Photodetachment to the ground state of C2H (*X*2Σ+) involves ejecting an electron from an *s*−like s orbital (approximately 5σ*g* in symmetry character), whereas detachment to the excited *Ã*2Π state occurs from a *p*−like *π* orbital (approximately 1*πu* in character). Therefore, the electron anisotropies may be described using the mixed *s-p* model,76

 (11)

where is the electron kinetic energy and is the fraction of *p* character of the detachment orbital described as

(12)

*A*1 and *B*1 in Eq. (11) are the generalized HanstorpREF1 coefficients describing the assumed Wigner-likeREF2 relative scalings of the radial transition dipole matrix elements for different allowed detachment channels. Specifically, describes the energy-dependent ratio of the *p* → *d* and *p* → *s* transition amplitudes, while corresponds to the *s* → *p* and *p* → *s* cross-section ratio.76 It can be shown that under certain approximations *B*1/*A*1 = 8/3.REF3 Finally, in Eq. (11) is the phase shift between the *s* and *d* partial waves, which in most cases of anion photodetachment is assumed to be small, corresponding to .

From Eq. (11) it can be seen that detachment from a pure *s* orbital ( will have a positive anisotropy (*β* = +2), whereas detachment from a pure *p* orbital ( will have a negative anisotropy for electron kinetic energies . Therefore, measuring the anisotropy can help determine the electronic character of each individual transition, which may be compared to the calculated symmetries in Figure 3. The anisotropy parameters were measured for every detachment wavelength and prominent transition in the C2H− photoelectron spectra from this work, and are presented in Figure 5. Fitting Eq. (11) to the anisotropy parameters from 2Π state detachment, with produces a Hanstorp coefficient of *A*1 = 0.66(4) eV−1.

REF1. Hanstorp, D.; Bengtsson, C.; Larson, D. J., Angular distributions in photodetachment from O-. *Phys. Rev. A* **1989,** *40*, 670-675.

REF2. Wigner, E. P., On the behavior of cross sections near thresholds. *Phys. Rev.* **1948,** *73*, 1002-1009.

REF3. Sanov, A.; Grumbling, E. R.; Goebbert, D. J.; Culberson, L. M., Photodetachment anisotropy for mixed s-p orbitals: 8/3 and other fractions. *J. Chem. Phys.* **2013,** *138*, 054311.