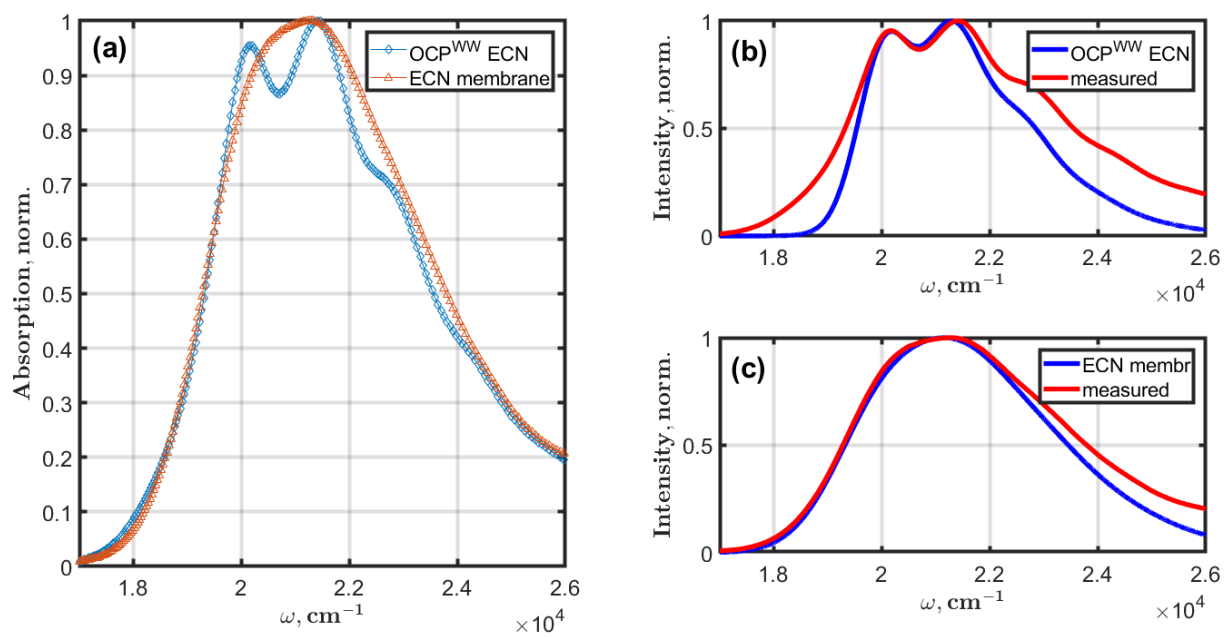


Supplementary Figure 1. Resonance (532 nm) Raman spectra of ECN and CAN in different OCP-like proteins and environments. Also, the corresponding spectra of spheroidene and spheroidenone are shown for comparison.



Supplementary Figure 2. Measured (A) and simulated (B, C) absorption of OCP^{WW} (ECN) and ECN in membrane at RT, respectively.

Supplementary Table 1. Result of the (TD)DFT/TDA/D3/6-311G** calculation of the hECH S0-S2 excitation energy done with different functionals and for different conformations. «Planar» conformation correspond to all-trans hECH with exact planar dihedral angles across the π -conjugated system. «Dihedral 90» conformations correspond to the disrupted π -conjugated system with dihedral angle equal to 90 degree (dihedral angle labeling as in Fig 3).

Functional	E(S0-S2), Planar, cm ⁻¹	E(S0-S2), Dihedral 90, cm-1				
		3	5	7	9	11
B3LYP	17727.0	19710.3	21232.1	22120.9	23520.5	24964.4
CAM- B3LYP	20800.5	22293.2	23266.2	24509.5	25857.3	27110.7
WB97X	22011.6	23371.2	24288.1	25478.7	26811.4	28401.1
M06-2x	19797.4	22026.7	23019.5	24286.3	25632.2	26921.8
RI- wB2PLYP def2- TZVPP	22143.8	24644.5	25547.3	26731.9	28100.7	29381.8