GEC Student Award for Excellence Finalist: Fluorescence Polarization of H₂, D₂, and N₂ Molecules Excited by Polarized Electron Impact

J.W. MASEBERG, T.J. GAY, University of Nebraska — We report relative Stokes parameters for both molecular and dissociated atomic transitions in H₂, D₂, and N₂ excited by spin-polarized electrons. In the case of molecular transitions, we find that values of the normalized circular polarization fraction, \( P_3/P_e \), for light emitted in the direction of electron spin polarization are non-zero for H₂ and D₂, but consistent with zero for N₂. Specifically, we have succeeded in rotationally isolating the H₂ \( d^3\Pi_u \rightarrow a^3\Sigma^+_g Q(1) \) 601.8 nm transition. It exhibits relatively large near-threshold values for \( P_3/P_e \) (∼17%). This is in contrast to the null measurements for the N₂ \( C^3\Pi_u \rightarrow B^3\Pi_g \) 380.5 nm and N\(_2^+\) \( B^2\Sigma^+_u \rightarrow X^2\Sigma^+_g \) 391.4 nm transitions.

For the case of fluorescence from dissociated atomic fragments we observe non-zero circular polarization values for H, D, and N. The near-threshold \( P_3/P_e \) values observed for the Balmer-alpha H and D 656.3 nm transitions are nearly equivalent (∼8%). For the N \((^3P)3p \rightarrow (^3P)3s\) 824.2 nm transition we find \( P_3/P_e \) values of approximately -7%. This surprising negative sign indicates that the atomic fragment is spinning the “wrong way,” i.e. in a direction opposite that of the incident electron responsible for the molecular dissociation.

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J.W. Maseberg
University of Nebraska

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