VIBRATIONAL AND GEOMETRIC STRUCTURES OF La$_3$C$_2$O AND La$_3$C$_2$O$^+$ FROM MASSE-ANALYZED THRESHOLD IONIZATION

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La$_3$C$_2$O is produced for the first time by laser vaporization in a pulsed cluster source and identified by photoionization time-of-flight mass spectrometry. Vibrationally-resolved ion spectra are obtained with mass-analyzed threshold ionization (MATI) spectroscopy. The adiabatic ionization energy of La$_3$C$_2$O is measured to be 30891(5) cm$^{-1}$. The spectra display several short vibrational progressions, and these progressions are associated mainly with La-La, La-C and La$_3$C$_2$O stretching excitations. The electron-spin multiplicities and molecular symmetries of La$_3$C$_2$O and La$_3$C$_2$O$^+$ are determined by combining the experimental measurements with ab initio calculations at MP2 level. Preliminary data analysis shows that the $^1A_1 \leftrightarrow ^2A_1$ transition is responsible for the observed MATI spectra. The cluster has $C_{2v}$ symmetry with La$_3$C$_2$O in a bi-pyramid structure and oxygen being attached to the La$_3$ plane.