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Plateau de Bure observations of the methanol in 103P/Hartley

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Abstract

The comet 103P/Hartley 2 made a close approach to the Earth in October 2010, down to a distance of 0.12 AU. In early November, the Deep Impact spacecraft performed a flyby of the comet, in the framework of its extended mission Epoxi [1]. It has been the target of various observing campaigns at all wavelengths involving ground- and space-based observatories [2]. We present here the results of observations performed with the IRAM Plateau de Bure. We observed the emission of several methanol lines from which we built the methanol rotation diagram and measured the rotational temperature in the coma. The interferometric maps have a spatial resolution of few arcseconds, corresponding to few hundred kilometers. Combined to single dish observations these data allow the measurement of the temperature profile in the coma. In addition, other coma properties can be investigateded from our data set such as the origin of methanol in the coma, the coma structure and its time variability.

1. Observations

The emission of six methanol lines around 157 GHz in comet 103P/Hartley 2 was observed with the IRAM Plateau de Bure interferometer on 28 October 2010. The geocentric and heliocentric distances of the comet were 0.13 AU and 1.06 AU, respectively. The resolution in the interferometric maps is of the order of 2". Figure 1 presents the interferometric map of the methanol emission line at 157.246 GHz (403-414 transition), where the brightness peak appears to be shifted by ∼4" to the south of the ephemeris and continuum brightness peak positions. Some single dish spectra were also recorded in a primary beam of ∼30", they are presented in Figure 2.

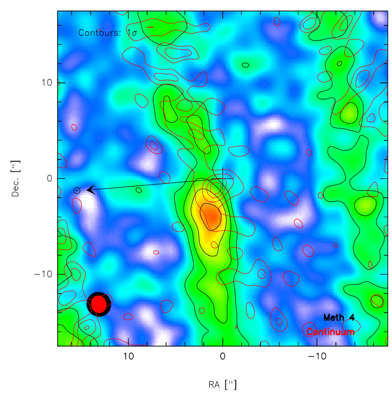

Figure 1: Interferometric map of the methanol 403-414 emission line at 157.246 GHz observed with the Plateau de Bure on 2010, October 28. The red contours represent the continuum emission map. The black and red ellipses in the bottom left corner represent the interferometric beam of the methanol and continuum map, respectively.

2. Temperature measurements

Building rotation diagrams from the fluxes of different rotational lines of methanol is the usual way to measure temperatures in cometary atmospheres [4]. From the 6 lines we observed in Single Dish and interferometry, we built 2 rotational diagrams (Figure 3), corresponding to different scales in the coma. We deduce temperatures of 46.9±1.3 and 41.6±6.7 K from the Single Dish and interferometric data, respectively. This suggests a faint increase of the temperature between the innermost coma (∼200 km) probed in interferometry and outer regions (∼3000 km) probed in Single Dish mode. However given the low signal-to-noise ratio of the interferometric dataset, the error

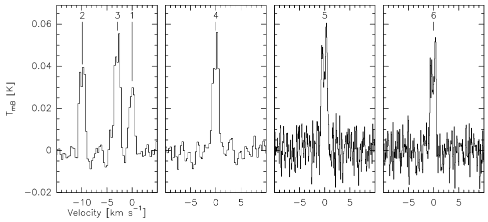

Figure 2: On-Off single dish spectra of 6 methanol transitions around 157 GHz obtained at the IRAM Plateau de Bure on 2010, October 28.

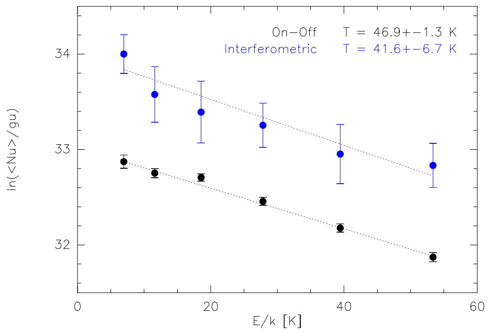

Figure 3: Methanol rotation diagrams as deduced from Single Dish (**black**) and Interferometric (**blue**) observations.

bar on the temperature measurement in the innermost coma is large.

3. Extended source of methanol

The Deep Impact observations of 103P as well as the radar experiments performed at Arecibo revealed the presence of large icy grains around the comet, that could represent an extended source of gas in the comet atmosphere [1, 3]. Our simultaneous On-Off and interferometric observations can be used to study the radial extent of molecules in cometary atmospheres, as it was done for molecules observed in Hale-Bopp [5, 6]: the On-Off to interferometric flux ratio depends on the parent scalength of the observed molecule. We compared the observed ratio to the values deduced from coma models taking into account different origins for the methanol in Hartley 2. Though the results are affected by strong uncertainty, our study suggests the contribution of a slightly extended source that could be the "snowballs" as observed by the Deep Impact space craft.

4. Summary and Conclusions

The analysis we performed so far revealed that: 1) the temperature profile in the coma is rather flat, though the temperature seems to slightly increase with the distance to the nucleus; 2) a part of the methanol could be released by the sublimation of the snowballs observed by Deep Impact. Some other aspects of the coma can be studied in our data set: time variations, coma structure, comparison to simultaneous continuum measurements. These are the objects of ongoing studies which results will be also presented.

Acknowledgements

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References

[1] A'Hearn, M.F., & the DIXI Science Team 2011, 42nd Lunar Plant. Sci. Conf., 2516

[2] Meech, K.J., A'Hearn, M.F., Adams, J.A., et al. 2011, Astrophys. J. Letters, 734, L1

[3] Harmon, J.K., Nolan, M.C., Howell, E.S., et al. 2011, Astrophys. J. Letters, 734, L2

[4] Bockelée-Morvan, D., Crovisier, J., Colom, P., & Despois, D. 1994, Astron. Astrophys., 287, 647

[5] Bockelée-Morvan, D., Boissier, J., Biver, N., & Crovisier, J. 2010, Icarus, 210, 898

[6] Boissier, J., Bockelée-Morvan, D., Biver, N., et al. 2007, Astron. Astrophys., 475, 1131