Submm observation of Mars using ALMA

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Mars is well known for its dusty atmosphere, that is, the atmosphere always contains floating dust particles. Such dust particles are constantly supplied from the surface, and play a key role in controlling the thermal structure of the planet by absorbing the solar radiation.
The best remote-sensing tool to investigate the Martian atmosphere inside such dusty condition is to use mm/submm wavelength. This is mainly because the dust opacity becomes almost transparent at these wavelength. At the same time, thanks to high frequency resolution of the heterodyne technique, which is one of the uniqueness of mm/submm observations, one can measure the pressure-broadened line shape of opaque ^{12}CO lines. This gives the information on the vertical profile of atmospheric temperature. In addition, the high frequency resolution enables to measure the atmospheric wind velocity (in the line-of-sight projection) by detecting the Doppler-shift of those molecular lines.
In this paper, we present the results of the submm observations of Mars using ALMA which have been conducted as a part of the Target-of-Opportunity observation. The observations were carried out on 1 and 14 May, 2014, when Mars apparent disk size was 14.5 arcsec. The solar longitude was 124 and 130 degree, respectively, corresponding to the late summer in the northern hemisphere. During the observation, the ALMA array was consist of 32 antennas with the baseline length ranging between 17 and 558 m. This configuration yields the synthesis beam size of 0.6 arcsec, which corresponds to ~300 km at the sub-earth point in the Martian surface. We observed ^{12}CO (3–2) at 345 GHz with two correlator configurations: a high frequency resolution (122 kHz) and a bit sparse one (1 MHz) for the line center (234 MHz-width) and for the broad wings of the absorption line (1 GHz), respectively.
Due to the fact that Mars being significantly larger than the maximum recoverable spatial scale of the ALMA array, the resolve-out of the brightness of extended features was the main issue in the data analysis. Also, we have to deal with the bright continuum emission which makes the deconvolution (CLEAN) procedure time consuming. We will discuss how to optimize the interferometric data reduction for such a bright and extended object.

Keywords: ALMA, Mars, Planetary Atmosphre

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