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J/A+A/628/A72 C_2_O and C_3_O in low-mass star-forming regions (Urso+, 2019)

C_2_O and C_3_O in low-mass star-forming regions.
Urso R.G., Palumbo M.E., Ceccarelli C., Balucani N., Bottinelli S., Codella C., Fontani F., Leto P., Trigilio C., Vastel C., Bachiller R., Baratta G.A., Buemi C.S., Caux E., Jaber Al-Edhari A., Lefloch B., Lopez-Sepulcre A., Umana G., Testi L.
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Abstract:
C_2_O and C_3_O belong to the carbon chain oxides family. Both molecules have been detected in the gas phase towards several star-forming regions, and to explain the observed abundances, ion-molecule gas-phase reactions have been invoked. On the other hand, laboratory experiments have shown that carbon chain oxides are formed after energetic processing of CO-rich solid mixtures. Therefore, it has been proposed that they are formed in the solid phase in dense molecular clouds after cosmic ion irradiation of CO-rich icy grain mantles and released in the gas phase after their desorption.

In this work, we contribute to the understanding of the role of both gas-phase reactions and energetic processing in the formation of simple carbon chain oxides that have been searched for in various low-mass star-forming regions.

We present observations obtained with the Noto-32m and IRAM-30m telescopes towards star-forming regions. We compare these with the results of a gas-phase model that simulates C_2_O and C_3_O formation and destruction, and laboratory experiments in which both molecules are produced after energetic processing (with 200 keV protons) of icy grain mantle analogues.

New detections of both molecules towards L1544, L1498, and Elias 18 are reported. The adopted gas phase model is not able to reproduce the observed C_2_O/C_3_O ratios, while laboratory experiments show that the ion bombardment of CO-rich mixtures produces C_2_O/C_3_O ratios that agree with the observed values.

Based on the results obtained here, we conclude that the synthesis of both species is due to the energetic processing of CO-rich icy grain mantles. Their subsequent desorption because of non-thermal processes allows the detection in the gas-phase of young star-forming regions. In more evolved objects, the non-detection of both C_2_O and C_3_O is due to their fast destruction in the warm gas.

Description:
Data reported in Figure 1 correspond to newly detected C_2_O and C_3_O lines towards: L1544 (panels A, B, C, D, E and F); L1498 (panels G and H); and Elias 18 (panels I and J). Each panel reports the molecule and its transition. The detection reported in panel G (performed with the Noto-32m telescope) was acquired with a lower resolution than that used for the observations reported in the other panels (IRAM-30m telescope). For clarity we give a larger VLSR scale that allows a better evaluation of the baseline.

Table 1 and Table 2 in the paper report information on the spectroscopic parameters and telescope used.

Further details are given in Section 2 in the paper.

Files are given in FITS and ASCII format for each panel.

Objects:

RA (2000)	DE	Designation(s)
05 04 16.6	+25 10 48	L1544 = LDN 1544
04 11.0	+24 58	L1498 = LDN 1498
04 39 55.75	+25 45 01.9	Elias 18 = Elia 3-18

File Summary:

FileName	Lrecl	Records	Explanations
ReadMe	80	.	This file
list.dat	95	10	List of fits spectra
fits/*	.	10	Individual fits spectra
sp/*	.	10	Individual ascii spectra

Byte-by-byte Description of file: list.dat

Bytes	Format	Units	Label	Explanations
1- 3	I3	---	Nx	Number of pixels along X-axis
5	I1	Kibyte	size	Size of FITS file
7- 22	A16	---	FileName	Name of FITS file, in subdirectory fits
24- 33	A10	---	Table	Name of the table, in subdirectory sp
35- 95	A61	---	Title	Title of the FITS file

Byte-by-byte Description of file: sp/*

Bytes	Format	Units	Label	Explanations
1- 15	F15.11	km/s	VLSR	LSR velocity
16- 31	F16.12	mK	Tmb	Mean brightness temperature

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(End) Patricia Vannier [CDS] 17-Jul-2019