An analysis of large-scale solar structures observed with ALMA



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Fig. 1: ALMA intensity map at 248 GHz (λ = 1.21 mm, 20:12:21 UT, December 18th, 2015). The brightness temperature is given in K. AR indicates the position of several active regions, FIL filaments, while CH denotes the position of a coronal hole (adapted from Brajša et al.

Fig. 2: SDO composite image from AIA 30.4 nm, 21.1 nm, and 17.1 nm instruments (20:12:58s UT, December 18th, 2015).

Fig. 3: Hα filtergram from Cerro Tololo Observatory, NISP (20:12m UT, December 18th, 2015).



The dependence of the product $n_e \cdot T_e$ on the height above the solar photosphere. This quantity has the same profile for the various prominence models as well as for the quiet Sun model, since the temperature is divided and the density multiplied by the same factor *f*.



The calculated quiet Sun temperature (lowest curve, black) as a function of wavelength covering the ALMA wavelength range. The three curves in the upper part of



The assumed dependence of the temperature, T, on the height, h, above the solar photosphere for all non-hole solar models NH1-4.



A comparison of the brightness temperatures calculated with the quiet Sun model and several previous measurements summarized by Benz (2009). Red dot indicates ALMA quiet Sun measurement from Table 1.







Wavelength dependence of the calculated brightness temperature for the quiet Sun model (black, lowest curve) and the four non-hole solar models NH1-4. Red

the plot indicate the wavelength dependence of the three models of active regions (HTR1, HTR2, HTR3). Red dot indicates ALMA AR2 measurement from Table 1. presented here together with the quiet Sun model (QS). Red dot indicates ALMA FIL1 measurement from Table 1. dot indicates ALMA CH measurement from Table 1.

Table 1: Brightness temperature of different solar structures as measured from ALMA 248 GHz single dish image (adapted from Brajša et al. 2018)

Structure	r [pixels]	T _b (QS) [K]	n (QS) [pixels]	T _b (structure) [K]	n (structure) [pixels]	$\Delta T_{b} = T_{b}(structure) - T_{b}(QS) [K]$
QS (quiet Sun)	0	6040 ± 70	78	6040 ± 70	78	0
SS (sunspot)	77	6170 ± 140	2833	6080 ± 210	136	-90
AR 2 (active region)	105	6240 ± 150	2832	7250 ± 210	3048	+1010
IL (inversion line)	147	6300 ± 160	2833	6130 ± 160	897	-170
FIL 1 (filament)	229	6460 ± 160	2824	6350 ± 110	154	-110
CH (coronal hole)	273	6590 ± 140	2833	6540 ± 130	2804	-50

Notes: Structures refer to regions of interest denoted in Fig. 1. The mean value of brightness temperature of each structure is compared with the quiet Sun region at the same radial distance from the center of the disk, *r* in pixels. The averaging was performed within the regions of interest and the number of pixels is denoted by *n*.

References:

• Benz, A. O.: 2009, Landolt Börnstein p. 4116.

• Brajša, R., Sudar, D., Benz, A. O., Skokić, I., Bárta, M. et al.: 2018, Astron. Astrophys. 613, A17.