

OBSERVING INTERSTELLAR COMET 2I/BORISOV FOR RADIO OH LINES WITH THE ARECIBO OBSERVATORY. K. N. Ortiz Ceballos^{1,2}, E. S. Howell³, A. Méndez¹, Y. R. Fernandez⁴, A. J. Lovell⁵, C. A. Schambeau⁶, N. Pinilla-Alonso⁶, and M. Womack⁶. ¹Planetary Habitability Laboratory, University of Puerto Rico at Arecibo, Arecibo, PR, USA (kevin.ortiz22@upr.edu), ²Department of Physics, University of Puerto Rico, Río Piedras Campus, San Juan, PR, USA, ³Lunar and Planetary Laboratory, University of Arizona, Tucson, AZ, USA, ⁴Department of Physics, University of Central Florida, Orlando, FL, USA, ⁵Agnes Scott College, Decatur, GA, USA, ⁶Florida Space Institute, University of Central Florida, Orlando, FL, USA.

Introduction: Comet 2I/Borisov was first observed September 8, 2019 and was quickly identified as originating from outside the Solar System due to its highly eccentric, hyperbolic orbit ($e > 3$) [1]. This is only the second such body that has been detected, after 1I/2017 U1 (‘Oumuamua). ‘Oumuamua, however, showed no coma. The presence of this coma in Borisov may indicate an icier composition with sublimating volatiles [2].

Radio observations of comets have been successfully performed since the 1973 observation of Comet C/1973 E1 (Kohoutek). This first detection measured the presence of the hydroxyl (OH) radical in the comet’s coma; the OH radical is a photodissociation product of water and can be used to quantify the activity of the comet; it is found in the coma [3]. Spectroscopy of the OH lines in comets using the Arecibo Observatory has been successfully performed previously [4, 5]. Crovisier *et al.* were able to use the Nançay Radio Observatory telescope to detect a marginal OH line from 2I/Borisov after 15 hours of observation.

Observations: We observed interstellar comet 2I/Borisov on 8 occasions between September 22 and November 9. The 1612, 1665, 1667 and 1720 MHz lines were observed, but results are reported for the 1667 MHz line only since it is strongest [6].

An ephemeris was taken from the Jet Propulsion Laboratory’s HORIZONS system, and used to track the comet by adjusting pointing in 5-minute intervals. The single-pixel L-wide receiver was used for all observations. Radio-frequency interference is not typically a problem for the lines of interest, because these are narrow lines, but is nonetheless identified in the full spectra as not contaminating these lines. Two observational approaches were utilized.

“Interim” Correlator Observations. This first observational approach followed the protocol laid out in Howell *et al.* which proved effective in observations of 9P/Tempel 1 with Arecibo [7]. The “interim” correlator was used as the selected correlator. Spectra are produced in dual-linear polarizations for the 4 specific lines investigated; both polarizations are combined in the results presented here.

Mock Spectrometer Observations. This second observational approach was similar to the protocol used by Gicquel *et al.* to successfully observe the OH line in comet 103P/Hartley 2 using the Green Bank Telescope [8]. It was implemented with Arecibo using the Mock Spectrometer as the selected correlator. While not as sensitive as the first approach, it was implemented optimistically to test the Mock Spectrometer for cometary OH observations and obtain full spectra of the comet.

Results: The OH line was not detected in our observations. Our results agree with previous optical and near-IR observations of 2I/Borisov, which are consistent with low water production [9]. Results from the interim correlator are presented in Figure 1, where no significant detection can be appreciated. 2I/Borisov did not undergo significant outbursts during our observations. Future work will detail upper limits that can be established on the water production of 2I/Borisov from this non-detection.

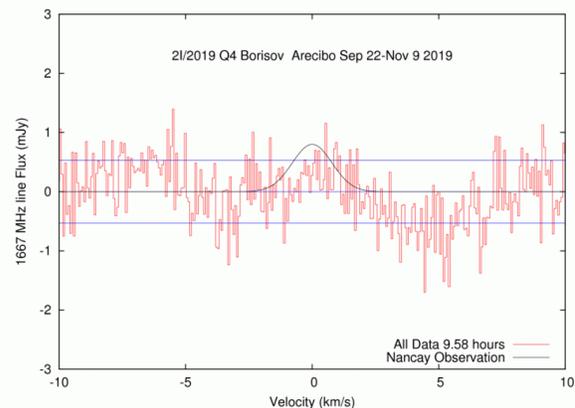


Figure 1. Preview of results of ~10 hours of Arecibo observations of the 1667 MHz radio OH line in interstellar comet 2I/Borisov. No line is detected.

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