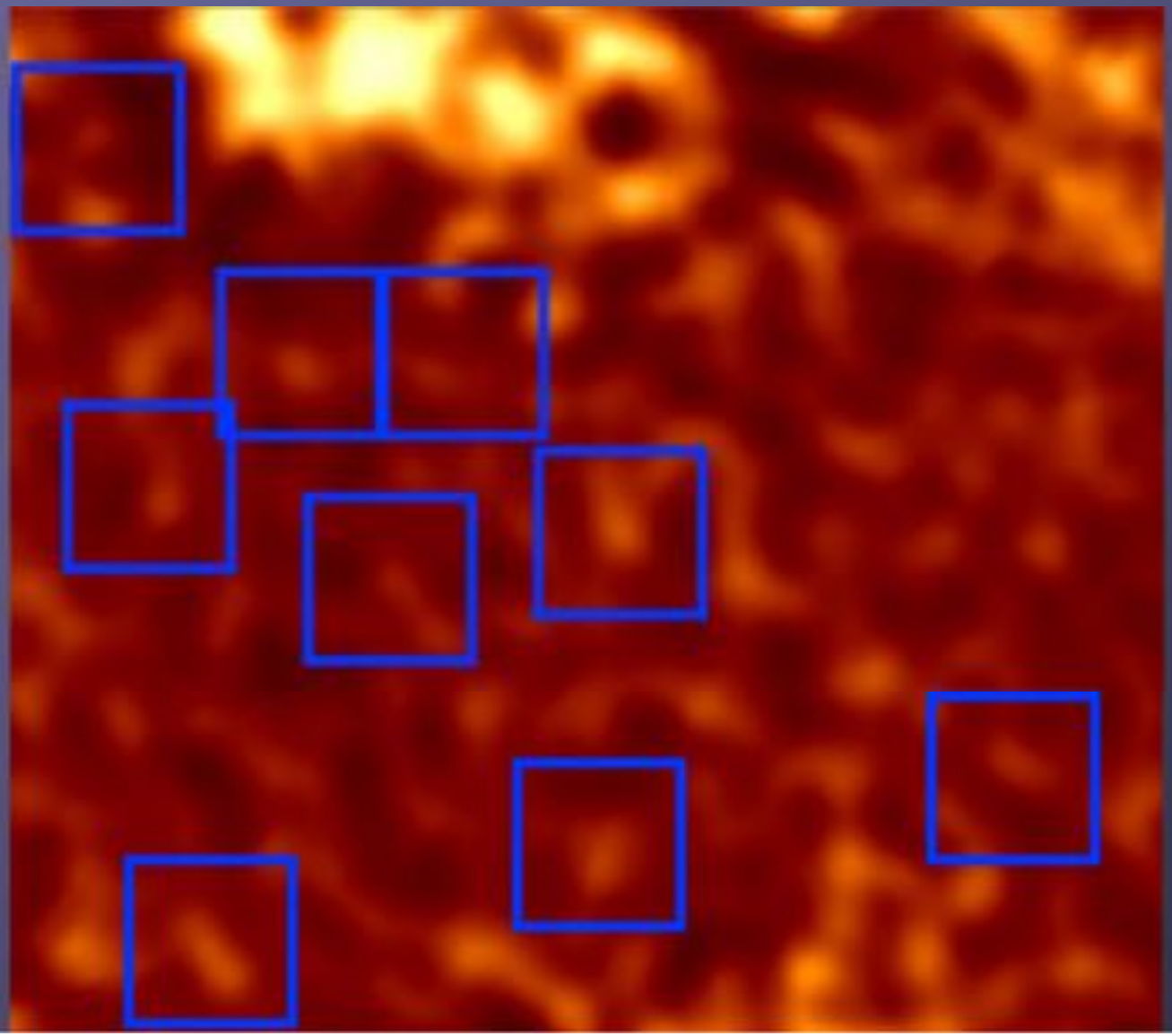
He 1083 nm dark points, NSO/SOLIS, Tucson, assoc. rate = 75 %



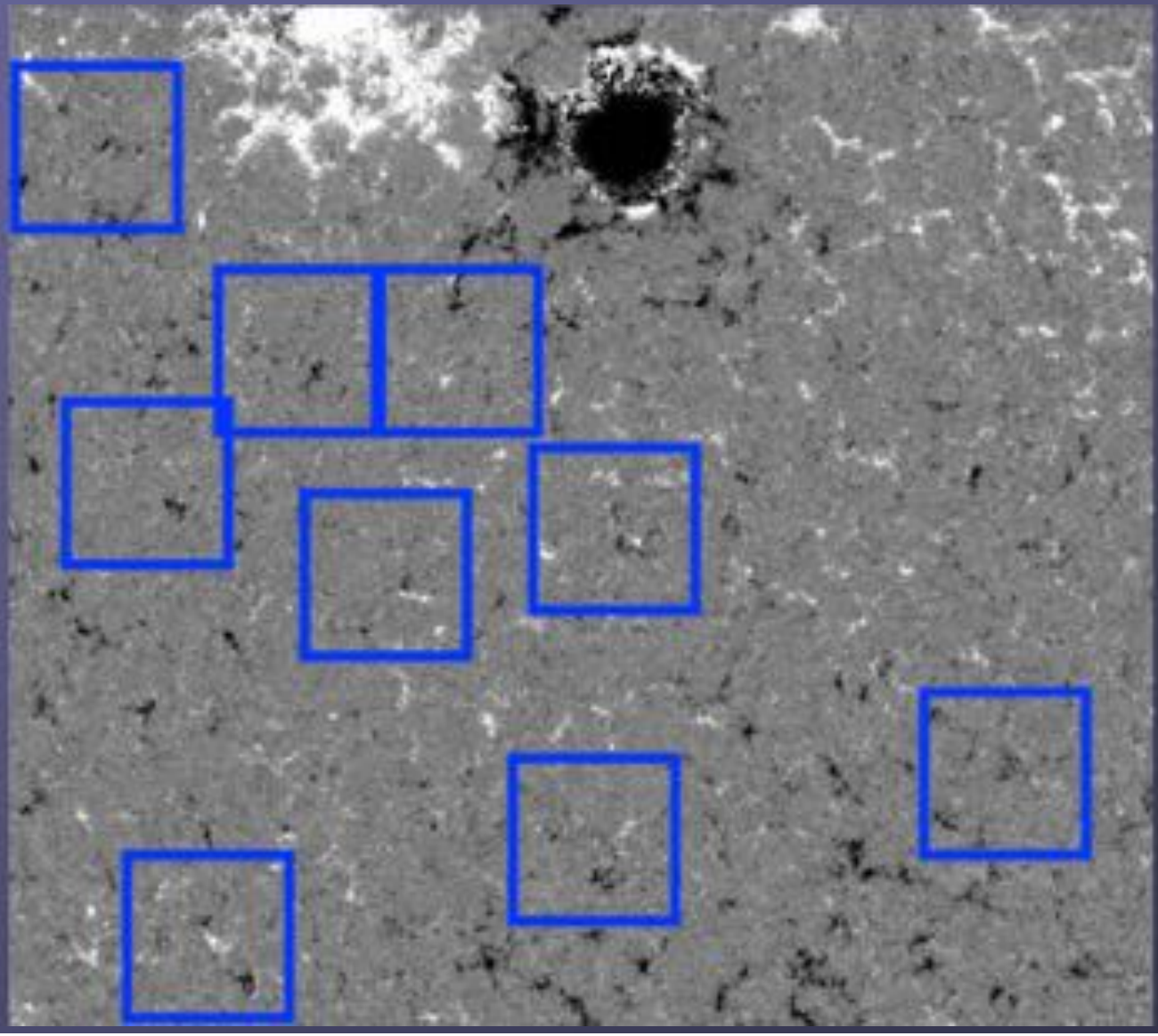
ALMA, λ=1.21 mm, 248 GHz, assoc. rate = 82 %



Zoom in, ALMA, d ≈ 486 Mm



Zoom in, SDO/HMI

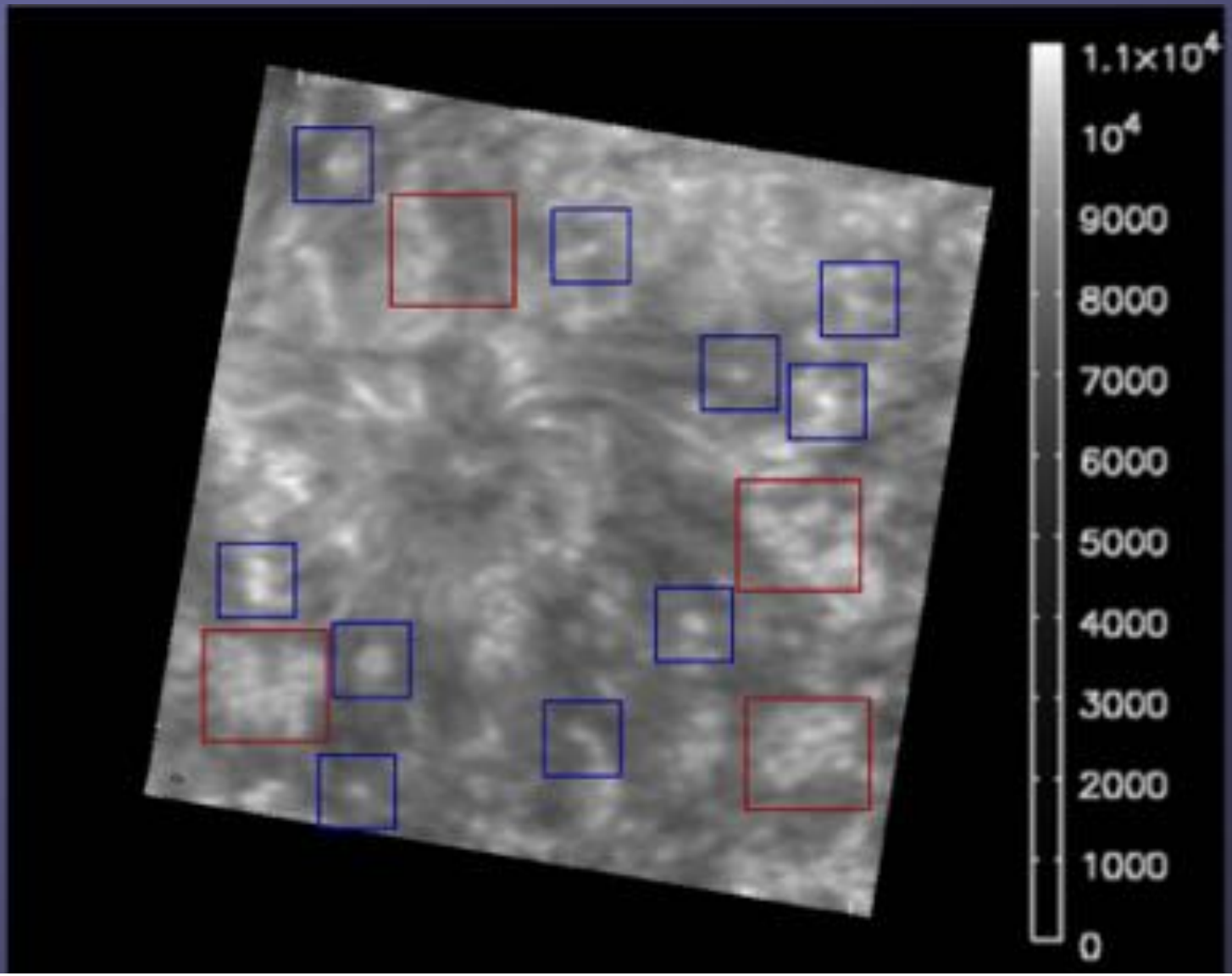


Topic 3: Interferometric images, fine structures

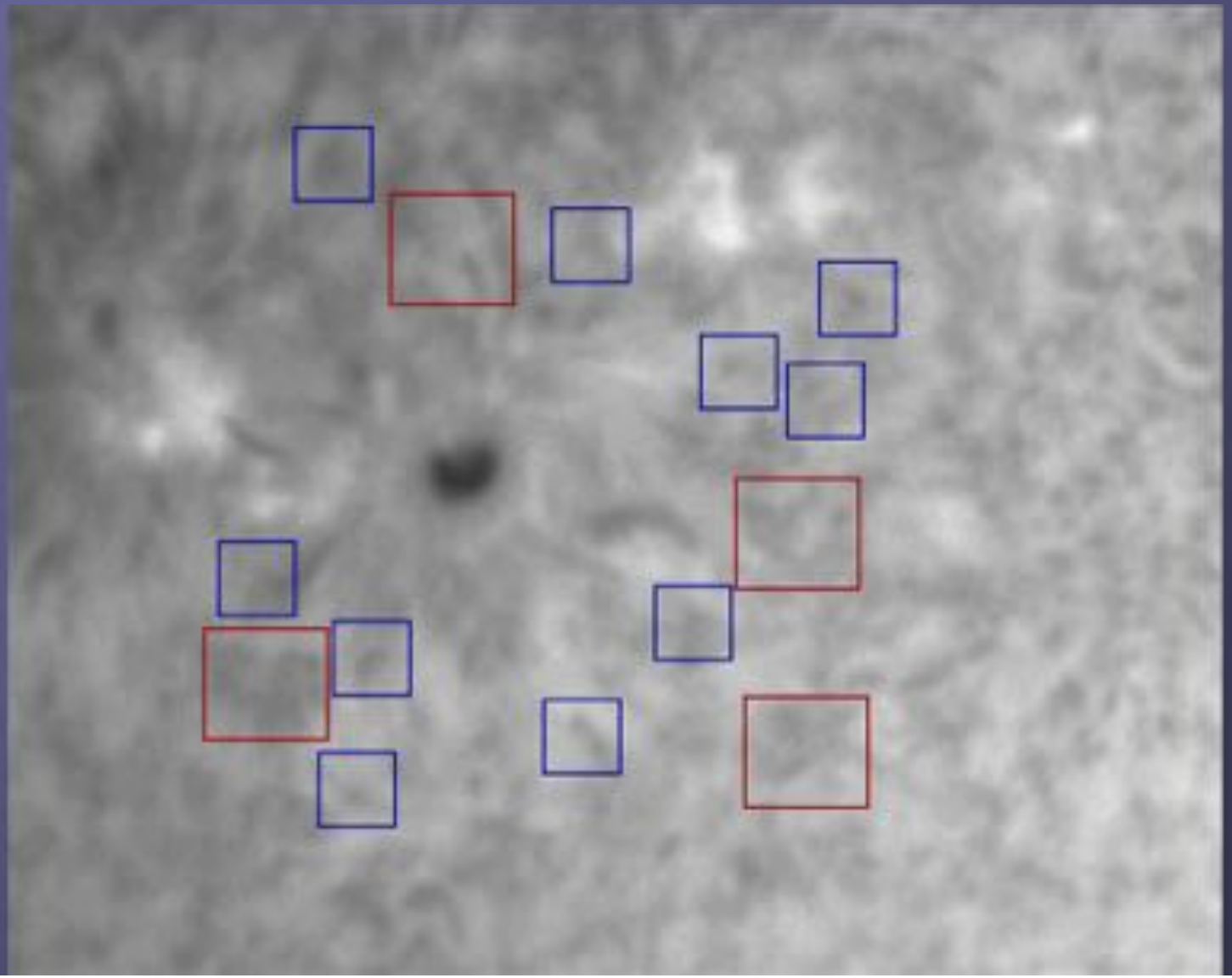
- What are small bright structures seen in high resolution interferometric images ?
- λ=3 mm, 100 GHz Band 3, 16 December 2015
- Sunspots ?
- Brajša et al. (2017b)

ALMA, 16 December 2015, λ=3 mm, 100 GHz Band 3

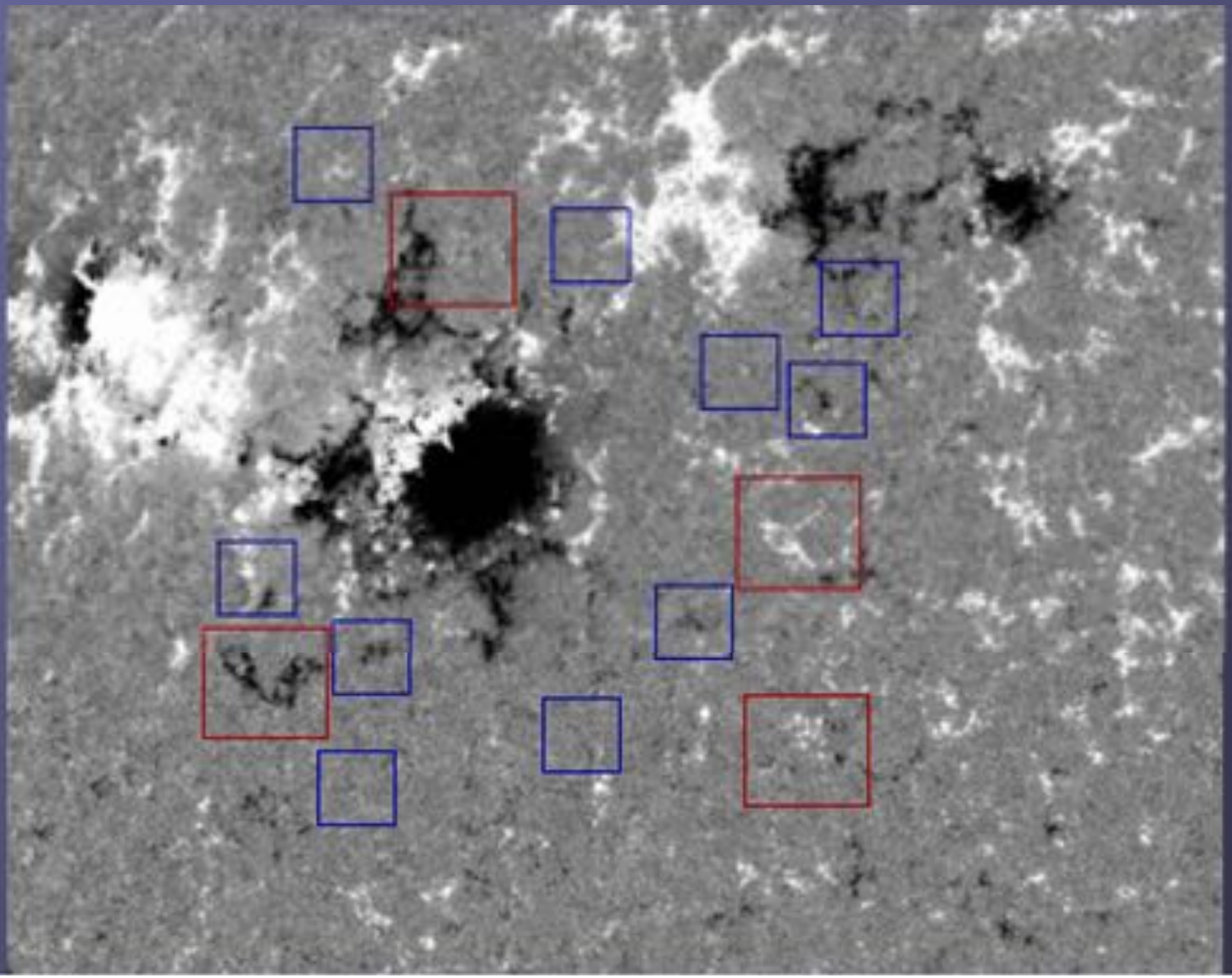
- ă:32 UT
- ą ïpt
- ÿÿx300 arc sec
- Āx5 arc sec



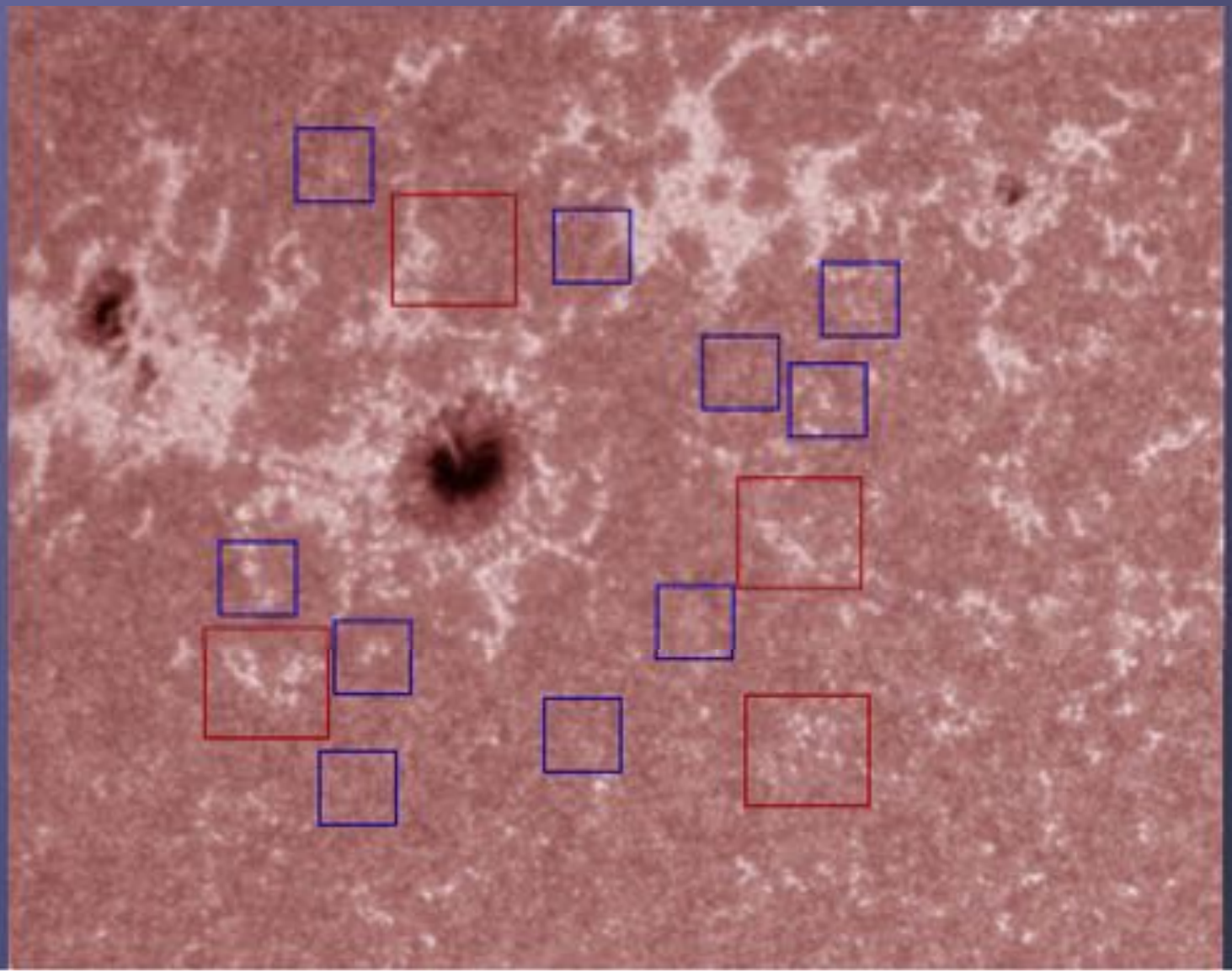
NSO/SOLIS, H-alpha wing, Tucson



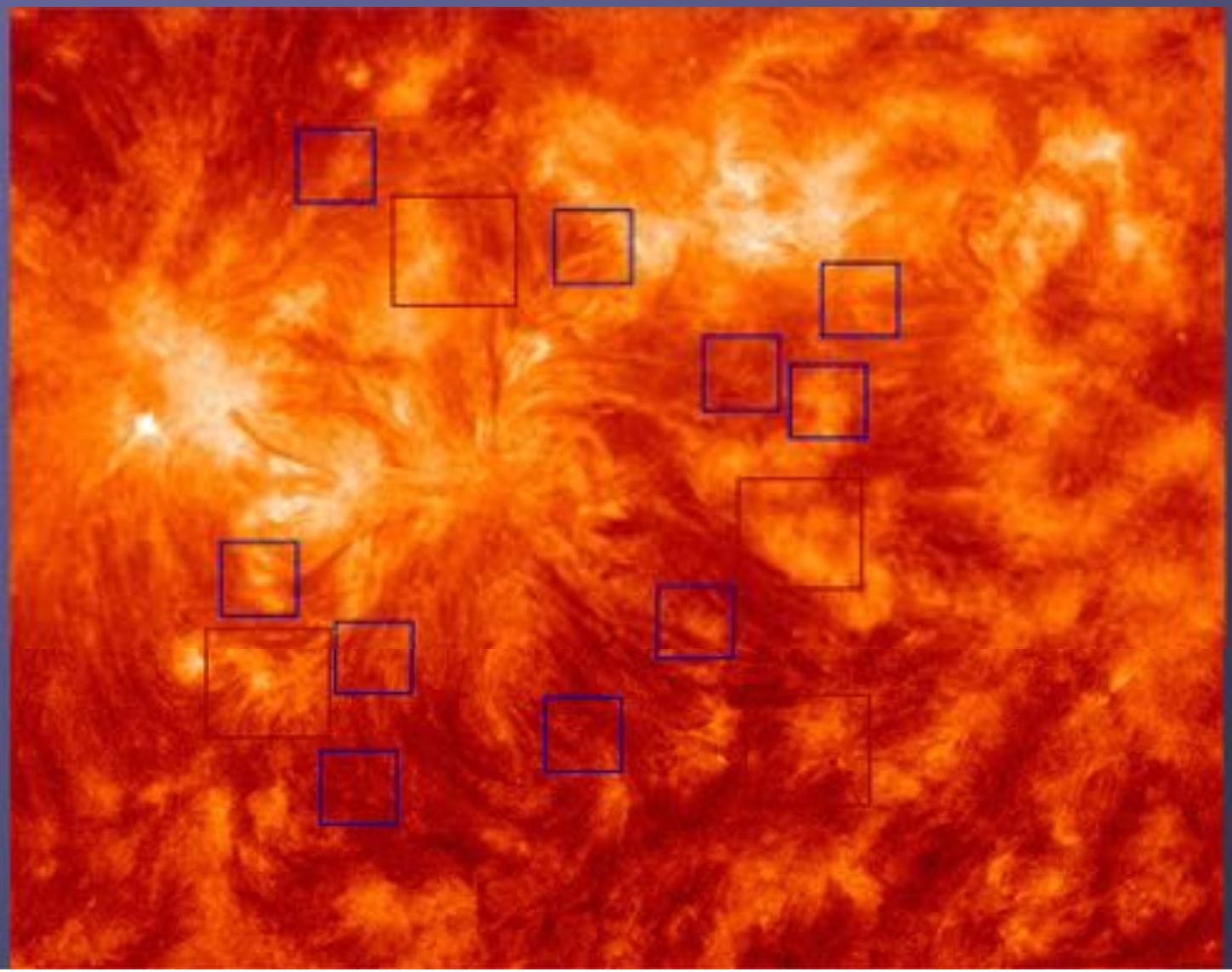
SDO/HMI, magnetogram



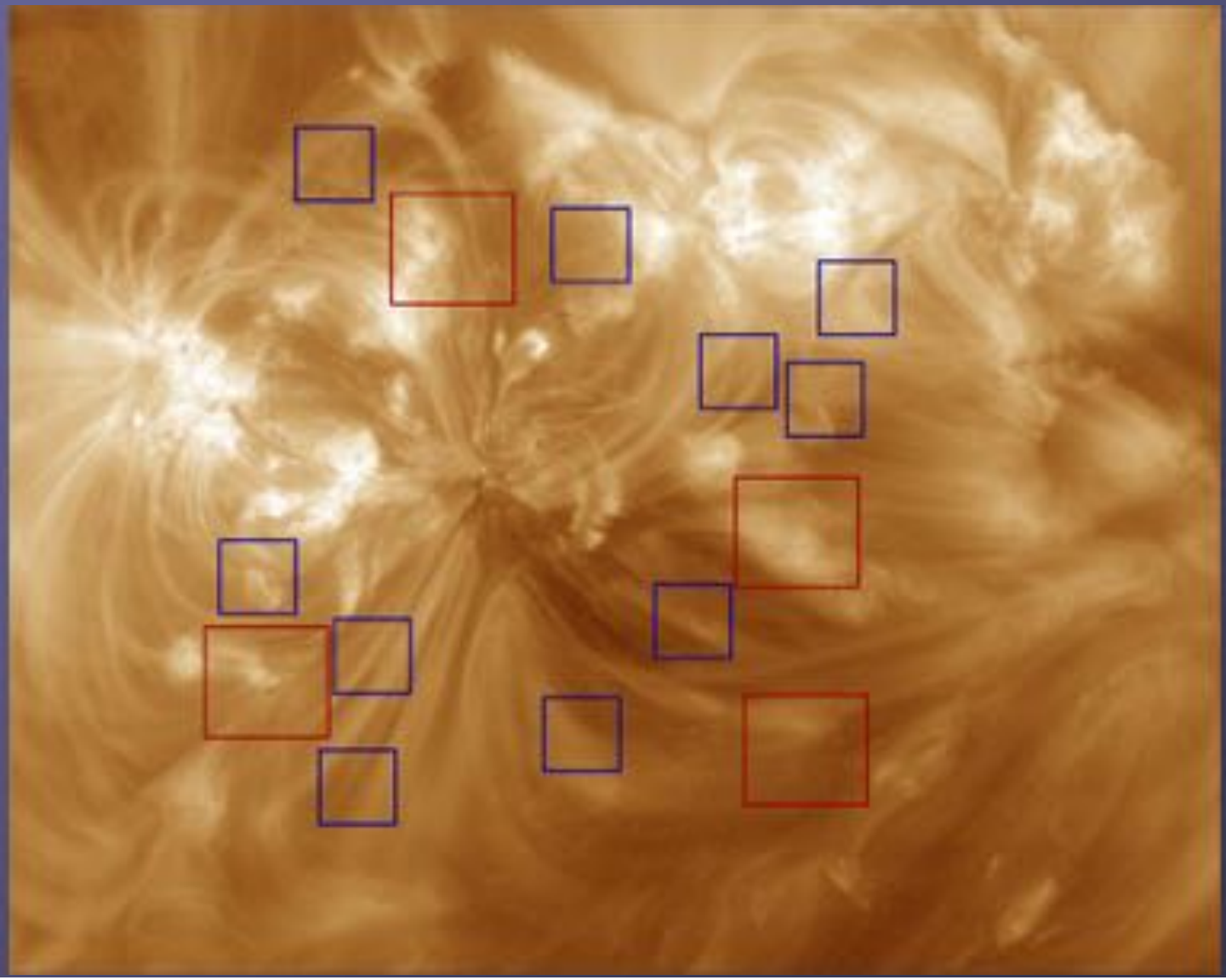
SDO/AIA, 170 nm



SDO/AIA, 30.4 nm



SDO/AIA, 19.3 nm



Conclusions

- INT image reconstruction → correct
- pointing and overlaying (coalignment) of ALMA images with other images → successful, TP & INT
- ARs → bright in B6 & B3
- sunspot umbra → dark in B6, but → bright in B3
- filaments (on disc) and CHs are not discernible against the QS background
- large-scale elongated dark structures in B6 → inversion lines of the magnetic field
- coronal bright points → He 1083 dark points → ALMA B6 (TP) bright points; strongly correlated with magnetograms
- small bright ALMA B3 (INT) structures → Hα dark points → magnetograms → UV continuum
- limb brightening

Acknowledgements

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