High resolution analysis of chromospheric fine structure with ALMA

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Agenda

Topic 1: Full-disc solar ALMA image, $\lambda=1.21$ mm: general look

Topic 2: Full-disc solar ALMA image, $\lambda=1.21$ mm: coronal bright points

Topic 3: Interferometric ALMA image, $\lambda=3.0$ mm: fine structures & series of images ("movie")

Conclusions

Acknowledgements
Topic 1: Full-disc solar images, general look

- Identification of solar structure in full disc ALMA images
- Single dish, total power, 18 December 2015
- $\lambda=1.21$ mm, 248 GHz, Band 6
- Brajša et al. (2017a)
SDO/AIA, 18 December 2015, \( \lambda = 170 \text{ nm} \); 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, \(\lambda=30.4\) nm; AR, FIL, IL
SDO/HMI, 18 December 2015; IL, AR1: $B_{\text{max}} \approx 1000$ G; SS: $B_{\text{max}} = 1500$-$2500$ G
ALMA, 18 December 2015, \( \lambda=1.21 \text{ mm}, \) 248 GHz, Band 6, RoI

CSV data release

20:12:21 UT

Brajša et al. (2017a)
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 $\approx 10\%$
Can coronal bright points be seen in full disc ALMA images of the Sun?

- single dish, total power, 18 December 2015
- $\lambda=1.21$ 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, $\lambda=1.21$ mm, 248 GHz, assoc. rate = 82 %
Zoom in, ALMA, $d \approx 490 \text{ Mm}$
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, \( \lambda=3 \) mm, 100 GHz Band 3.
NSO/SOLIS, H-alpha wing, Tucson
SDO/HMI, magnetogram
SDO/AIA, 170 nm
SDO/AIA, 30.4 nm
SDO/AIA, 19.3 nm
Conclusions

- pointing and overlaying (coalignment) of ALMA images with other images → successful, TP (≈5") & INT (≈1")
- INT image reconstruction → correct
- 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

Research leading to this work was performed within ESO Development Plan Study: Solar Research with ALMA (2014 - 2017).

This work has been supported in part by Croatian Science Foundation under the project 6212 ”Solar and Stellar Variability” and by the European Commission FP7 project SOLARNET (312495, 2013 - 2017), which is an Integrated Infrastructure Initiative (I3) supported by FP7 Capacities Programme.

The authors would like to thank: M. Barta, T.S. Bastian, A.S. Hales, R.E. Hills, H.S. Hudson, K. Iwai, A. Kobelski, M. Loukitcheva, N.M. Phillips, P. Saint-Hilaire, M. Shimojo, S. Wedemeyer, S.M. White, P. Yagoubov for help, support and excellent cooperation during various phases of this work.