

VIBRATION AND VIBRATION-TORSION LEVELS OF THE  $S_1$  AND GROUND CATIONIC  $D_0^+$  STATES OF PARA-FLUOROTOLUENE AND PARA-XYLENE BELOW  $1000\text{ cm}^{-1}$

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We have employed resonance-enhanced multiphoton ionisation (REMPI) spectroscopy and zero-kinetic-energy (ZEKE) spectroscopy to investigate the first excited electronic singlet ( $S_1$ ) state and the cationic ground state ( $D_0^+$ ) of *para*-fluorotoluene (*p*FT) and *para*-xylene (*p*Xyl). Spectra have been recorded *via* a large number of selected intermediate levels, to support assignment of the vibration and vibration-torsion levels in these molecules and to investigate possible couplings.

The study of levels in this region builds upon previous work on the lower energy regions of *p*FT and *p*Xyl<sup>*a,b,c*</sup> and here we are interested in how vibration-torsion (vibtor) levels might combine and interact with vibrational ones, and so we consider the possible couplings which occur. Comparisons between the spectra of the two molecules show a close correspondence, and the influence of the second methyl rotor in *para*-xylene on the onset of intramolecular vibrational redistribution (IVR) in the  $S_1$  state is a point of interest. This has bearing on future work which will need to consider the role of both more flexible side chains of substituted benzene molecules, and multiple side chains.

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<sup>*a*</sup>A. M. Gardner, W. D. Tuttle, L. Whalley, A. Claydon, J. H. Carter and T. G. Wright, *J. Chem. Phys.*, **145**, 124307 (2016).

<sup>*b*</sup>A. M. Gardner, W. D. Tuttle, P. Groner and T. G. Wright, *J. Chem. Phys.*, (2017, in press).

<sup>*c*</sup>W. D. Tuttle, A. M. Gardner, K. O'Regan, W. Malewicz and T. G. Wright, *J. Chem. Phys.*, (2017, in press).