The discovery of glycolaldehyde in a star forming region

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Abstract. Glycolaldehyde is the simplest of the monosaccharide sugars and is directly linked to the origins of life. We report on the detection of glycolaldehyde (CH₂OHCHO) towards the hot molecular core G31.41+0.31 through observations with the IRAM PdBI (Plateau de Bure Interferometer) at 1.4, 2.1, and 2.9 mm.

The CH₂OHCHO emission comes from the hottest (≥ 300 K) and densest (≥ 2×10⁸ cm⁻³) region closest (≤ 10⁴ AU) to the (proto)stars. The comparison of data with gas-grain chemical models of hot cores suggests for G31.41+0.31 an age of a few 10⁵ yr. We have also shown that only small amounts of CO need to be processed on grains in order for existing hot core gas-grain chemical models to reproduce the observed column densities of glycolaldehyde, making surface reactions the most feasible route to its formation (Beltràn et al. 2009).

Figure 1 shows the brightness temperature scale of the CH₂OHCHO (202,18−193,17), (140,14−131,13), and (101,9−92,8) at 220463.87, 143640.94, and 103667.91 MHz, respectively, as observed towards the central position of the G31.41+0.31 hot core - see Beltràn et al. 2009 for details. Rest frequencies are pointed out by vertical bars.

• Upper panel: the glycolaldehyde line is blended with the CH₃CN (12-11; K = 8) line. Two additional lines are present: (i) ¹³CH₃CN (12⁰−11⁰; labeled by K'), and (ii) HCOOCH₃-A (2511⁰−269⁰; 1204445.79 MHz; Eu = 272 K) which could contain an emission contribution due to the CH₂OHCHO (184,14−174,13) (220433.51 MHz; Eu = 108 K) line. The continuous line shows the fit to the group of three lines formed by the CH₂OHCHO (202,18−193,17), CH₃CN (12-11; K = 8), and ¹³CH₃CN(12-11; K’ = 6); the dotted lines draw the three individual Gaussian curves used for the fit.

• Middle panel: the CH₂OHCHO line is part of a spectral pattern containing also the HCCC¹³CCN (143636.63 MHz; Eu = 183 K), C₂H₅CN (332,31−324,28 (143646.50 MHz; Eu = 620 K), and C₂H₅OH (292,28−283,26 (143651.78 MHz; Eu = 415 K) lines. The results of the fit as drawn as in the upper panel.

• Lower panel: besides the glycolaldehyde emission, an unidentified spectral pattern is present around 103674 MHz. The solid curve shows the fit of the isolated CH₂OHCHO line.

References
Figure 1. Beam-averaged spectra in the hot core of G31.41+0.31 (after Beltrán et al. 2009)