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# Unusually high CO abundance of the first active interstellar comet

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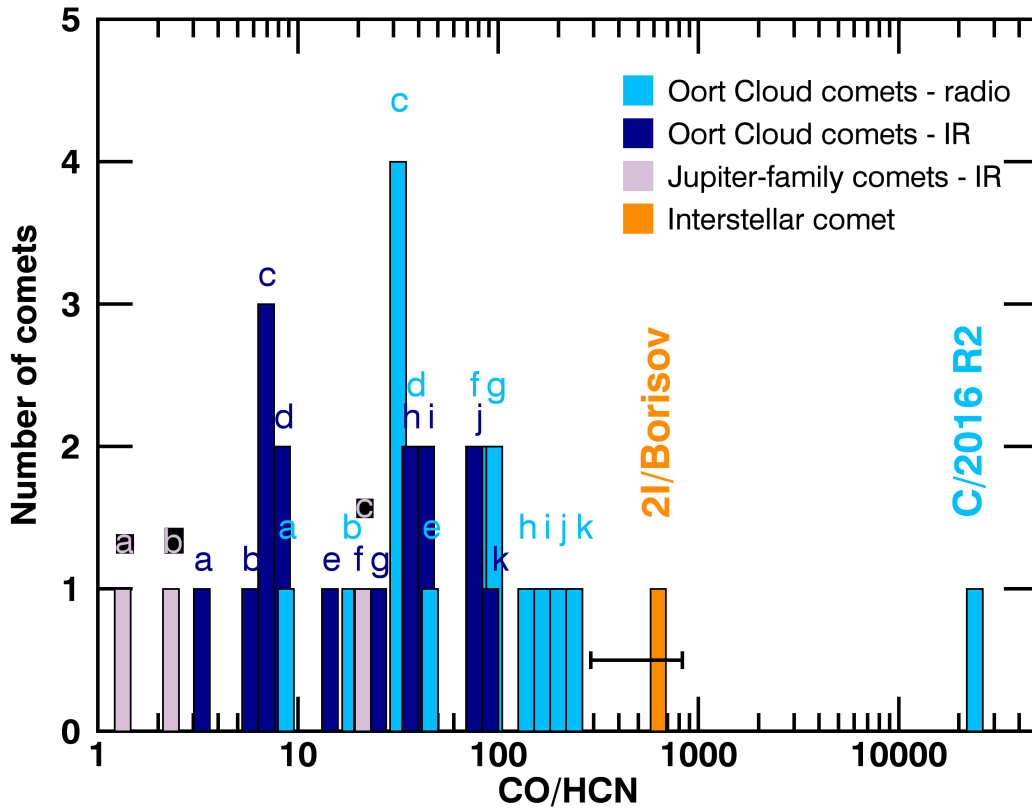
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# **Supplementary Information**

## **Unusually High CO Abundance of the First Active Interstellar Comet**

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## Supplementary Figures



Supplementary Figure 1: Histogram (based on Figure 4), showing previously-published CO/HCN mixing ratios observed in Solar System comets [1, 2]. This version of the Figure includes alphabetical labels on the histogram bins, and the comets included in each bin are listed in Supplementary Table 2. The unusually high CO/HCN ratio of 2I/Borisov ( $630^{+200}_{-340}$ ) is highlighted, along with the chemically peculiar outlier C/2016 R2 (PanSTARRS) (which had CO/HCN = 26,400) [3] (horizontal black bar indicates the uncertainty range of our measurement).

## Supplementary Tables

Supplementary Table 1: Mixing Ratios, H<sub>2</sub>O production Rates and Temperatures of Long-Period Cometary Comae Observed Around 2 au

Comet	$r_H$ (au)	$T$ (K)	$Q(\text{H}_2\text{O})$ (s <sup>-1</sup> )	CO/H <sub>2</sub> O (%)	HCN/H <sub>2</sub> O (%)	CO/HCN	Refs.
C/1995 O1	2.2	50	$2.4 \times 10^{29}$	[24 ± 3]	[0.12 ± 0.01]	200 ± 22	[4]
C/1996 B2	1.9	20	$1.2 \times 10^{29}$	[13 ± 3]	[0.08 ± 0.01]	162 ± 43	[5]
C/2009 P1 <sup>†</sup>	2.1	40*	$8.6 \times 10^{28}$	10 ± 2	0.28 ± 0.03	37 ± 8	[6]
C/2009 P1 <sup>†</sup>	1.7	50	$1.1 \times 10^{29}$	19 ± 2	0.12 ± 0.03	153 ± 33	[7]
C/2012 K1	1.8	42*	$3.6 \times 10^{28}$	3.9 ± 1	0.11 ± 0.02	36 ± 13	[8]
C/2012 X1	1.9	40	$4 \times 10^{28}$	32 ± 5	0.25 ± 0.03	137 ± 26	[9]
2I/Borisov	2.0	50 <sup>‡</sup>	$6.5 \times 10^{26}$	68 ± 35	0.11 ± 0.05	630 <sup>+200</sup> <sub>-340</sub>	[10]

Table Footnotes — \*Rotational temperature of H<sub>2</sub>O (true gas kinetic temperature may be slightly higher).  
<sup>†</sup>C/2009 P1 was observed on two epochs (before and after perihelion), exhibiting relatively more CO post-perihelion. <sup>‡</sup>Assumed kinetic temperature. Mixing ratios in parentheses are uncertain due to non-contemporaneous H<sub>2</sub>O measurements.

Supplementary Table 2: Comets included in Figure 4 (and Supplementary Figure 1)

Label	Jupiter-family comets
a	103P
b	73P
c	9P
Label	Oort Cloud comets - radio
a	C/2007 W1
b	C/2014 Q2
c	C/1997 J2, C/2006 P1, C/2012 F6, C/2004 Q2
d	153P, C/1999 H1
e	C/2013 R1
f	C/2001 Q4, C/1998 P1
g	C/1995 O1, C/2009 P1
h	C/2012 X1
i	C/1996 B2
j	C/1999 T1
k	C/2006 W3
Label	Oort Cloud comets - IR
a	C/2000 WM1
b	8P/Tuttle
c	C/1999 S4, C/1999 H1, C/2006 P1
d	C/2001 A2, C/2007 W1
e	C/2007 N3
f	C/2012 S1
g	153P
h	C/2004 Q2, C/2009 P1
i	C/2013 R1, C/1999 T1
j	C/2010 G2, C/1995 O1
k	C/1996 B2

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