

Electronic Supplementary Information for the article:
Anisotropic ultraviolet-plasmon dispersion in black phosphorus

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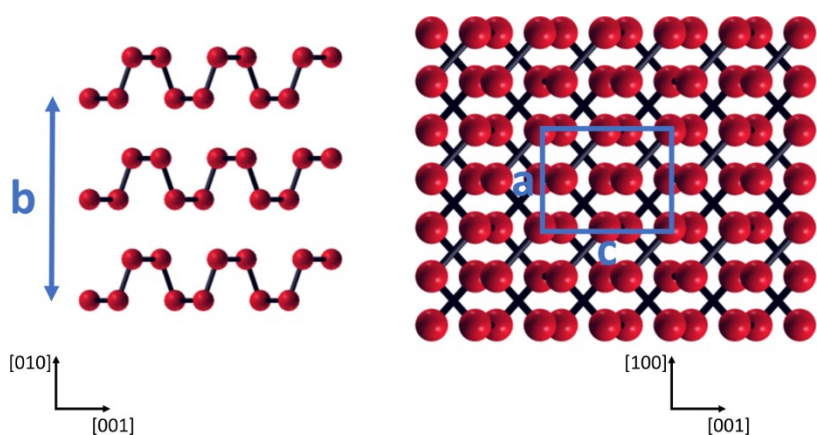


Figure S1: Visualization of BP structural parameters ¹.

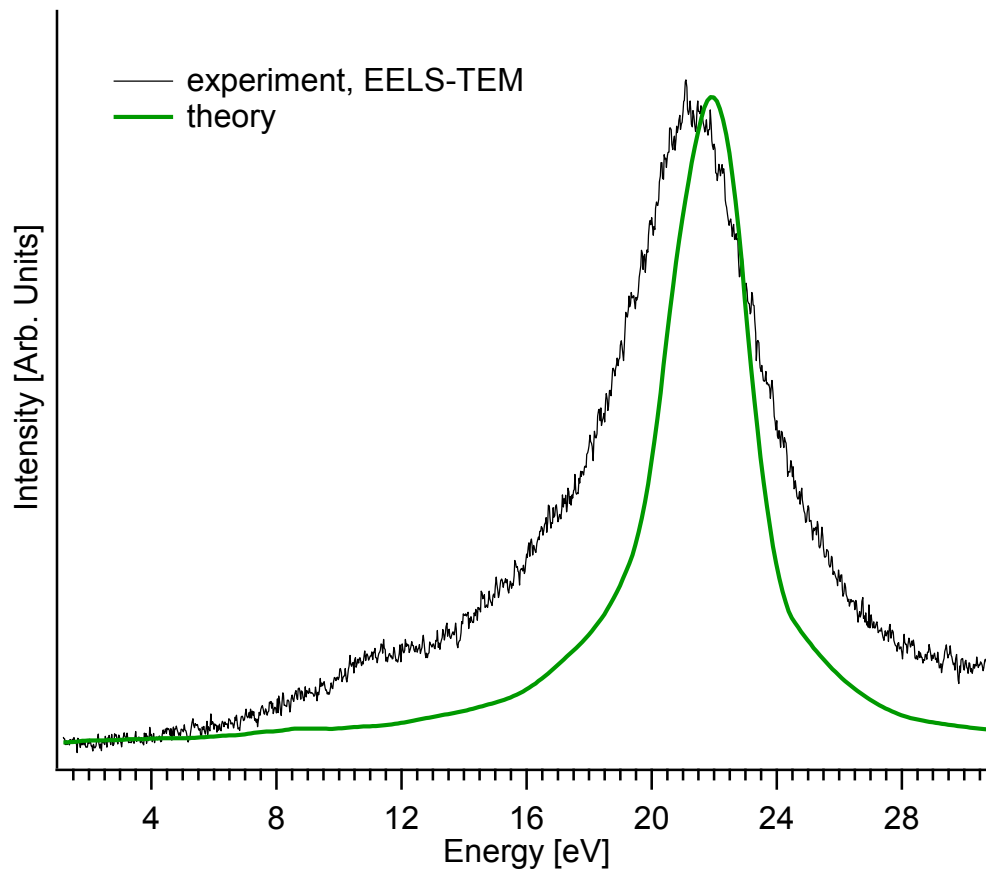


Figure S2: Comparison between the experimental spectrum (black curve) and the theoretical loss function computed by DFT (green curve) for a momentum of 0.132 \AA^{-1} along the armchair direction. The excitation spectrum is dominated by the intense mode around 20 eV.

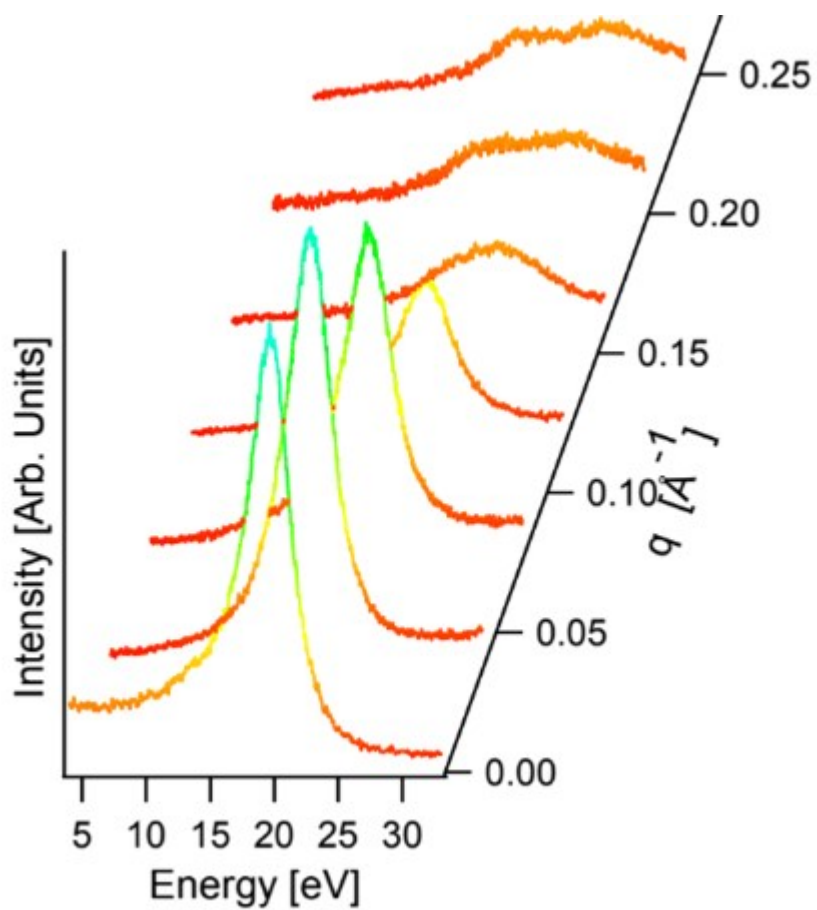


Figure S3: Spectra collected along the Γ -M direction.

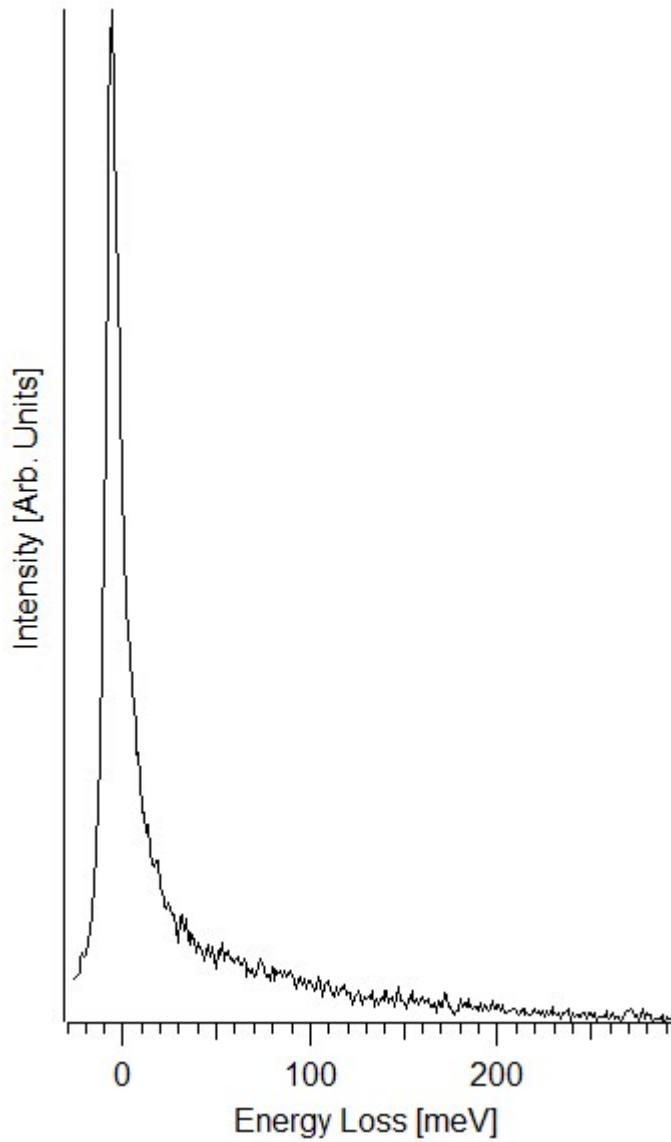


Figure S4: Vibrational spectrum of as-cleaved black phosphorus, acquired with a primary energy of 3 eV and in specular geometry (dipole scattering). Note the absence of vibrations of contamination. Especially, vibrational spectra indicate the total absence of oxidation, as indicated by the absence of the vibrational modes of P₂O₅ around 100 meV. For the sake of completeness, it is worth mentioning that phonon modes cannot be revealed in dipolar scattering conditions.

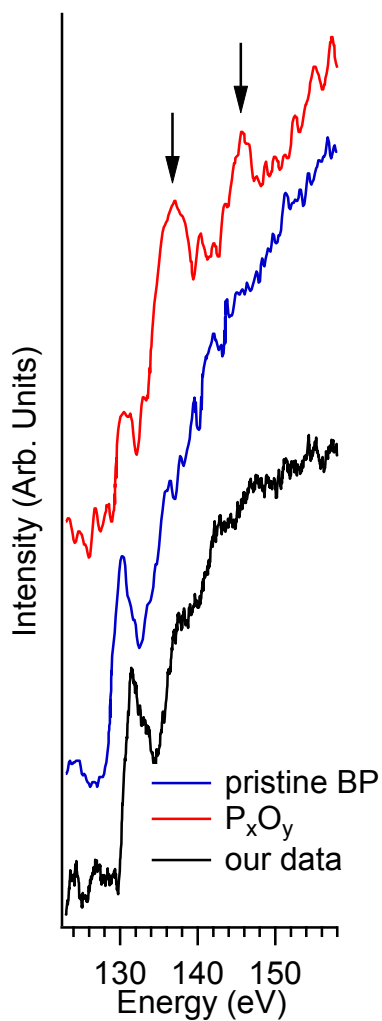


Figure S5: L_{23} edge reported in the *Nature Materials* by Favron et al. ² for pristine black phosphorus (blue curve) and for its oxidized phase P_xO_y (red curve). The arrows denote the spectroscopic fingerprint of oxidation, which are absent in our sample (black curve), which strongly resemble that of pristine black phosphorus.

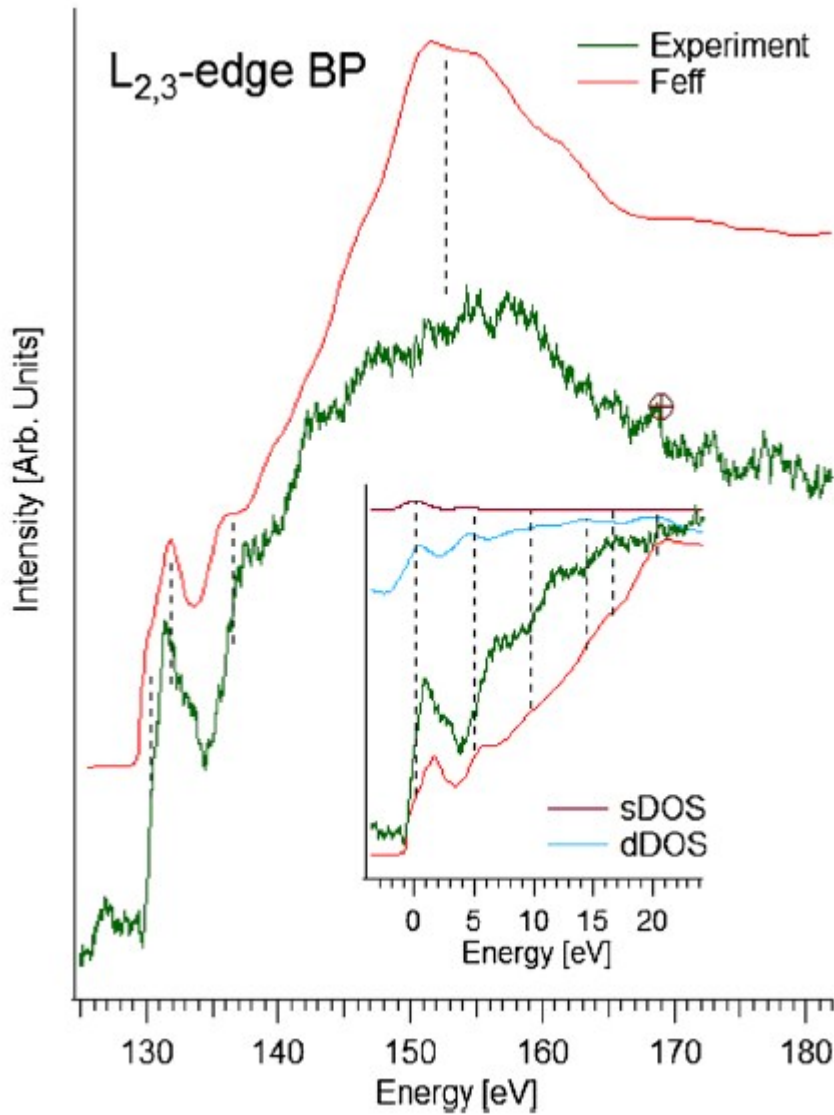


Figure S6: Experimental $L_{2,3}$ -edge of black phosphorus (abbreviated as BP) (green curve), theoretically reproduced by the Feff code (red curve). The s-DOS and d-DOS are reported for a direct comparison in the inset, as a function of the energy from the $L_{2,3}$ -edge.

1. L. H. de Lima, L. Barreto, R. Landers and A. de Siervo, *Phys. Rev. B*, 2016, **93**, 035448.
2. A. Favron, E. Gaufres, F. Fossard, A.-L. Phaneuf-Lheureux, N. Y. W. Tang, P. L. Levesque, A. Loiseau, R. Leonelli, S. Francoeur and R. Martel, *Nat. Mater.*, 2015, **14**, 826–832.