The first ALMA observation of a plasmoid ejection from an X-ray Bright Point

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Extended Abstract

Eruptive phenomena such as plasmoid ejections or jets are an important feature of solar activity with the potential for improving our understanding of the dynamics of the solar atmosphere. Such ejections are often thought to be signatures of the outflows expected in regions of fast magnetic reconnection. The 304 Å EUV line of Helium, formed at around 10^5 K, is found to be a reliable tracer of such phenomena, but the determination of physical parameters from such observations is not straightforward. We have observed a plasmoid ejection from an X-ray bright point simultaneously at millimeter wavelengths with ALMA, at EUV wavelengths with AIA, in soft X-rays with Hinode/XRT. This paper reports the physical parameters of the plasmoid obtained by combining the radio, EUV and X-ray data. As a result, we conclude that the plasmoid can consist either of (approximately) isothermal ~10^5 K plasma, or else a ~10^4 K core with a hot envelope. In both the cases, the 100 GHz emission detected by ALMA may be optically thin, confirming that the ALMA images show not only the τ =1 layer at 100 GHz located in chromosphere but also optically thin plasma located in transition region or corona. The analysis demonstrates the value of the additional temperature and density constraints that ALMA provides, and future science observations with ALMA will be able to match the spatial resolution of space-borne and other high-resolution telescopes.

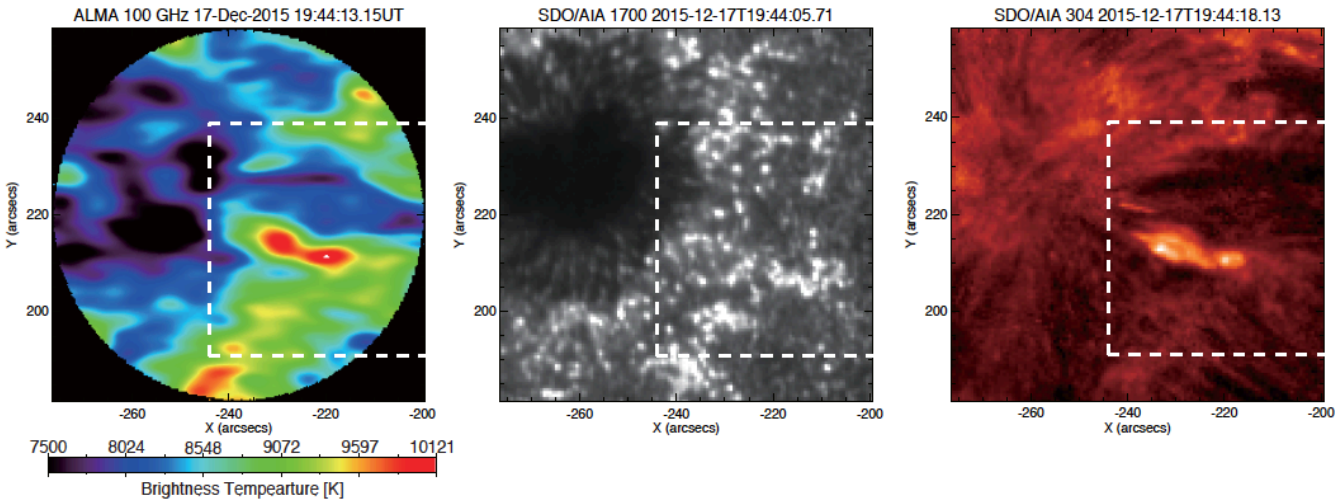

Figure 1: he leading sunspot of active region NOAA12470 observed with ALMA at Band 3 (100 GHz, left panel), in ultraviolet continuum from the lower chromosphere (AIA 1700 Å, middle panel), and the He II transition region line (AIA 304 Å, right panel).