Bulletin of the AAS • Vol. 52, Issue 6 (DPS52 Abstracts)

Probing the chemical composition of interstellar comet 2I/Borisov using ALMA

M. Cordiner[1], S. Milam[1], N. Biver[2], D. Bockelee-Morvan[2], N. Roth[1], E. Bergin[3], E. Jehin[4], A. Remijan[5], S. Charnley[1], M. Mumma[1], J. Boissier[6], J. Crovisier[2], L. Paganini[7], Y. Kuan[8], D. Lis[9]

[1]NASA GSFC, Greenbelt, MD, [2]Observatoire de Paris, Meudon, France, [3]University of Michigan, Ann Arbor, MI, [4]Universite de Liege, Liege, Belgium, [5]NRAO, Charlottesville, VA, [6]IRAM, Saint Martin d'Heres, France, [7]NASA HQ, Washington, DC, [8]National Taiwan Normal University, Taipei, Taiwan, [9]JPL, Caltech, Pasadena, CA

Published on: Oct 26, 2020

Updated on: Oct 23, 2020

Interstellar comet 2I/Borisov originated from the direction of Cassiopeia, and passed through the inner Solar System, reaching perihelion on 2019-12-08, giving us an unprecedented opportunity to study an object from another planetary system in close-up. We used the Atacama Large Millimeter/submillimeter Array (ALMA) to observe coma gases from 2I/Borisov on 15th-16th December 2019, at high spectral and spatial resolution. Emission from HCN (J=4-3) and CO (J=3-2) was detected, peaking at the expected position (and velocity) of 2I/Borisov's nucleus. Molecular production rates were derived using a 3D non-LTE radiative transfer code, including excitation due to gas collisions and radiative pumping. The HCN abundance relative to water (~0.12%) was found to be similar to typical Solar System comets, but the CO abundance (~68%) was among the highest observed in any comet within 2 au of the Sun. The observed CO/HCN ratio is an order of magnitude larger than the average ratio in Solar System comets, which shows that 2I/Borisov must have formed in a relatively CO-rich environment. Either 2I/Borisov is intrinsically enriched in CO, or the outgassing of the less-volatile species (H2O and HCN) was more strongly inhibited than usual, relative to the more-volatile CO. Various explanations for the CO-richness of 2I/Borisov's coma will be examined, and the importance of interstellar objects for our understanding of protoplanetary disk midplane chemistry will be discussed. See Cordiner et al. (2020, Nature Astronomy, doi:10.1038/s41550-020-1087-2) for further details.

This research was supported by the National Science Foundation (under Grant No. AST-1614471), and by the NASA Planetary Science Division Internal Scientist Funding Program through the Fundamental Laboratory Research (FLaRe) work package. Part of this research was carried out at the Jet Propulsion Laboratory, California Institute of Technology, under a contract with the National Aeronautics and Space Administration.