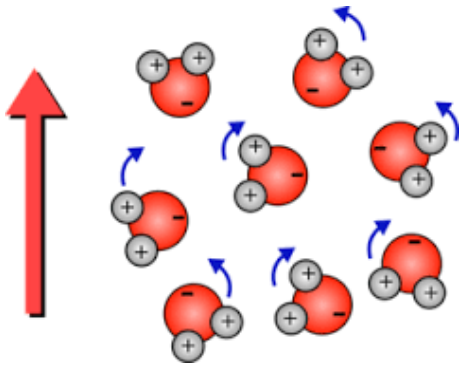
Dielectric Relaxation in Liquid Water [nln76]

- H_2O molecules have permanent electric dipole moment (polar molecules.)
- Alignment of dipole moments with external electric field **E** is energetically favorable.
- Alignment tendency is counteracted by thermal fluctuations.
- Turning **E** on/off initiates relaxation process toward equilibrium.



- $P(t)$: instantaneous electric polarization (average dipole moment)
- χ_0: static dielectric susceptibility
- τ_0: characteristic relaxation time
- $E(t)$: oscillating electric field
- $\frac{d}{dt}P(t) = -\frac{1}{\tau_0}\big[P(t) - \chi_0 E(t)\big]$: dielectric relaxation process
- $\langle P\rangle = \chi_0 E$: static (linear) response
- $\chi_{PP}(\omega) = \frac{\chi_0}{\tau_0}\chi_{xx}(\omega)$: link to classical relaxator [nex66]
- $\langle P(t)P\rangle - \langle P\rangle^2 = k_B T\chi_0 e^{-t/\tau_0}$: correlation fct. (from fluc.-diss. rel.)
- $\langle P^2\rangle \doteq \frac{1}{3}np_0^2 = k_B T\chi_0$: zero-field limit
- n: number density of molecules
- p_0: permanent molecular electric dipole moment
- $\chi_0(T) = \frac{np_0^2}{3k_B T}$: T-dependence of dielectric susceptibility